

KELOWNA SENIOR SECONDARY

**Provincial Exams
Question Review Booklet**

PHYSICS 12

EQUATIONS

Note: Vector quantities have not been indicated.

1. Kinematics: (for constant acceleration)

$$v = v_0 + at \qquad v_{av} = \frac{v + v_0}{2}$$

$$d = v_0 t + \frac{1}{2} at^2$$

2. Dynamics:

$$F_f = \mu F_N \qquad F_{net} = ma$$

3. Mechanical Energy and Momentum:

$$W = Fd \qquad E_p = mgh \qquad E_k = \frac{1}{2}mv^2$$

$$P = \frac{W}{t} \qquad p = mv \qquad \Delta p = F_{net} \Delta t$$

4. Equilibrium:

$$\tau = Fd$$

5. Circular Motion and Gravitation:

$$a_c = \frac{v^2}{r} = \frac{4\pi^2 r}{T^2} \qquad F = G \frac{m_1 m_2}{r^2}$$

$$E_p = -G \frac{m_1 m_2}{r}$$

6. Electrostatics:

$$F = k \frac{Q_1 Q_2}{r^2} \qquad E = \frac{V}{d} \qquad V = \frac{kQ}{r}$$

$$E_p = k \frac{Q_1 Q_2}{r} \qquad F = QE \qquad V = \frac{\Delta E_p}{Q}$$

7. Circuitry:

$$Q = It \qquad V = IR \qquad P = VI$$

EQUATIONS CONTINUED

8. Electromagnetism:

$$F = IlB \qquad B = \frac{\mu_0 I}{2\pi d} \qquad \Phi = BA$$

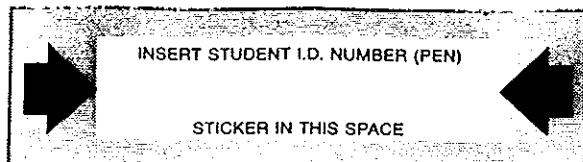
$$F = QvB \qquad B = \mu_0 n I \left(\text{where } n = \frac{N}{l} \right) \qquad \frac{V_s}{V_p} = \frac{N_s}{N_p}$$

$$\mathcal{E} = -N \frac{\Delta \Phi}{\Delta t} \qquad \mathcal{E} = Blv$$

The following chart relates the first seven final exams in the Provincial Exams Questions Review Booklet to the chapters of the Gore text. You will write an exam after each of the Gore Chapters is completed. The day you write an exam you must turn in your Review Booklet with the listed questions completed. All work (formula, substitution, answer) must be shown for problems and multiple choice. It is understood that a few questions require no supporting work and an answer is sufficient. When in doubt --show work!! Mark your answer right when it is completed properly.

Five to ten questions will be graded. Solutions not answers will be marked. Marks will be deducted for non-graded work, sloppy work, and lateness. Remember -- in most cases answers only are worth nothing!!

Gore	June 99	Aug 99	Jan 00	June 00	Aug 00	Jan 01	June 01
Chapter							
1	4,11-12	3, 9-11	2,10-12	1,11-13	10-11	1,12-14	1,11-13
	Prob 3	Prob 3	Prob 3	Prob 3	Prob 1,3,9		Prob 3
2		1-2	1, 3	3		2, 3	3
	Prob 1			Prob 8			
3	2,3,5,7-10	4-8	4-9	2,4-10	1-9	4-11	4 - 8, 10
	Prob 2,8	Prob 1,2,9	Prob 1,2,8,9	Prob 1,2	Prob 2	Prob 1-3,8	Prob 2, 1
4	1,6,13-18	12-17	13-18	14-17	12-17	15-19	2,14-18
	Prob 4	Prob 4	Prob 4	Prob 4,9	Prob 4	Prob 4,9	Prob 4
5	19-21	18-20	19-21	18-20	18-20	20-22	19-20
	Prob 5	Prob 5	Prob 5	Prob 5	Prob 5	Prob 5	Prob 5,9
6	22-24	22-23	22-23	21-23	21-23	23-24	21 -23, 9
	Prob 6	Prob 6	Prob 6a	Prob 6	Prob 6,8	Prob 6	Prob 6
7	25-26	24-26	24-27	25-27	24-27	25-27	24-26
	Prob 9					Prob 7	Prob 7,8
8	27-30	21,27-30	28-30	24, 28-30	28-30	28-30	27 -30
	Prob 7	Prob 7,8	Prob 7	Prob 7	Prob 7		



JUNE 1999

PROVINCIAL EXAMINATION

MINISTRY OF EDUCATION

PHYSICS 12

GENERAL INSTRUCTIONS

1. Insert the stickers with your Student I.D. Number (PEN) in the allotted spaces above and on the **back** cover of this booklet. **Under no circumstance is your name or identification, other than your Student I.D. Number, to appear on this booklet.**
2. Ensure that in addition to this examination booklet, you have an **Examination Response Form**. Follow the directions on the front of the Response Form.
3. **Disqualification** from the examination will result if you bring books, paper, notes or unauthorized electronic devices into the examination room.
4. All multiple-choice answers must be entered on the Response Form using an **HB pencil**. Multiple-choice answers entered in this examination booklet will **not** be marked.
5. For each of the written-response questions, write your answer in the space provided in this booklet.
6. When instructed to open this booklet, **check the numbering of the pages** to ensure that they are numbered in sequence from page one to the last page, which is identified by

END OF EXAMINATION.

7. At the end of the examination, place your Response Form inside the front cover of this booklet and return the booklet and your Response Form to the supervisor.

©1999 Ministry of Education

JUN 1999

PART A: MULTIPLE CHOICE

Value: 60 marks (2 marks per question)

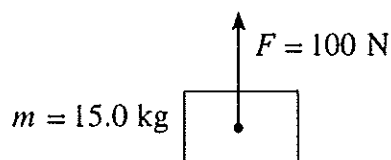
Suggested Time: 60 minutes

INSTRUCTIONS: For each question, select the **best** answer and record your choice on the Response Form provided. Using an HB pencil, completely fill in the circle that has the letter corresponding to your answer.

1. Which of the following is a correct unit for gravitational field strength?

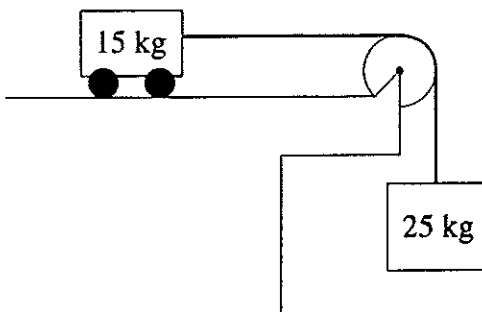
A. N
B. N/C
C. N/kg
D. N·m

2. A 15 kg block on a horizontal surface has a 100 N force acting on it as shown.



What is the normal force?

- A. 47 N
B. 100 N
C. 147 N
D. 247 N
3. A 15 kg cart is attached to a hanging 25 kg mass. Friction is negligible.



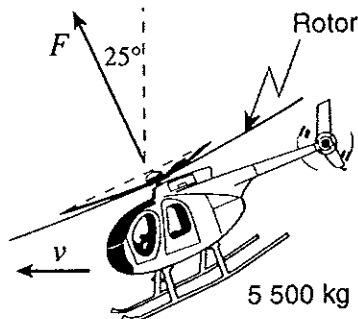
What is the acceleration of the 15 kg cart?

A. 2.5 m/s^2
B. 6.1 m/s^2
C. 6.5 m/s^2
D. 16 m/s^2

JUN 1999

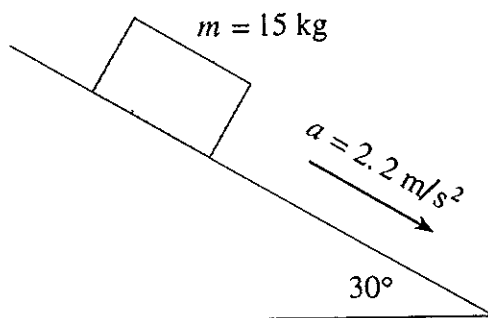
OVER

4. A 5 500 kg helicopter is travelling at constant speed in level flight.



What is the force F provided by the rotor?

- A. 4.9×10^4 N
 - B. 5.4×10^4 N
 - C. 5.9×10^4 N
 - D. 1.2×10^5 N
5. A 15 kg block has a constant acceleration of 2.2 m/s^2 down a 30° incline.



What is the magnitude of the friction force on the block?

- A. 33 N
 - B. 41 N
 - C. 74 N
 - D. 130 N
6. A satellite is in a stable orbit around the earth at a constant altitude. Its gravitational potential energy is -1.5×10^{10} J. How much work is done on the satellite during one orbit?
- A. -1.5×10^{10} J
 - B. 0 J
 - C. 7.5×10^9 J
 - D. 1.5×10^{10} J

JUN 1999

7. Which of the following correctly describes momentum and impulse?

	MOMENTUM	IMPULSE
A.	vector	vector
B.	vector	scalar
C.	scalar	vector
D.	scalar	scalar

8. A stationary object explodes into two fragments. A 4.0 kg fragment moves westwards at 3.0 m/s. What are the speed and kinetic energy of the remaining 2.0 kg fragment?

	SPEED	KINETIC ENERGY
A.	4.2 m/s	18 J
B.	4.2 m/s	36 J
C.	6.0 m/s	18 J
D.	6.0 m/s	36 J

9. A 1 000 kg vehicle travelling westward at 15 m/s is subjected to a 1.0×10^4 N·s impulse northward. What is the magnitude of the final momentum of the vehicle?

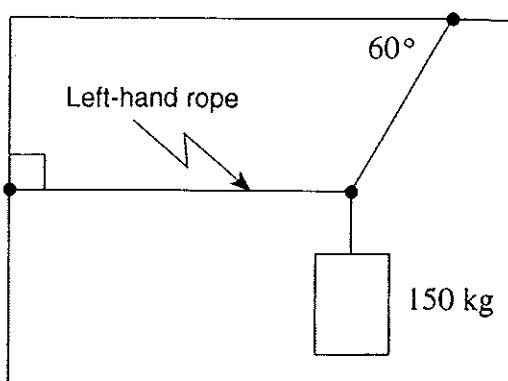
- A. 5.0×10^3 kg·m/s
- B. 1.5×10^4 kg·m/s
- C. 1.8×10^4 kg·m/s
- D. 2.5×10^4 kg·m/s

10. A body is in static equilibrium when

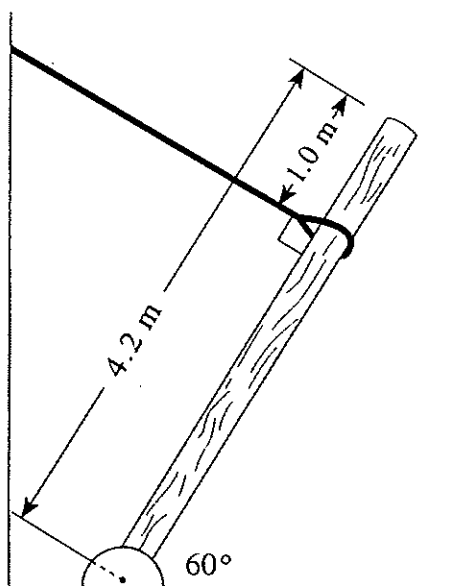
- A. $\Sigma \tau = 0$ only.
- B. $\Sigma F = 0$ only.
- C. $\Sigma F = 0$ and $\Sigma \tau = 0$.
- D. $\Sigma F = 0$ and $\Sigma \tau \neq 0$.

JUN 1999

11. A 150 kg object is suspended from a ceiling and attached to a wall. What is the tension in the left-hand rope?



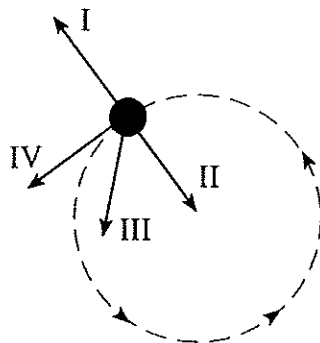
- A. 7.4×10^2 N
B. 8.5×10^2 N
C. 1.3×10^3 N
D. 2.5×10^3 N
12. A 4.2 m long uniform post is supported by a cable having a tension of 1 700 N. What is the mass of this post?



- A. 160 kg
B. 260 kg
C. 300 kg
D. 530 kg

JUN 22 1999

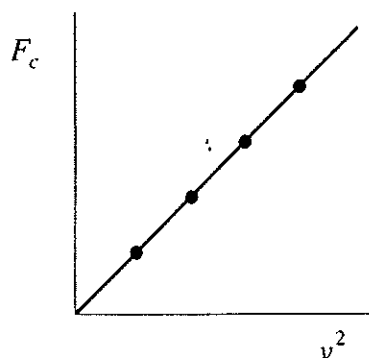
13. A satellite moves in a circular path at a constant speed. Which vector in the diagram below best represents the satellite's acceleration?



- A. I
B. II
C. III
D. IV
14. A 2.5 kg object moves at a constant speed of 8.0 m/s in a 5.0 m radius circle. What is the object's acceleration?
- A. 0 m/s²
B. 1.6 m/s²
C. 13 m/s²
D. 32 m/s²
15. What is the magnitude of Earth's centripetal acceleration as it orbits the Sun?
- A. $1.9 \times 10^{-10} \text{ m/s}^2$
B. $4.2 \times 10^{-4} \text{ m/s}^2$
C. $5.9 \times 10^{-3} \text{ m/s}^2$
D. 9.8 m/s^2

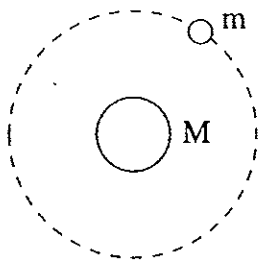
JUN 1999

16. A student plots a graph of centripetal force F_c versus the square of velocity v^2 for an object in uniform circular motion.



What is the slope of this graph?

- A. $\frac{m}{r}$
 B. $\frac{r}{m}$
 C. $\frac{4\pi^2 r}{T^2}$
 D. $\frac{T^2}{4\pi^2 r}$
17. Which of the following is a correct expression for the total energy of the orbiting satellite shown below?



- A. $E_T = -G \frac{Mm}{r}$
 B. $E_T = G \frac{Mm}{r}$
 C. $E_T = \frac{1}{2}mv^2 + mgr$
 D. $E_T = \frac{1}{2}mv^2 + \left(-G \frac{Mm}{r}\right)$

JUN 1999

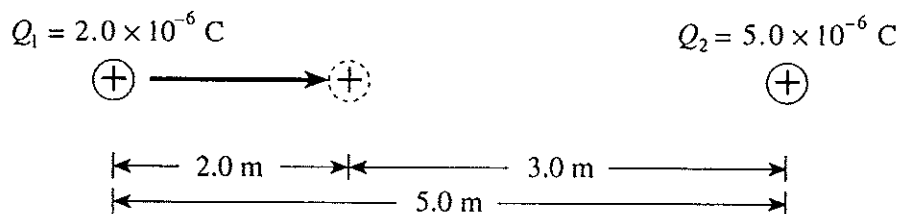
18. A satellite orbits Earth at a velocity of 3.1×10^3 m/s. What is the radius of this orbit?

- A. 9.7×10^3 m
- B. 6.4×10^6 m
- C. 4.2×10^7 m
- D. 8.3×10^7 m

19. In a cathode ray tube,

- A. protons are accelerated from anode (positive) to cathode (negative).
- B. protons are accelerated from cathode (negative) to anode (positive).
- C. electrons are accelerated from anode (positive) to cathode (negative).
- D. electrons are accelerated from cathode (negative) to anode (positive).

20. Charge Q_1 is located 5.0 m from charge Q_2 as shown.



How much work must be done to move charge Q_1 2.0 m closer to charge Q_2 ?

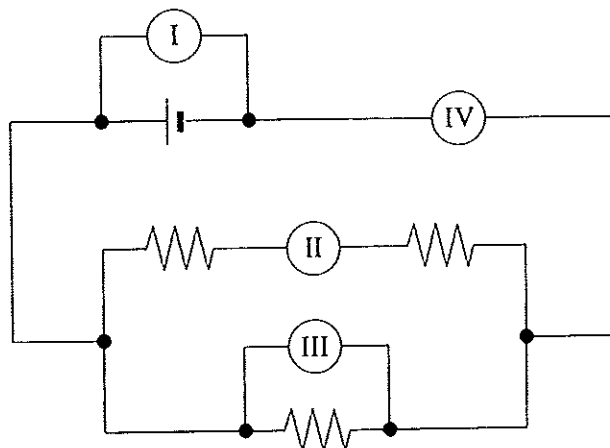
- A. 7.2×10^{-3} J
- B. 1.1×10^{-2} J
- C. 1.2×10^{-2} J
- D. 2.0×10^{-2} J

21. An electron orbits the nucleus of an atom with velocity v . If this electron were to orbit the same nucleus with twice the previous orbital radius, its orbital velocity would now be

- A. $\frac{v}{2}$
- B. $\frac{v}{\sqrt{2}}$
- C. v
- D. $2v$

JUN 1999

22. The circuit shown below includes two ammeters and two voltmeters. Identify the correct placement of these meters.

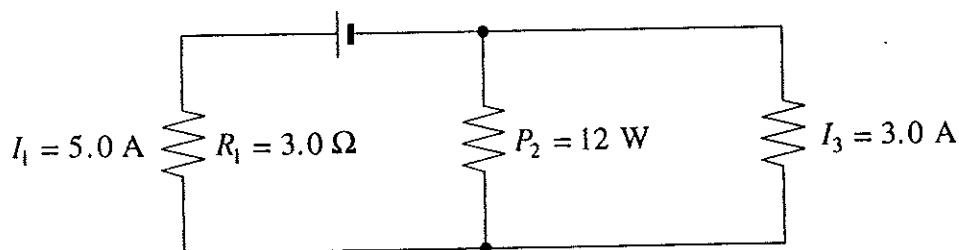


	AMMETERS	VOLTMETERS
A.	I, II	III, IV
B.	I, III	II, IV
C.	II, IV	I, III
D.	III, IV	I, II

23. A 120 V supply is connected to a heater of resistance $15\ \Omega$. What must the resistance of another heater be in order to produce the same power output when connected to a 240 V supply?

- A. $3.8\ \Omega$
 B. $7.5\ \Omega$
 C. $30\ \Omega$
 D. $60\ \Omega$

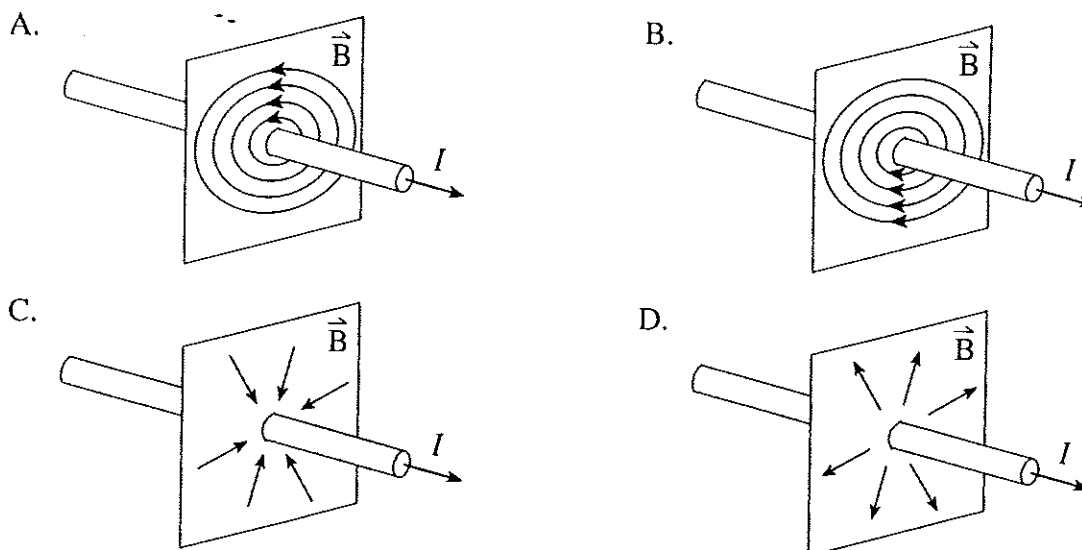
24. What is the voltage of the power supply shown in the diagram?



- A. 12 V
 B. 19 V
 C. 21 V
 D. 27 V

JUN 1999

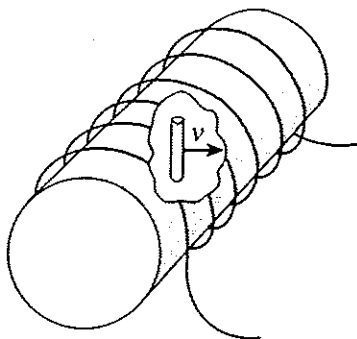
25. Which of the following diagrams best shows the magnetic field due to a long straight wire carrying a conventional current I as shown?



26. A proton is travelling at 2.3×10^6 m/s in a circular path in a 0.75 T magnetic field. What is the magnitude of the force on the proton?

- A. 1.6×10^{-24} N
- B. 2.9×10^{-21} N
- C. 2.8×10^{-13} N
- D. 1.7 N

27. A solenoid of length 0.75 m has a radius 0.092 m. A current of 25 A flows through its 4 700 turns. Within this solenoid a 0.10 m long conductor moves at 4.3 m/s perpendicular to the field in the solenoid.

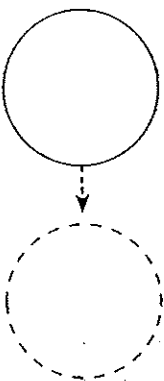


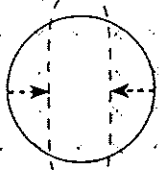
What emf is induced between the ends of the conductor?

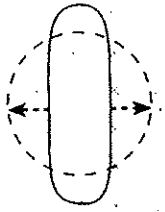
- A. 0.085 V
- B. 0.197 V
- C. 0.430 V
- D. 4.80 V


JUN 1999

28. In which of the following situations would the greatest emf be induced in the coil? All changes occur in the same time interval.

A.  \vec{B}
coil moves

B.  \vec{B}
coil changes shape

C.  \vec{B}
coil changes shape

D.  \vec{B}
coil moves

29. A motor is connected to a 12 V dc supply and draws 5.0 A when it first starts up. What will be the back emf when the motor is operating at full speed and drawing 1.2 A?
- A. 7.0 V
B. 7.8 V
C. 9.1 V
D. 10.8 V

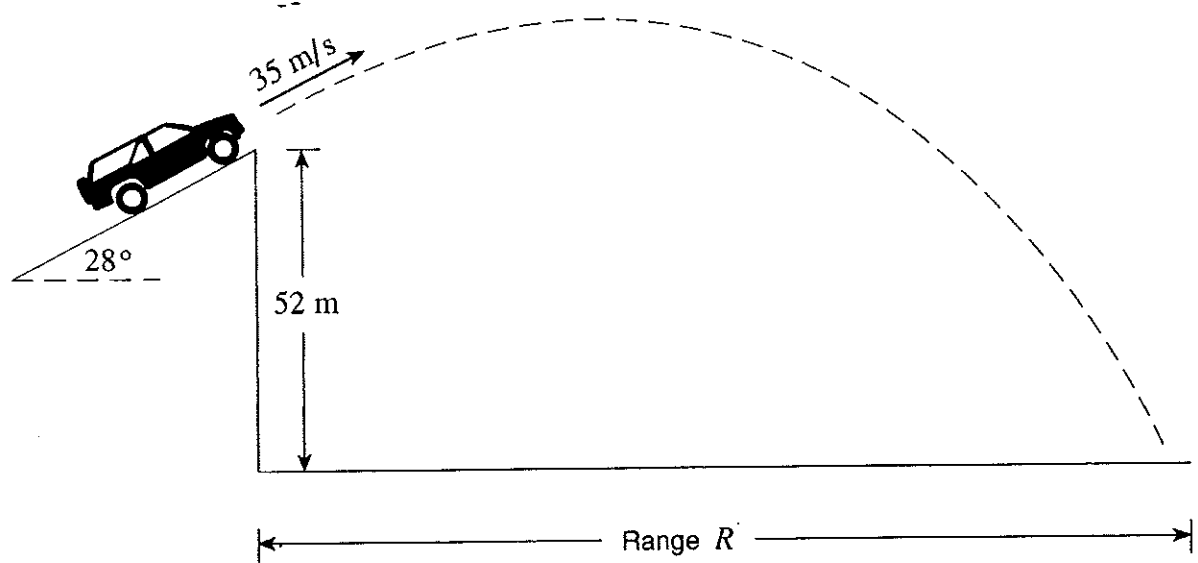
JUN 1999

30. An ideal transformer has a potential difference of 130 V ac across the primary windings and a potential difference of 780 V ac across the secondary windings. There are 390 turns in the secondary. The secondary current is
- A. twice the primary current.
 - B. one half the primary current.
 - C. six times the primary current.
 - D. one-sixth the primary current.

JUN 11 1999

**This is the end of the multiple-choice section.
Answer the remaining questions directly in this examination booklet.**

1. A stunt vehicle leaves an incline with a speed of 35 m/s at a height of 52 m above level ground. Air resistance is negligible.



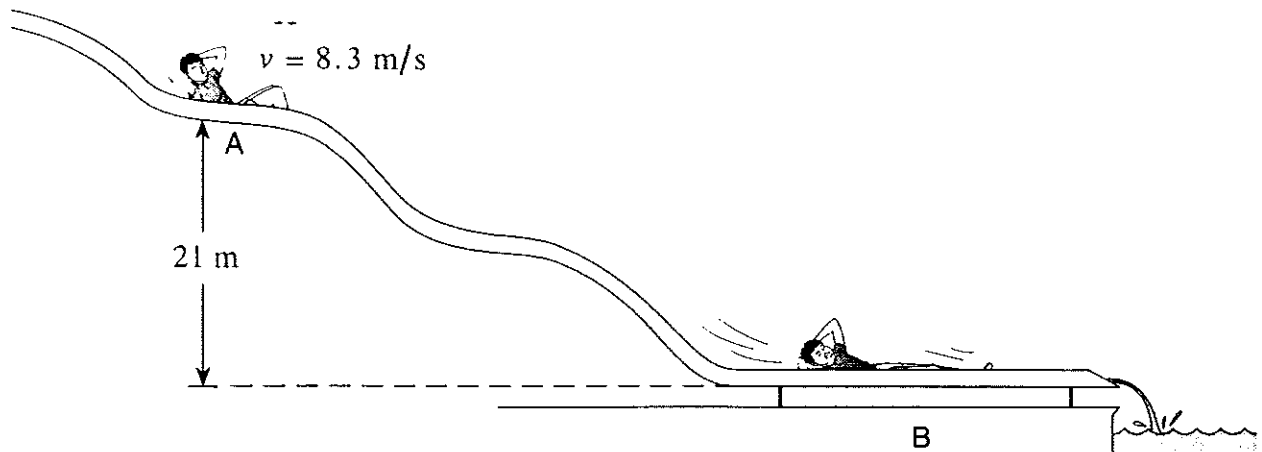
- a) What are the vehicle's vertical and horizontal velocity components as it leaves the incline? (1 mark)

b) What is the vehicle's time of flight? (4)

c) What is the vehicle's range R ? (2)

JUN 1999

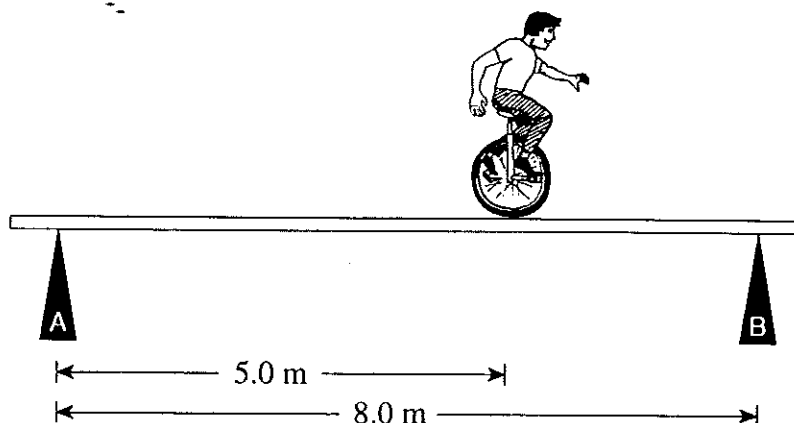
2. A 45 kg child on a water slide passes point A at 8.3 m/s .



As the child descends from A to B, 3 600 J of heat energy is created because of friction. What is his speed at B? (7 marks)

JUN 1999

3. A circus performer on a unicycle of total mass 55 kg rides across a uniform 30 kg beam. The supports are placed equal distances from the ends of the beam.



- a) When he is at the position shown, determine the forces exerted by the supports on the beam. (5 marks)

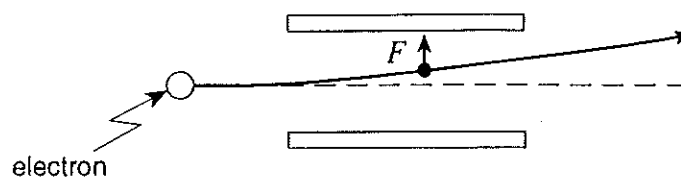
b) As the performer moves toward the right the force exerted by support B will. (1)
remain the same ☐ increase ☐ decrease ☐

c) Using principles of physics, explain your answer to b) (3)

4. A 1 500 kg satellite travels in a stable circular orbit around the earth. The orbital radius is 4.2×10^7 m. What is the satellite's kinetic energy? (7 marks)

JUN 11 1999

5. An electron passing between parallel plates 0.025 m apart experiences an upward electrostatic force of $5.1 \times 10^{-16}\text{ N}$.



- a) What is the magnitude of the electric field between the plates?

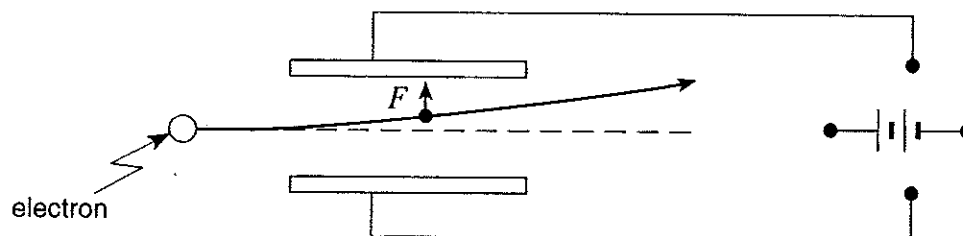
(3 marks)

b) What is the potential difference between the plates?

(2 marks)

c) On the diagram below draw in the connections to the power supply necessary for the electron to experience this upward force.

(2 marks)



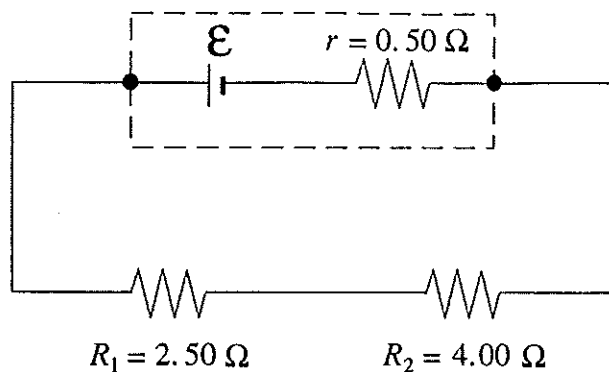
JUN 1999

ANSWER:

a) electric field: _____

b) potential difference: _____

6. The cell shown in the diagram supplies a 1.80 A current to the resistors R_1 and R_2 .



- a) What is the terminal voltage of the cell?

(3 marks)

- b) What is the emf of the cell? (4)

JUN 1999

7. A rectangular coil of wire containing 250 loops is placed in a magnetic field. Each loop measures 0.075 m by 0.28 m. The magnetic field changes over a time interval of 0.36 s producing an average emf of 1.3 V. What is the change in the magnetic field strength?
- (7 marks)

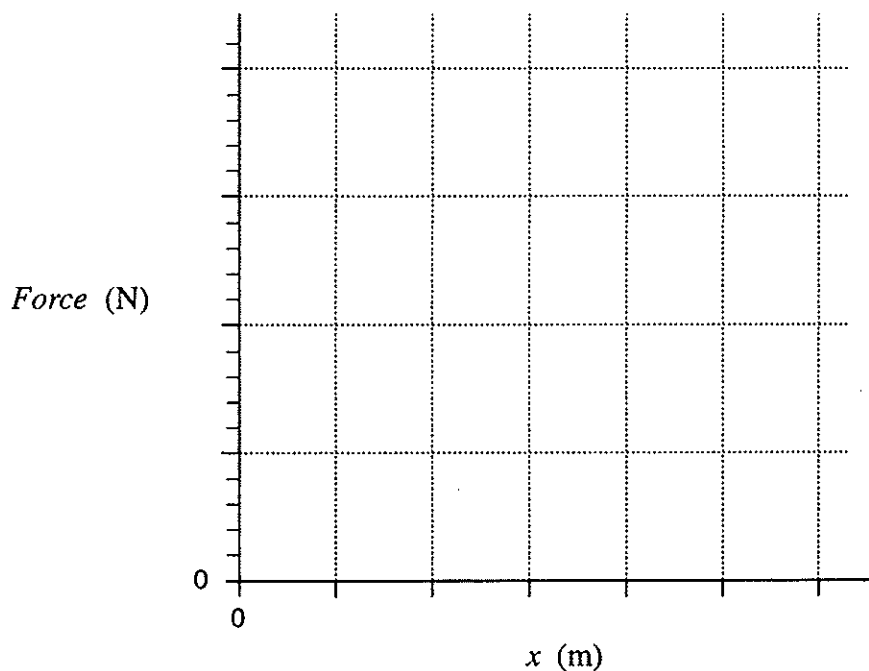
JUN 1999

8. A daredevil is attached by his ankles to a bungee cord and drops from the top of a bridge. The force exerted on the daredevil by the bungee cord is measured against the change in length, x , of the cord as the cord is stretched, slowing the daredevil's fall.

Force (N)	0	300	600	1 000	1 200	1 700	1 900
x (m)	0	5	10	15	20	25	30

- a) Plot a graph of force vs. change in length on the graph below.

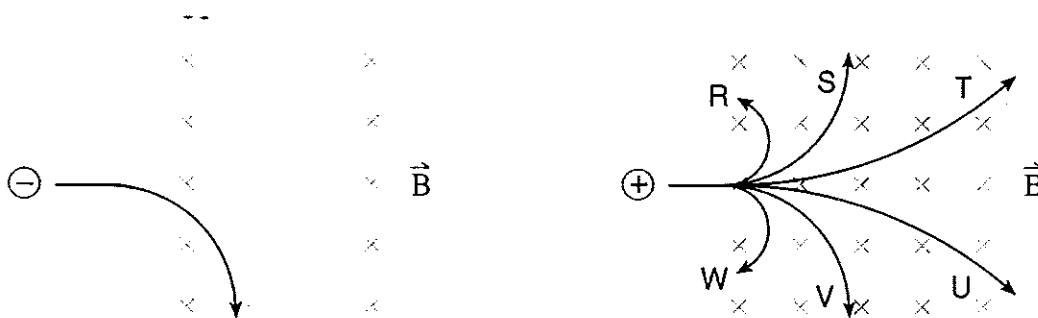
(2 marks)



- b) Use the graph to determine the work done by the bungee cord during its stretch.
(3)

JUN 1999

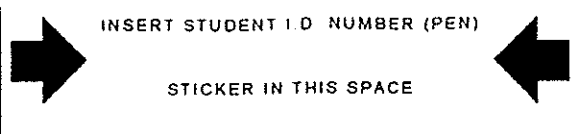
9. An electron travelling at a high speed enters a magnetic field as shown. A proton travelling at the same speed then enters the magnetic field.



- a) Which of the six choices best illustrates the path the proton will follow? (1 mark)

- b) Using principles of physics, explain why the proton takes the path selected in a). (3 marks)

END OF EXAMINATION



AUGUST 1999

PROVINCIAL EXAMINATION

MINISTRY OF EDUCATION

PHYSICS 12

GENERAL INSTRUCTIONS

1. Insert the stickers with your Student I.D. Number (PEN) in the allotted spaces above. **Under no circumstance is your name or identification, other than your Student I.D. Number, to appear on this paper.**
2. Take the separate Answer Sheet and follow the directions on its front page.
3. Be sure you have an HB pencil and an eraser for completing your Answer Sheet. Follow the directions on the Answer Sheet when answering multiple-choice questions.
4. For each of the written-response questions, write your answer in the space provided.
5. When instructed to open this booklet, **check the numbering of the pages** to ensure that they are numbered in sequence from page one to the last page, which is identified by

END OF EXAMINATION

6. At the end of the examination, place your Answer Sheet inside the front cover of this booklet and return the booklet and your Answer Sheet to the supervisor.

©1995 Ministry of Education

PART A: MULTIPLE CHOICE

Value: 60 marks (2 marks per question)

Suggested Time: 60 minutes

INSTRUCTIONS: For each question, select the best answer and record your choice on the Response Form provided. Using an HB pencil, completely fill in the circle that has the letter corresponding to your answer.

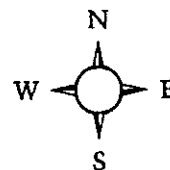
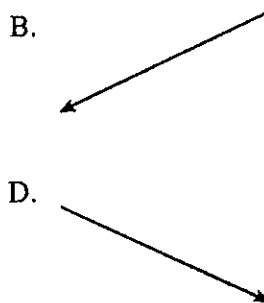
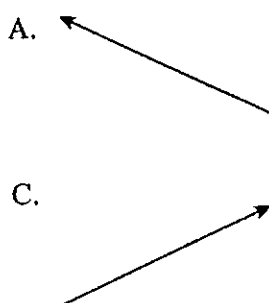
1. Which of the following is true for projectile motion? (Ignore friction.)

	HORIZONTAL COMPONENT	VERTICAL COMPONENT
A.	constant velocity	constant velocity
B.	constant velocity	changing velocity
C.	changing velocity	constant velocity
D.	changing velocity	changing velocity

2. A ball is thrown vertically upward at 20 m/s from a height of 30 m above the ground. What is its speed on impact with the ground below?

- A. 14 m/s
- B. 24 m/s
- C. 31 m/s
- D. 44 m/s

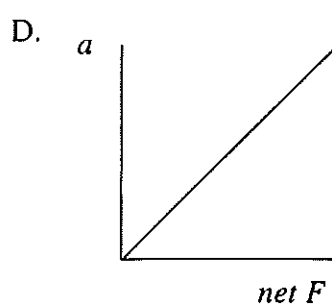
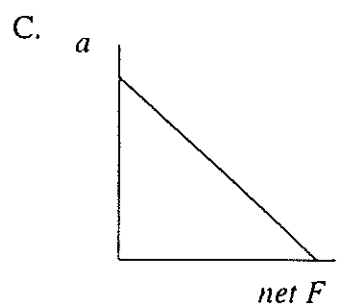
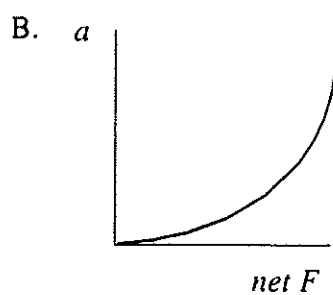
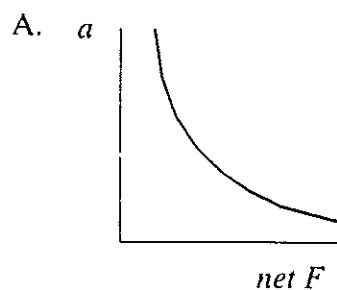
3. A car travelling north at 20 m/s is later travelling west at 30 m/s. What is the direction of the change in velocity?



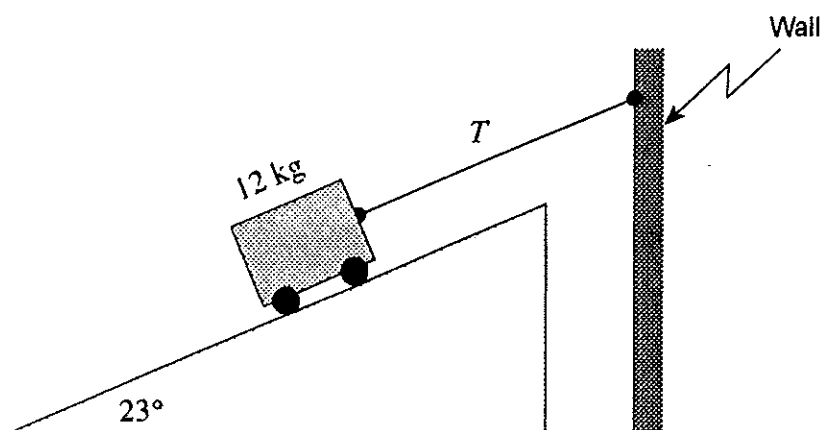
AUG --- 1999

OVER

4. Which of the following graphs shows the relationship between acceleration and net force?



5. A 12 kg cart on a 23° frictionless incline is connected to a wall as shown.



What is the tension T in the cord?

- A. 46 N
- B. 50 N
- C. 110 N
- D. 120 N

AUG -- 1999

6. Is power a scalar or vector quantity, and which are the correct units for measuring it?

	TYPE OF QUANTITY	UNITS
A.	Scalar	J/m
B.	Scalar	J/s
C.	Vector	J/m
D.	Vector	J/s

7. A climber's gravitational potential energy increases from 14 000 J to 21 000 J while climbing a cliff. She expends 18 000 J of energy during this activity. What is the efficiency of this process?

- A. 3%
- B. 39%
- C. 61%
- D. 97%

8. A 40 000 kg rail car travelling at 2.5 m/s collides with and locks to a stationary 30 000 kg car. Determine the speed of the locked cars and state whether the collision is elastic or inelastic.

	SPEED OF LOCKED CARS	TYPE OF COLLISION
A.	1.4 m/s	Elastic
B.	1.4 m/s	Inelastic
C.	1.9 m/s	Elastic
D.	1.9 m/s	Inelastic

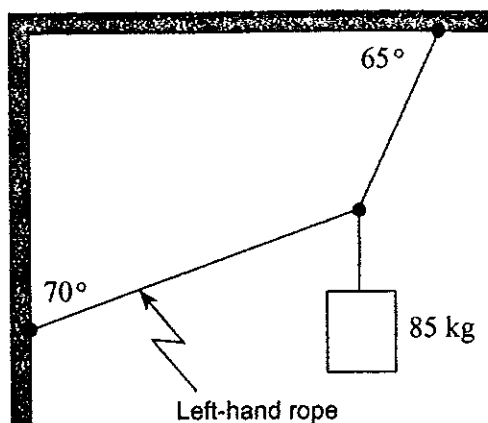
9. The unit for torque is

- A. J
- B. N · m
- C. N · s
- D. kg · m/s

AUG --- 1999

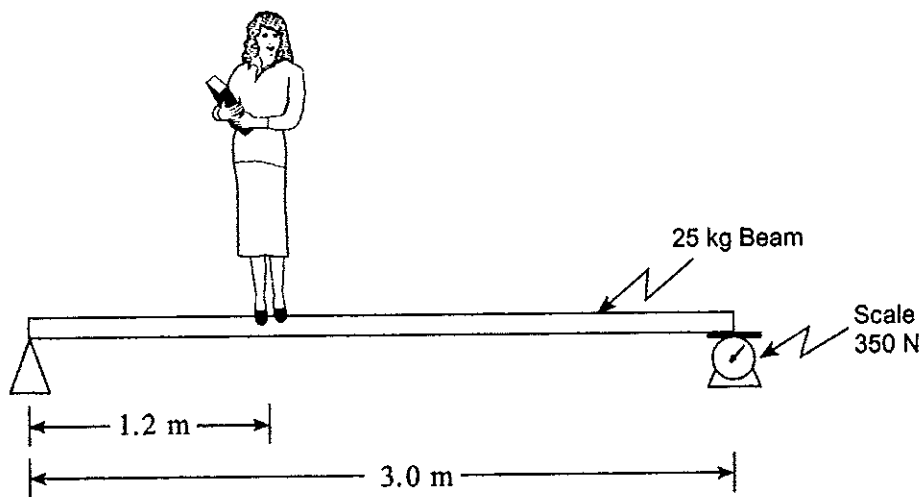
OVER

10. An 85 kg object is suspended from a ceiling and attached to a wall.



What is the tension in the left-hand rope?

- A. 280 N
 - B. 350 N
 - C. 500 N
 - D. 1 100 N
11. A student stands on a uniform 25 kg beam. The scale on the right end reads 350 N.

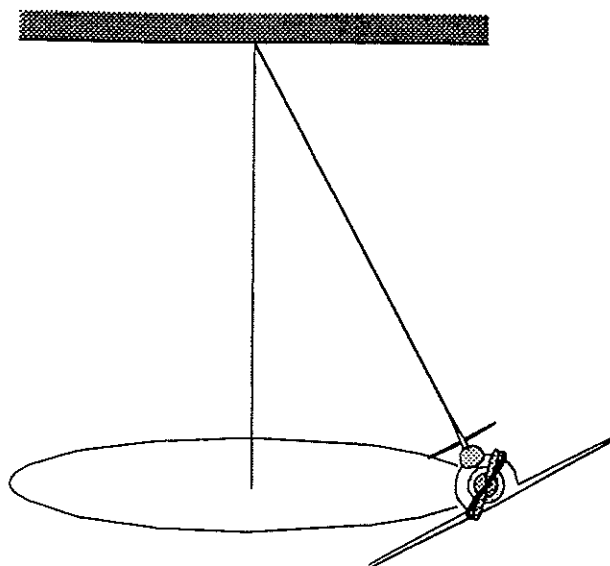


What is the mass of the student?

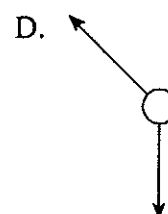
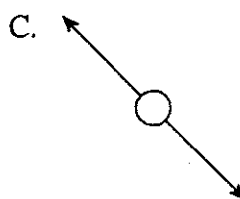
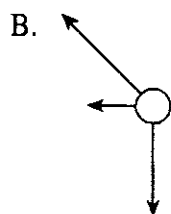
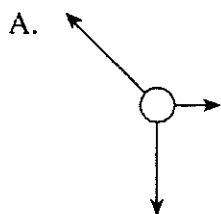
- A. 45 kg
- B. 54 kg
- C. 58 kg
- D. 89 kg

AUG -- 1999

12. A small toy airplane suspended as shown below flies in a circular path.



Which of the following free body diagrams best describes the forces acting on the airplane at the position shown?

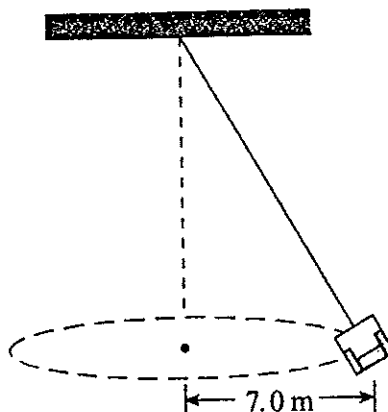


13. A 1.5 kg object is in uniform circular motion with a period of 3.0 s. If the radius of the path is 4.0 m, what is the centripetal force on the object?

- A. 18 N
- B. 26 N
- C. 41 N
- D. 59 N

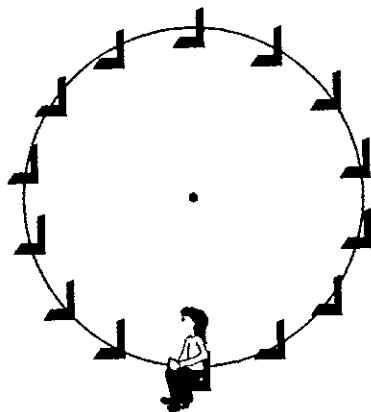
AUG --- 1999

14. An empty 12 kg seat on a swing-type ride at the fairgrounds has a kinetic energy of 480 J.



What is the centripetal force on the empty seat?

- A. 1.2×10^2 N
 - B. 1.4×10^2 N
 - C. 8.2×10^2 N
 - D. 5.8×10^3 N
15. A 75 kg person rides a Ferris wheel which is rotating uniformly. The centripetal force acting on the person is 45 N.

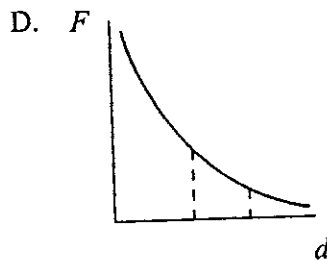
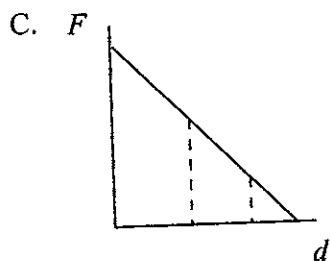
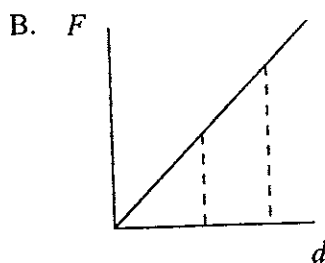
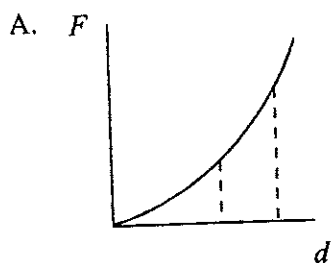


What force does the seat exert on the rider at the top and at the bottom of the ride?

	FORCE AT TOP	FORCE AT BOTTOM
A.	690 N	690 N
B.	690 N	780 N
C.	780 N	690 N
D.	780 N	780 N

AUG -- 1999

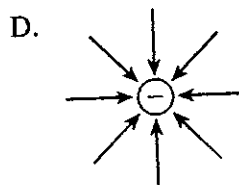
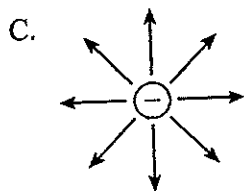
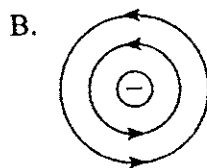
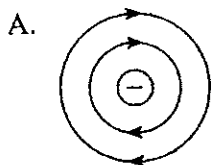
16. Which of the following illustrates the work required to move an object in a gravitational field?



17. A 1 500 kg satellite orbits the earth at 2 500 m/s. What is the satellite's centripetal acceleration?

- A. 0.098 m/s^2
- B. 0.98 m/s^2
- C. 9.8 m/s^2
- D. $1.5 \times 10^2 \text{ m/s}^2$

18. Which diagram shows the electric field near a negative point charge?



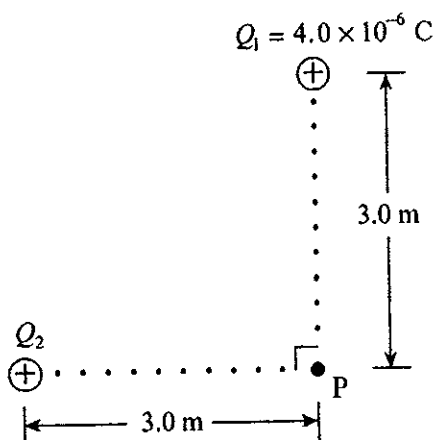
AUG --- 1999

OVER

19. Which pair of values will cause the greatest deflection of an electron beam in a cathode ray tube?

	ACCELERATING VOLTAGE	DEFLECTION (PLATE) VOLTAGE
A.	400 V	20 V
B.	400 V	40 V
C.	800 V	20 V
D.	800 V	40 V

20. The magnitude of the net electric field at P in the diagram below is $5.0 \times 10^3 \text{ N/C}$.

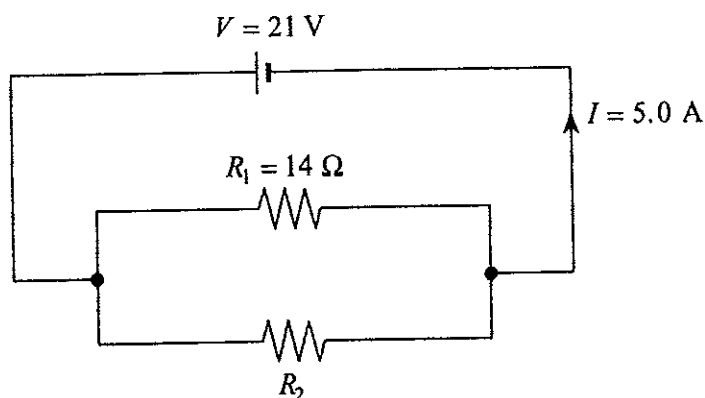


Find the magnitude of charge Q_2 .

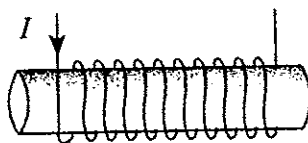
- A. $1.0 \times 10^{-6} \text{ C}$
 B. $3.0 \times 10^{-6} \text{ C}$
 C. $6.4 \times 10^{-6} \text{ C}$
 D. $1.0 \times 10^{-5} \text{ C}$
21. Electricity is transmitted at high potential to
- A. operate heavy equipment.
 B. maximize current in the transmission lines.
 C. minimize the energy lost as heat in the transmission lines.
 D. produce alternating currents because they always require high voltages.

AUG -- 1999

22. Find the current flowing through resistor R_2 in the circuit shown below.



- A. 1.5 A
B. 2.5 A
C. 3.5 A
D. 5.0 A
23. A cell has an internal resistance of $0.50\ \Omega$. It has a terminal voltage of 1.4 V when connected to a $5.0\ \Omega$ external resistance. What will its terminal voltage be if the $5.0\ \Omega$ resistor is replaced by a $10.0\ \Omega$ resistor?
- A. 0.70 V
B. 1.4 V
C. 1.5 V
D. 2.8 V
24. An electric current flows through a solenoid as shown below.



What is the direction of the magnetic field inside the solenoid?

A. \vec{B} (points right)

B. \vec{B} (points left)

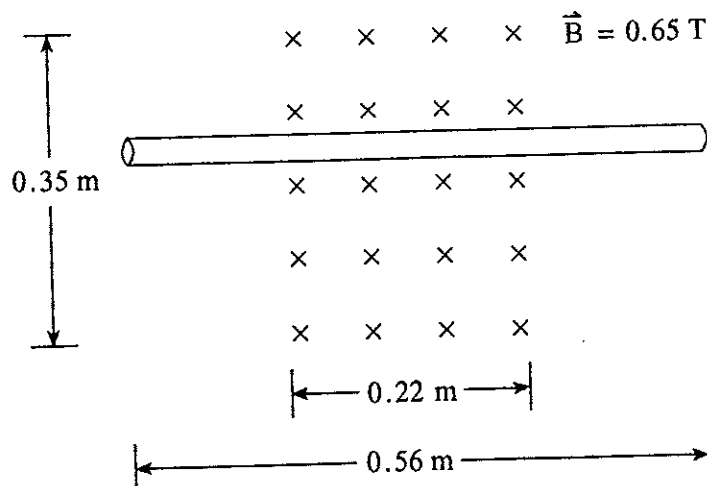
C. \vec{B} (points up)

D. \vec{B} (points down)

AUG -- 1999

OVER

25. A long conductor is placed in a 0.65 T magnetic field as shown below.



What are the magnitude and direction of the current that produces a 1.6 N force on the wire directed up the page?

	MAGNITUDE OF CURRENT	DIRECTION OF CURRENT
A.	4.4 A	Right
B.	4.4 A	Left
C.	11 A	Right
D.	11 A	Left

26. A proton has a speed of $5.0 \times 10^6 \text{ m/s}$ while travelling perpendicular to a 0.14 T magnetic field. What is the magnetic force on the proton?

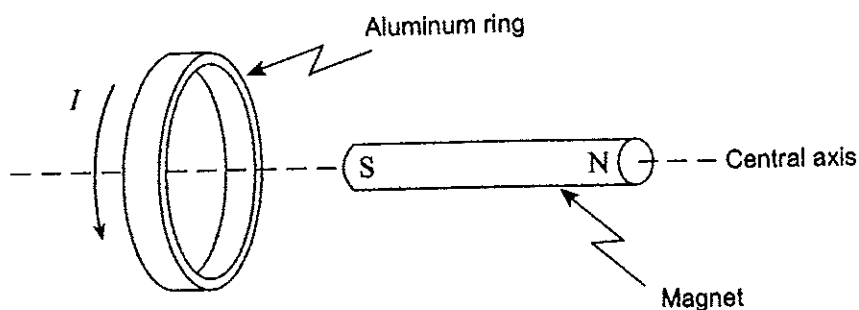
- A. $1.6 \times 10^{-26} \text{ N}$
- B. $8.4 \times 10^{-21} \text{ N}$
- C. $2.2 \times 10^{-20} \text{ N}$
- D. $1.1 \times 10^{-13} \text{ N}$

27. The flux through a circular coil with a radius of 0.075 m is 0.013 Wb when placed perpendicular to a magnetic field. What is the strength of the magnetic field?

- A. 0 T
- B. 0.17 T
- C. 0.74 T
- D. 2.3 T

AUG -- 1999

28. The diagram below shows an aluminum ring and the current induced in it by the nearby magnet that is free to move along its central axis.



The magnet must be

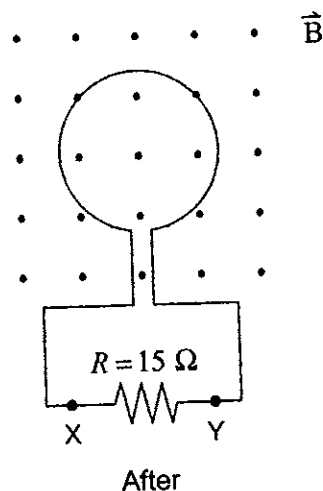
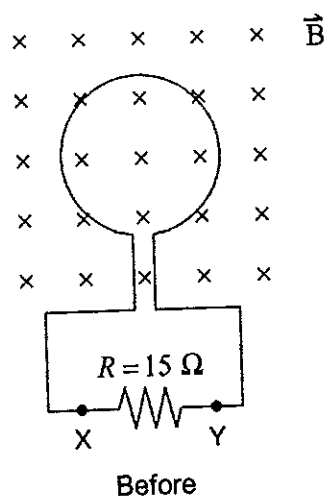
- A. stationary.
 - B. moving to the left.
 - C. moving to the right.
 - D. spinning about its central axis.
29. A computer adapter contains a transformer that converts 120 V ac across its primary windings to 24 V ac across its secondary windings. The primary current is 1.2 A. What is the secondary current and what is the type of transformer?

	MAGNITUDE OF CURRENT	DIRECTION OF CURRENT
A.	0.24 A	Step-up
B.	0.24 A	Step-down
C.	6.0 A	Step-up
D.	6.0 A	Step-down

AUG -- 1999

OVER

30. A loop of wire of area 0.32 m^2 is placed in a 0.75 T magnetic field as shown. The magnetic field is changed to 0.35 T in the opposite direction in 0.45 s .

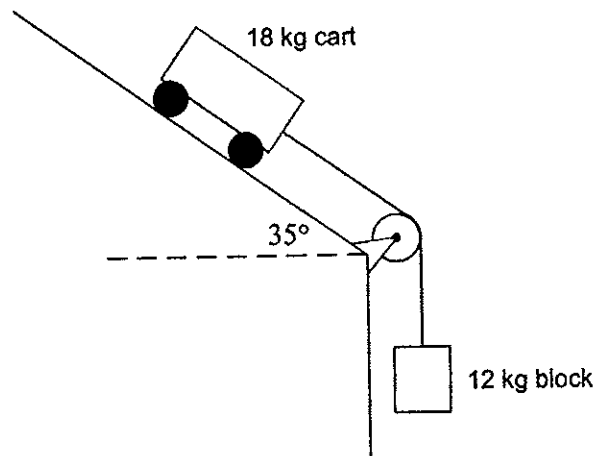


What are the magnitude and direction of the current through the 15Ω resistor?

	MAGNITUDE OF CURRENT	DIRECTION OF CURRENT
A.	0.019 A	X to Y
B.	0.019 A	Y to X
C.	0.052 A	X to Y
D.	0.052 A	Y to X

This is the end of the multiple-choice section.
Answer the remaining questions directly in this examination booklet.

1. An 18 kg cart is connected to a 12 kg hanging block as shown. (Ignore friction.)



- a) Draw and label a free body diagram for the 18 kg cart. (2 marks)

- b) What is the magnitude of the acceleration of the cart? (5 marks)

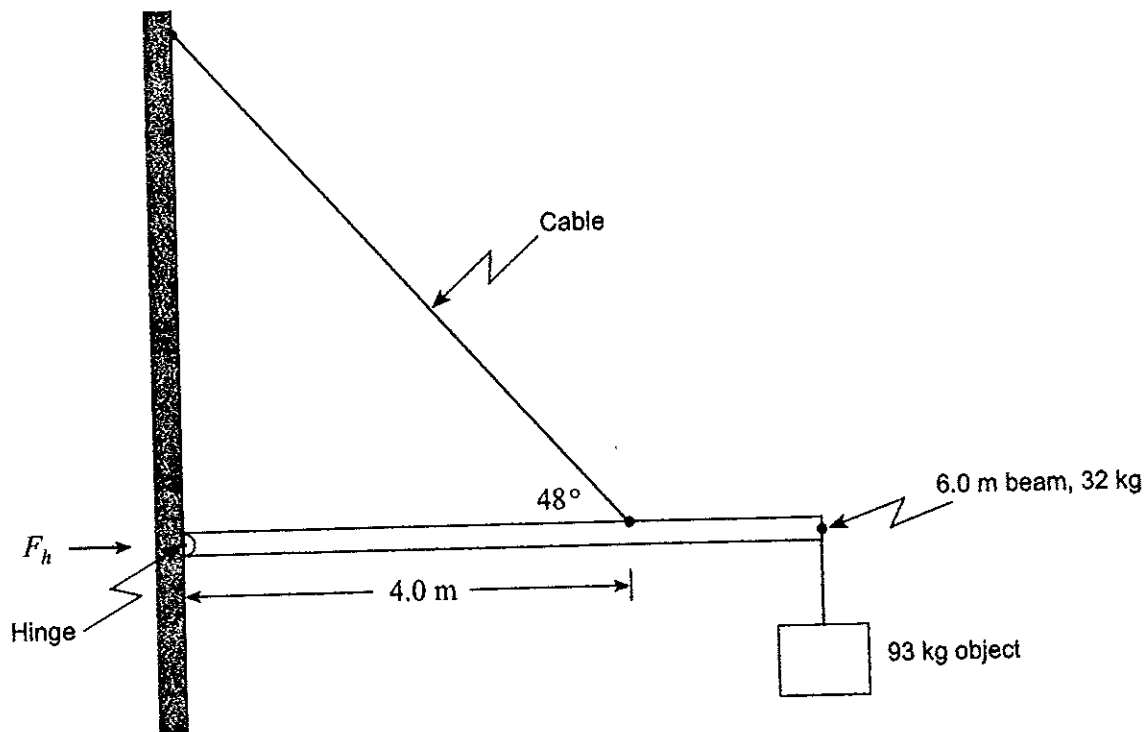
2. A 0.25 kg cart travelling at 3.0 m/s collides with and sticks to an identical stationary cart on a level track. (Ignore friction.)



To what height h do the combined carts travel up the hill?

(7 marks)

3. A 6.0 m uniform beam of mass 32 kg is suspended horizontally by a hinged end and a cable. A 93 kg object is connected to one end of the beam.



What is the magnitude of the horizontal force F_h that the hinge exerts on the beam? (7 marks)

4. A 1 500 kg satellite travels around the earth in a stable orbit with a radius of 1.3×10^7 m.

a) What is the speed of the satellite in this orbit?

(5 marks)

- b) The satellite is then moved to a new orbit with twice the radius of the first orbit. The speed in this orbit is

- ☐ the same as
☐ less than
☐ more than

the speed in the first orbit. (Check one response.)

(1 mark)

- c) Using principles of physics, explain your answer to b).

(3 marks)

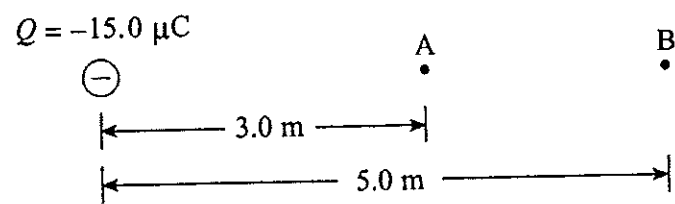
AUG -- 1999

ANSWER:

a) speed: _____

OVER

5. a) Find the electric potential at point A and at point B. (Note: $1.0 \mu\text{C}$ is $1.0 \times 10^{-6} \text{ C}$)
(3 marks)



AUG -- 1999

ANSWER:

a) potential at A: _____

potential at B: _____

b) What is the potential difference between A and B?

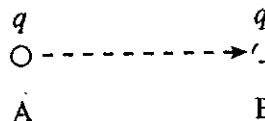
(1 mark)

ANSWER:

b) potential difference: _____

c) 0.036 J of work must be done to move a charge q from A to B. Find the magnitude and polarity of this charge. (3 marks)

$$Q = -15.0 \mu\text{C}$$



AUG -- 1999

ANSWER:

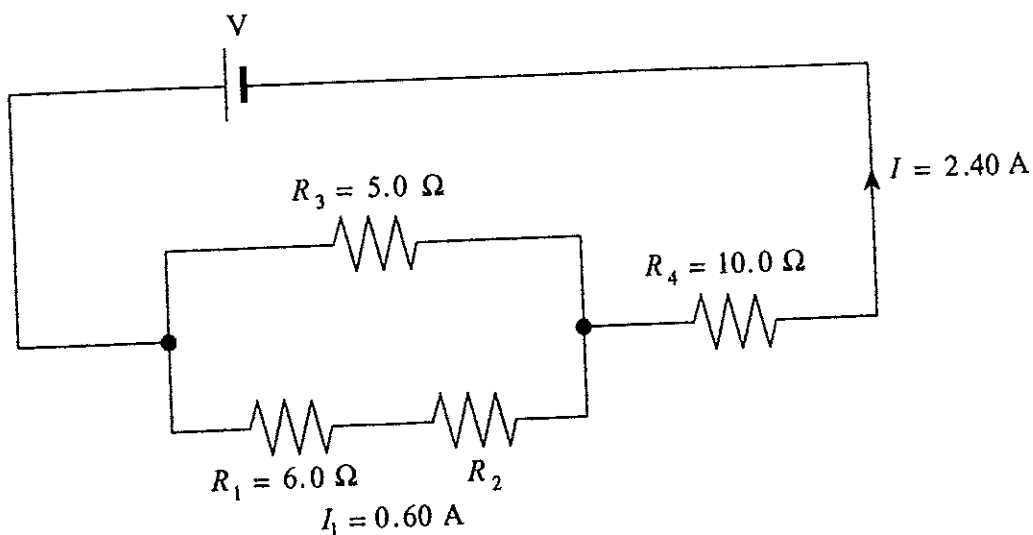
c) charge: _____

polarity: _____

OVER

6. a) Find the value of resistor R_2 .

(5 marks)



- b) Find the potential difference of the power supply V . (2 marks)

ANSWER:

a) resistor R_2 : _____

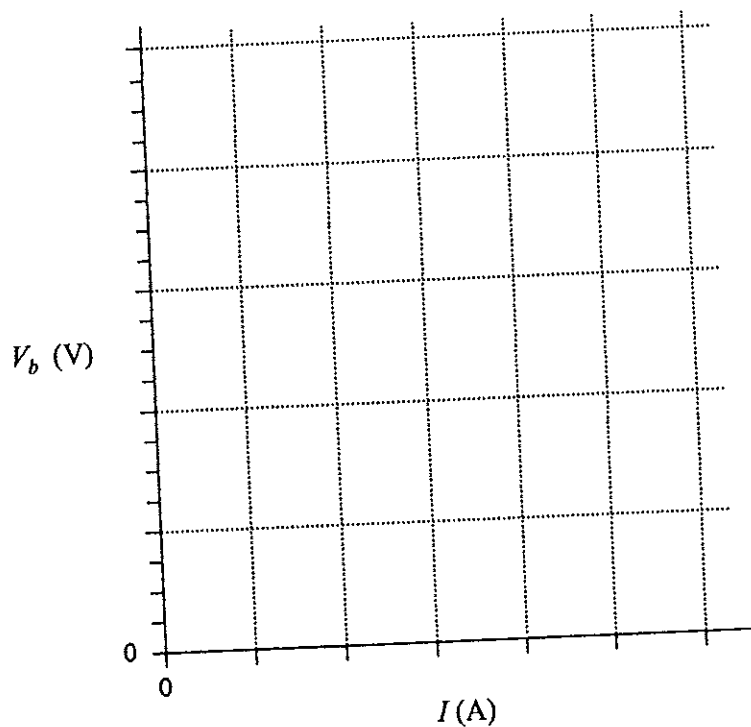
7. An automobile starter motor, connected to a 12.0 V battery, produces a back emf of 9.7 V when operating at normal speed. A malfunction prevents the starter motor from turning and the current increases to 180 A . What current does the starter motor draw when operating normally? (7 marks)

8. An electric motor is connected to a 9.0 V power supply. The data table below shows how the back emf of the motor, V_{back} , varies with the current through the armature, I , as the mechanical load changes.

Back emf V_{back} (V)	7.5	6.0	4.5	3.0	1.5	0
Current I (A)	1.0	2.0	3.0	4.0	5.0	6.0

a) Plot this data on the graph below.

(2 marks)



b) Determine the slope of this graph.

(2 marks)

c) What property of the motor does the slope of this graph represent?

(1 mark)

ANSWER:

b) slope: _____

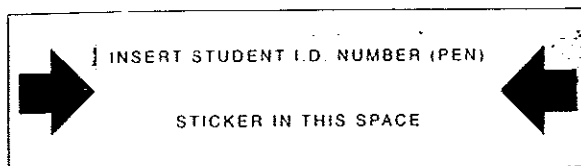
OVER

-384

AUG -- 1999

9. A cyclist must do 1 000 J of work to speed up from 0 m/s to 5.0 m/s. The same cyclist must do 3 000 J of work to speed up from 5.0 m/s to 10.0 m/s. (In both instances friction has been ignored.) Using principles of physics, explain why more work must be done to speed up from 5.0 m/s to 10.0 m/s than from 0 m/s to 5.0 m/s. (Remember, friction plays no role in this problem.) (4 marks)

END OF EXAMINATION



JANUARY 2000

PROVINCIAL EXAMINATION

MINISTRY OF EDUCATION

PHYSICS 12

GENERAL INSTRUCTIONS

1. Insert the stickers with your Student I.D. Number (PEN) in the allotted spaces above and on the back cover of this booklet. **Under no circumstance is your name or identification, other than your Student I.D. Number, to appear on this booklet.**
2. Ensure that in addition to this examination booklet, you have an **Examination Response Form**. Follow the directions on the front of the Response Form.
3. **Disqualification** from the examination will result if you bring books, paper, notes or unauthorized electronic devices into the examination room.
4. All multiple-choice answers must be entered on the Response Form using an **HB pencil**. Multiple-choice answers entered in this examination booklet will **not** be marked.
5. For each of the written-response questions, write your answer in the space provided in this booklet.
6. When instructed to open this booklet, **check the numbering of the pages** to ensure that they are numbered in sequence from page one to the last page, which is identified by

END OF EXAMINATION

7. At the end of the examination, place your Response Form inside the front cover of this booklet and return the booklet and your Response Form to the supervisor.

©2000 Ministry of Education

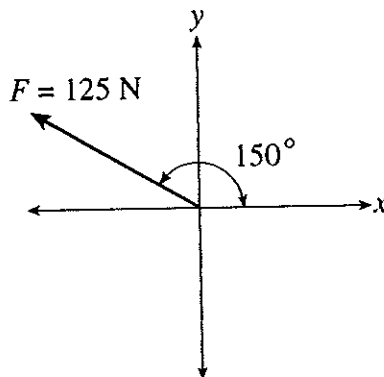
PART A: MULTIPLE CHOICE

Value: 60 marks (2 marks per question)

Suggested Time: 60 minutes

INSTRUCTIONS: For each question, select the **best** answer and record your choice on the Response Form provided. Using an HB pencil, completely fill in the circle that has the letter corresponding to your answer.

- Which of the following situations involves the use of kinematics?
 - Solving a back emf problem
 - Solving a projectile motion problem
 - Determining the internal resistance of a cell
 - Determining the sum of two momentum vectors
- Consider the diagram below.



What are the components of the 125 N force?

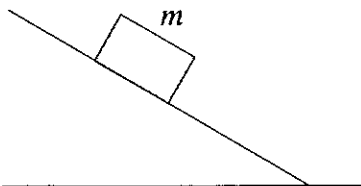
	x-COMPONENT	y-COMPONENT
A.	-62.5 N	72.2 N
B.	-72.2 N	62.5 N
C.	-62.5 N	108 N
D.	-108 N	62.5 N

- A projectile is launched at 35.0° above the horizontal with an initial velocity of 120 m/s. What is the projectile's speed 3.00 s later?
 - 68.8 m/s
 - 98.3 m/s
 - 106 m/s
 - 120 m/s

JAN -- 2000

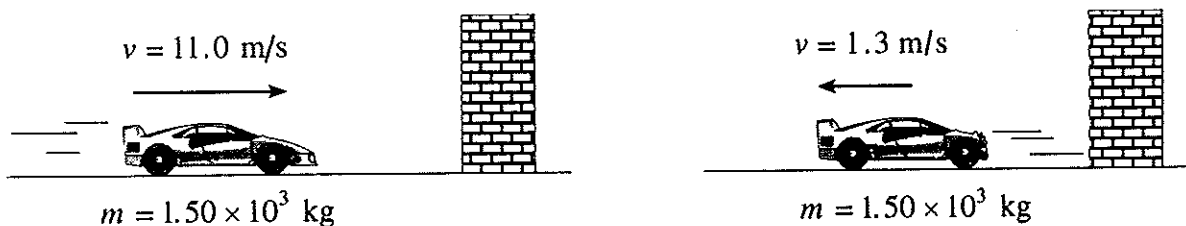
OVER

4. A block of mass m remains at rest on an incline as shown in the diagram.



The force acting up the ramp on this block is

- A. 0.
 - B. mg .
 - C. less than mg .
 - D. more than mg .
5. What is the minimum work done when a 65 kg student climbs an 8.0 m-high stairway in 12 s?
- A. 420 J
 - B. 520 J
 - C. 5 100 J
 - D. 6 200 J
6. Which of the following is equal to impulse?
- A. Energy
 - B. Momentum
 - C. Change in energy
 - D. Change in momentum
7. A 1.50×10^3 kg car travelling at 11.0 m/s collides with a wall as shown.



The car rebounds off the wall with a speed of 1.3 m/s. If the collision lasts for 1.7 s, what force does the wall apply to the car during the collision?

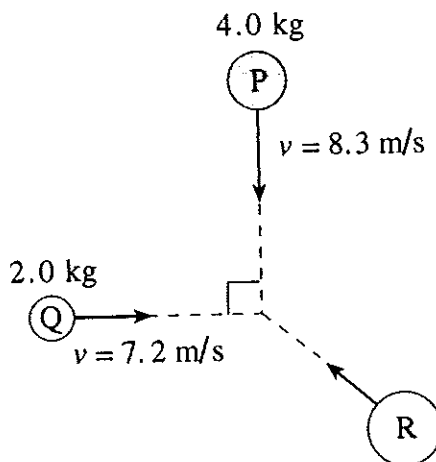
- A. 8.6×10^3 N
- B. 1.1×10^4 N
- C. 1.5×10^4 N
- D. 1.8×10^4 N

JAN -- 2000

8. A 1 500 kg car travelling at 25 m/s collides with a 2 500 kg van stopped at a traffic light. As a result of the collision the two vehicles become entangled. With what initial speed will the entangled mass move off, and is the collision elastic or inelastic?

	SPEED	TYPE OF COLLISION
A.	9.4 m/s	Elastic
B.	9.4 m/s	Inelastic
C.	15 m/s	Elastic
D.	15 m/s	Inelastic

9. Three objects travel as shown.



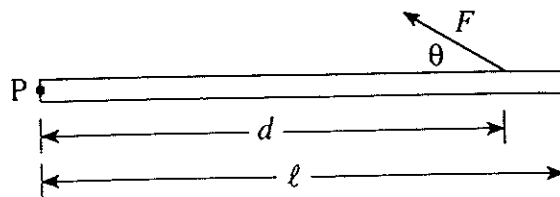
What is the magnitude of the momentum of object R so that the combined masses remain stationary after they collide?

- A. 19 kg · m/s
- B. 30 kg · m/s
- C. 36 kg · m/s
- D. 48 kg · m/s

JAN - - 2000

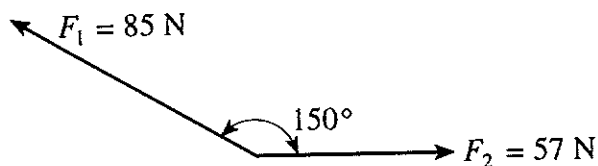
OVER

10. A force F is applied to a uniform horizontal beam as shown in the diagram below.

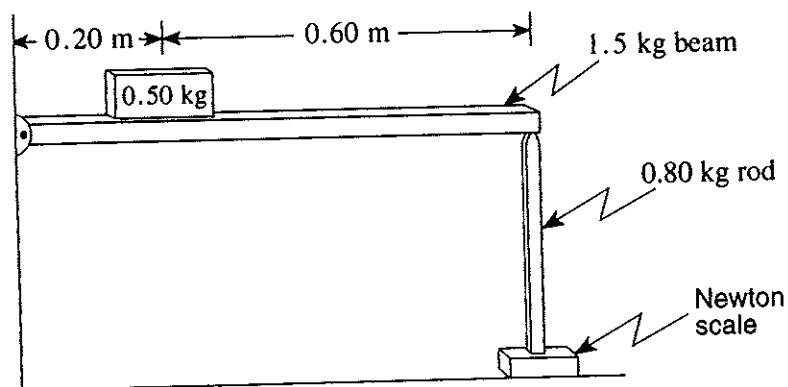


Which of the following is a correct expression for the torque on the beam about pivot point P due to this force?

- A. $F \sin \theta \cdot d$
 - B. $F \sin \theta \cdot d/\ell$
 - C. $F \cos \theta \cdot d$
 - D. $F \cos \theta \cdot d/\ell$
11. What is the magnitude of the sum of the two forces shown in the diagram below?



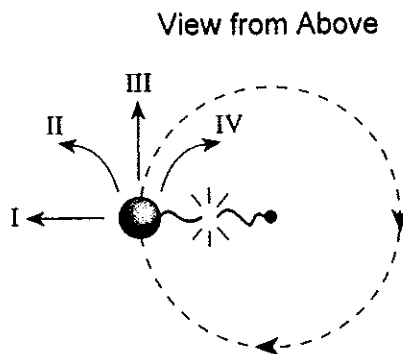
- A. 46 N
 - B. 102 N
 - C. 137 N
 - D. 142 N
12. A uniform 1.5 kg beam hinged at one end supports a 0.50 kg block. The beam is held level by a vertical 0.80 kg rod resting on a Newton scale at the other end.



What is the reading on the scale?

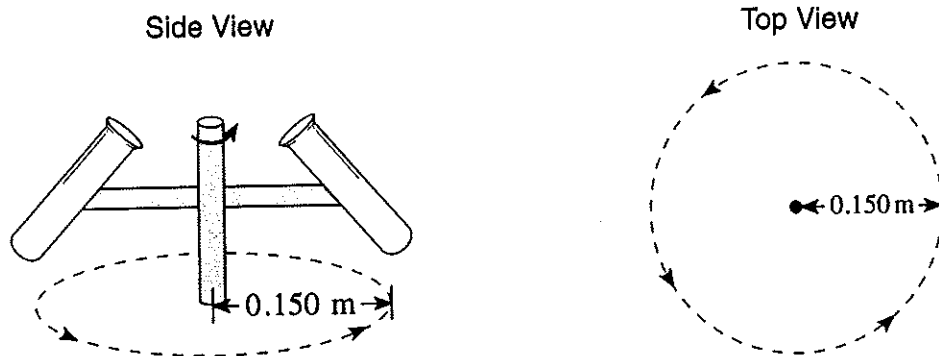
- A. 8.6 N
- B. 9.1 N
- C. 16 N
- D. 27 N

13. A ball attached to a string is swung in a horizontal circle.



Which path will the ball follow at the instant the string breaks?

- A. I
 - B. II
 - C. III
 - D. IV
14. A test tube rotates in a centrifuge with a period of 1.20×10^{-3} s. The bottom of the test tube travels in a circular path of radius 0.150 m.



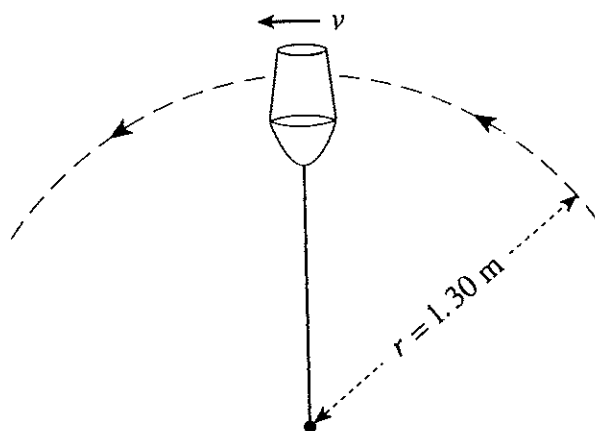
What is the centripetal force exerted on a 2.00×10^{-8} kg amoeba at the bottom of the tube?

- A. 9.86×10^{-5} N
- B. 2.08×10^{-3} N
- C. 8.22×10^{-2} N
- D. 4.11×10^6 N

JAN -- 2000

OVER

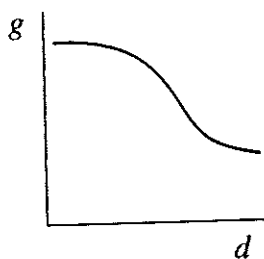
15. A physics student swings a 5.0 kg pail of water in a vertical circle of radius 1.3 m.



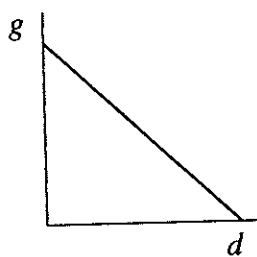
What is the minimum speed, v , at the top of the circle if the water is not to spill from the pail?

- A. 3.6 m/s
B. 6.1 m/s
C. 8.0 m/s
D. 9.8 m/s
16. Which of the following is a correct graph for gravitational field strength, g , versus the distance, d ?

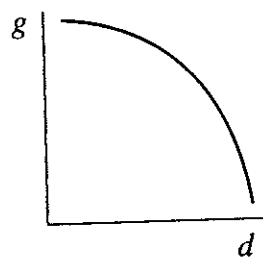
A.



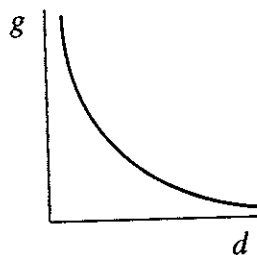
B.



C.



D.



JAN -- 2000

17. *Sputnik I*, Earth's first artificial satellite, had an orbital period of 5 760 s. What was the average orbital radius of *Sputnik's* orbit?

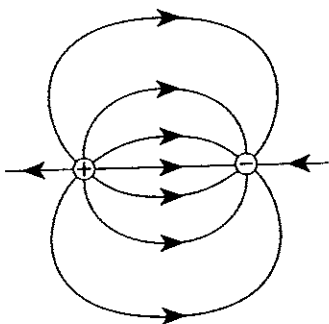
- A. 6.38×10^6 m
- B. 6.95×10^6 m
- C. 8.24×10^6 m
- D. 3.84×10^8 m

18. A 620 kg satellite orbits the earth where the acceleration due to gravity is 0.233 m/s^2 . What is the kinetic energy of this orbiting satellite?

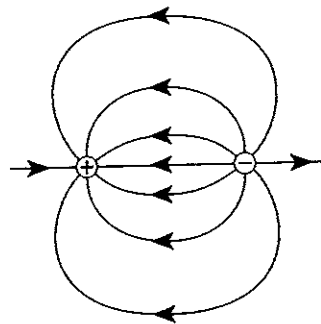
- A. -5.98×10^9 J
- B. -2.99×10^9 J
- C. 2.99×10^9 J
- D. 5.98×10^9 J

19. Which of the following diagrams shows the electric field between two equal but opposite charges?

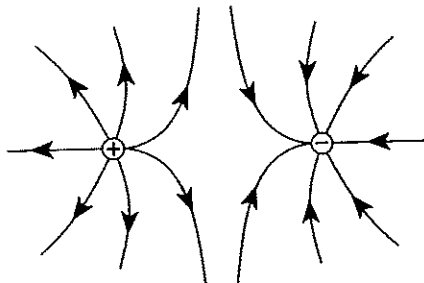
A.



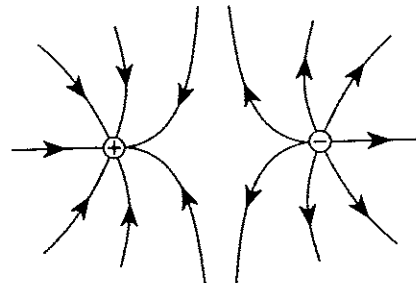
B.



C.



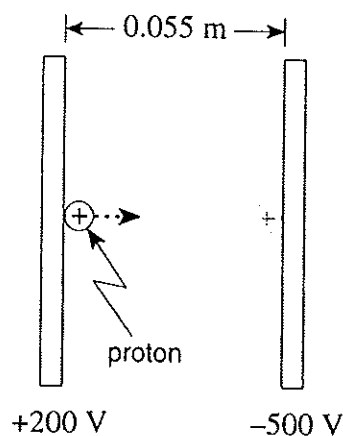
D.



JAN -- 2000

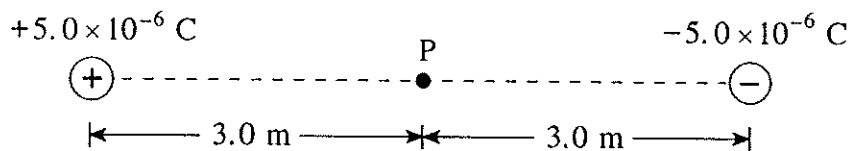
OVER

20. A proton initially at rest is accelerated between parallel plates through a potential difference of 700 V.



What is the maximum speed reached by the proton?

- A. 8.6×10^4 m/s
 - B. 3.1×10^5 m/s
 - C. 3.7×10^5 m/s
 - D. 1.6×10^6 m/s
21. What are the magnitudes of the electric field and the electric potential at point P midway between the two fixed charges?

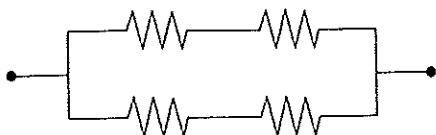


	MAGNITUDE OF ELECTRIC FIELD	ELECTRIC POTENTIAL
A.	0 N/C	0 V
B.	0 N/C	30 000 V
C.	10 000 N/C	0 V
D.	10 000 N/C	30 000 V

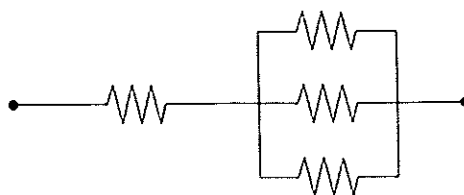
JAN -- 2000

22. Which of the following arrangements would draw the largest current when connected to the same potential difference? All resistors have the same value.

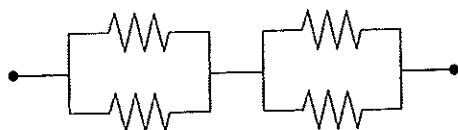
A.



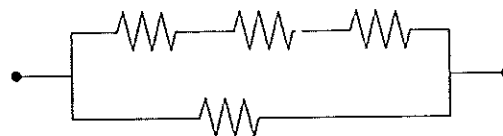
B.



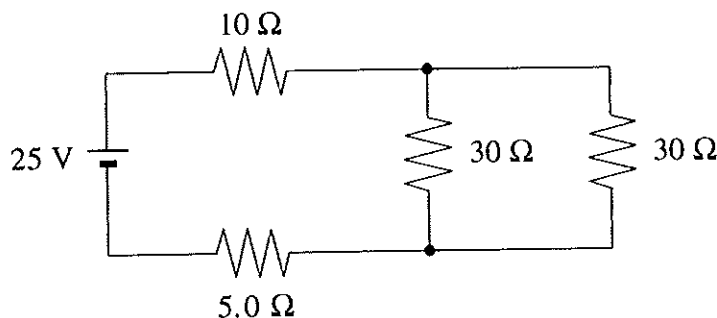
C.



D.



23. What is the power dissipated by the $5.0\ \Omega$ resistor in the following circuit?



- A. $0.56\ \text{W}$
- B. $3.5\ \text{W}$
- C. $6.2\ \text{W}$
- D. $130\ \text{W}$

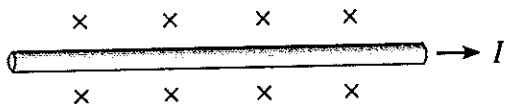
24. The direction of a magnetic field is determined to be the direction in which

- A. a positive charge would tend to move.
- B. a negative charge would tend to move.
- C. the north end of a compass needle would point.
- D. the south end of a compass needle would point.

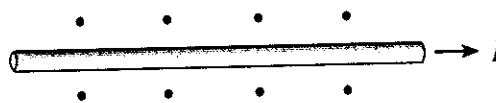
JAN -- 2009

25. Which diagram shows the magnetic field created near a conductor carrying current towards the right?

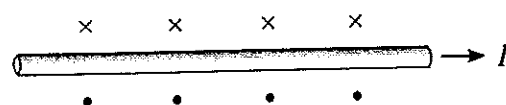
A.



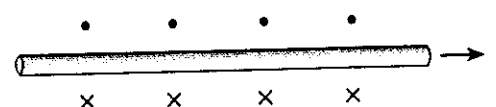
B.



C.

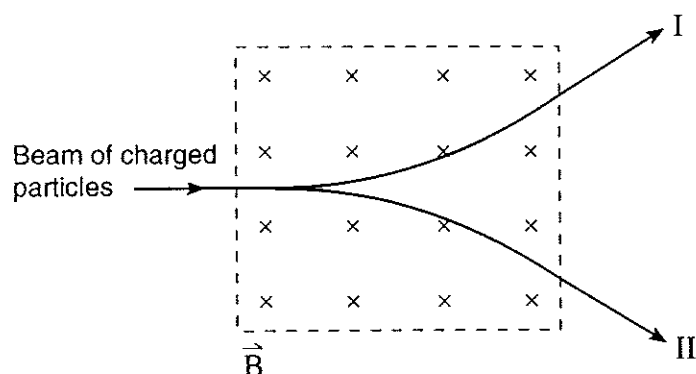


D.



OVER

26. A beam of positively and negatively charged particles enters a magnetic field as shown. Which paths illustrate the positive and negative charges leaving the magnetic field region?



	PATH OF POSITIVE CHARGES	PATH OF NEGATIVE CHARGES
A.	I	I
B.	I	II
C.	II	I
D.	II	II

27. A solenoid has a length of 0.30 m, a diameter of 0.040 m and 500 windings. The magnetic field at its centre is 0.045 T. What is the current in the windings?

- A. 2.9 A
- B. 3.0 A
- C. 21 A
- D. 170 A

28. An aircraft with a wingspan of 24 m flies at 85 m/s perpendicular to a magnetic field. An emf of 0.19 V is induced across the wings of the aircraft. What is the magnitude of the magnetic field?

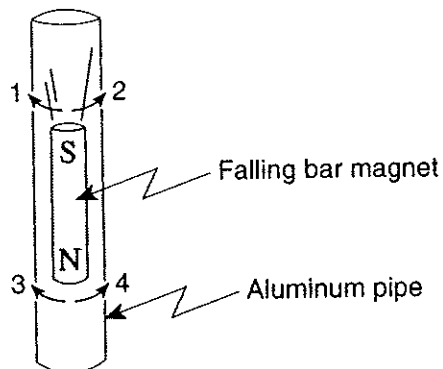
- A. 9.3×10^{-5} T
- B. 5.4×10^{-2} T
- C. 6.7×10^{-1} T
- D. 3.9×10^2 T

JAN -- 2000

29. As a carpenter drills into a beam, friction on the drill bit causes the armature of the drill to slow down. How will the back emf and the current through the armature change as the drill slows down?

	BACK EMF	CURRENT
A.	Increase	Increase
B.	Increase	Decrease
C.	Decrease	Increase
D.	Decrease	Decrease

30. The diagram shows a bar magnet falling through an aluminum pipe. Electric currents are induced in the pipe immediately above and below the falling magnet. In which direction do these currents flow?



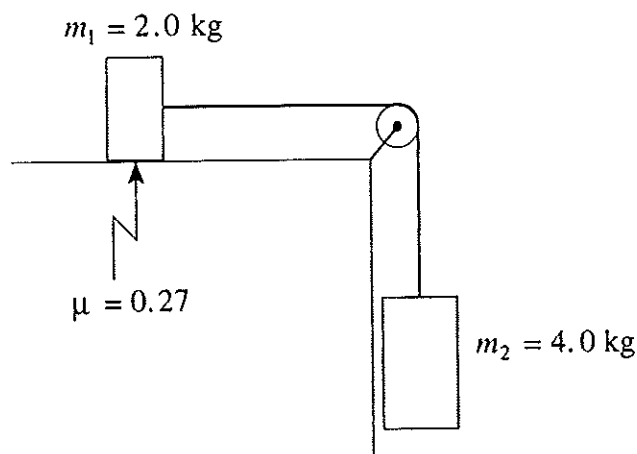
	ABOVE THE MAGNET	BELOW THE MAGNET
A.	1	3
B.	1	4
C.	2	3
D.	2	4

JAN -- 2000

**This is the end of the multiple-choice section.
Answer the remaining questions directly in this examination booklet.**

OVER

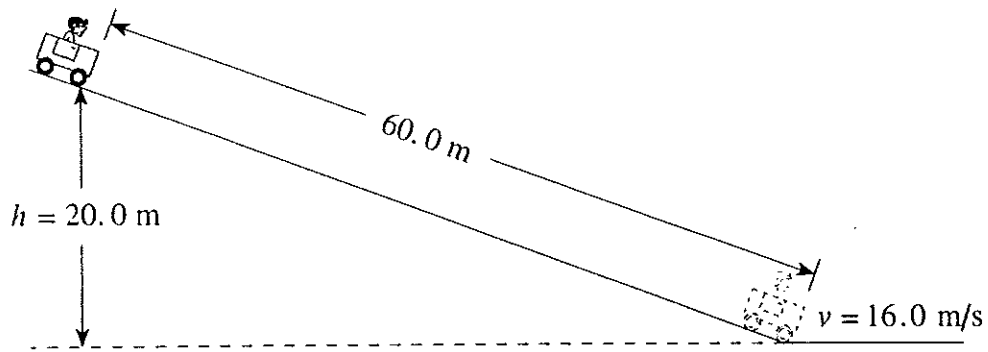
1. Two masses are connected by a light string over a frictionless massless pulley. There is a coefficient of friction of 0.27 between mass m_1 and the horizontal surface.



- a) Draw and label a free body diagram showing the forces acting on mass m_1 . (2 marks)

- b) What is the acceleration of m_2 ? (5 marks)

2. A 170 kg cart and rider start from rest on a 20.0 m high incline.



- a) How much energy is transformed to heat?

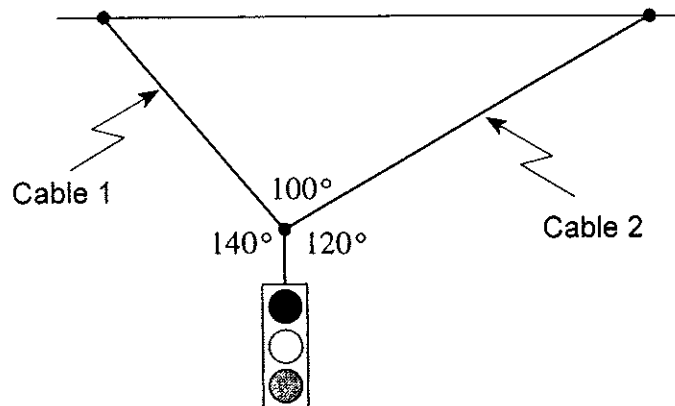
(5 marks)

- b) What is the average force of friction acting on the cart? (2 marks).

ANSWER:

a) energy: _____

3. A 35 kg traffic light is suspended from two cables as shown in the diagram.



What is the tension in each of these cables?

(7 marks)

JAN -- 2000

4. A 5.0 kg rock dropped near the surface of Mars reaches a speed of 15 m/s in 4.0 s.

a) What is the acceleration due to gravity near the surface of Mars?

(2 marks)

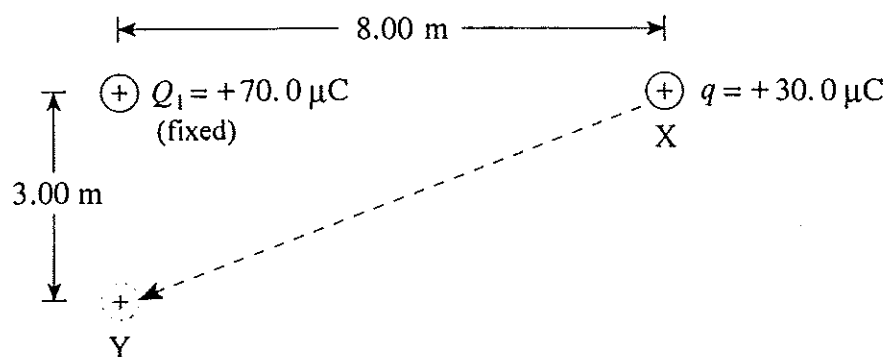
b) Mars has an average radius of $3.38 \times 10^6 \text{ m}$. What is the mass of Mars?
(5 marks).

JAN -- 2000

ANSWER:

a) acceleration: _____

5. A charge q of $30.0\ \mu\text{C}$ is moved from point X to point Y.

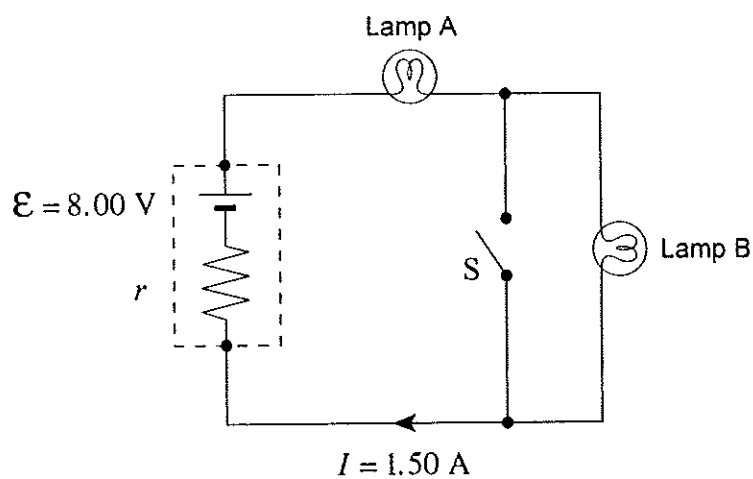


How much work is done on the $30.0\ \mu\text{C}$ charge? ($1\ \mu\text{C} = 1 \times 10^{-6}\ \text{C}$)

(7 marks)

JAN -- 2000

6. The circuit shown consists of an 8.00 V battery and two light bulbs. Each light bulb dissipates 5.0 W. Assume that the light bulbs have a constant resistance. Switch S is open.



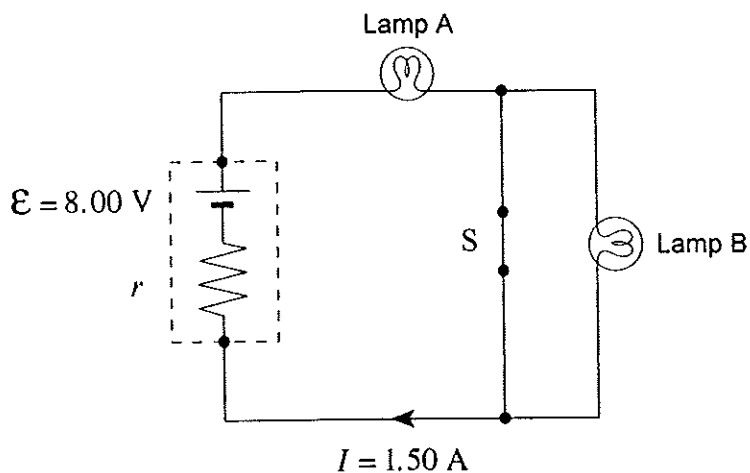
- a) If a current of 1.50 A flows in the circuit, what is the internal resistance r of the battery?
(4 marks)

JAN -- 2000

ANSWER:

a) internal resistance: _____

b) The switch S is now closed.



Lamp A will now be

- i) ☐ brighter.
☐ the same brightness as before.
☐ dimmer.

(Check one response.)

(1 mark)

The battery's terminal voltage will now be

- ii) ☐ greater than before.
☐ the same as before.
☐ less than before.

(Check one response.)

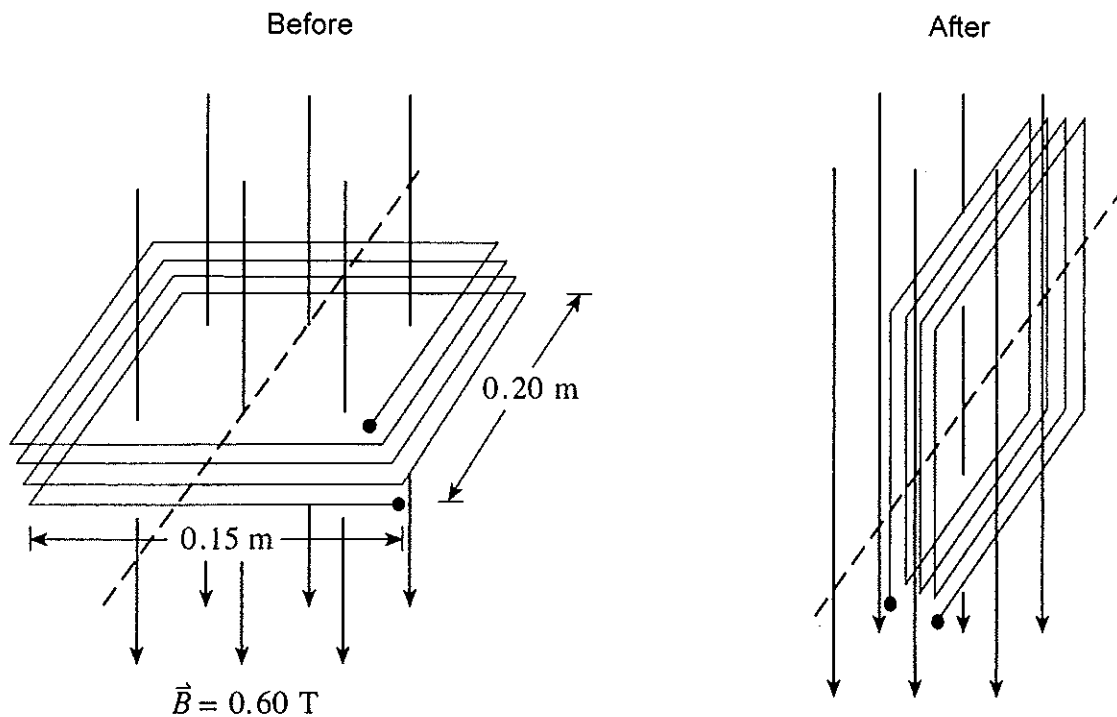
(1 mark)

c) Using principles of physics, explain your answers to b).

(3 marks)

omit

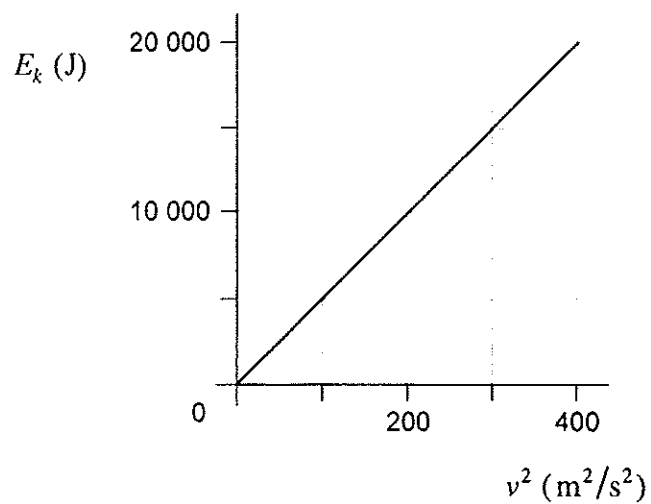
7. The diagram shows a coil with 25 windings and dimensions 0.15 m by 0.20 m. Its plane is perpendicular to a magnetic field of magnitude 0.60 T.



If the coil rotates 90° in 4.17×10^{-2} s so that its plane is now parallel to the magnetic field, what average emf is induced during this time? (7 marks)

JAN -- 2000

8. A student plots the graph below, showing the kinetic energy E_k of a motorbike versus the square of its velocity v^2 .



- a) What is the slope of this graph?

(2 marks)

ANSWER:

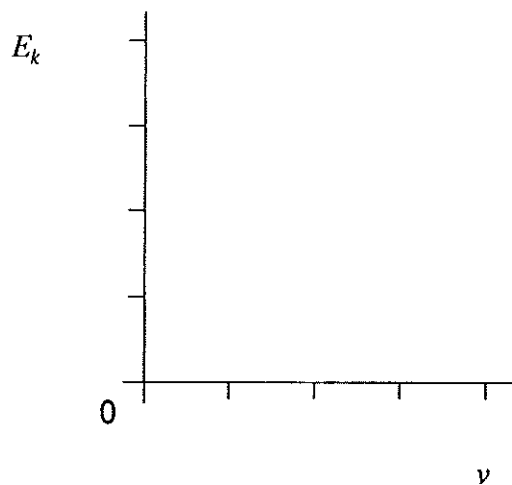
a) slope: _____

b) What does the slope represent?

(2 marks)

c) Using the axes below, sketch the graph of kinetic energy E_k versus velocity v for this motorbike. There is no need to plot any data points.

(1 mark)



JAN - - 2000

OVER

9. A classmate insists a book cannot be held against a wall by pushing horizontally as shown in Diagram A. He insists that there must be a vertical force component provided by pushing against the book from below, as shown in Diagram B.

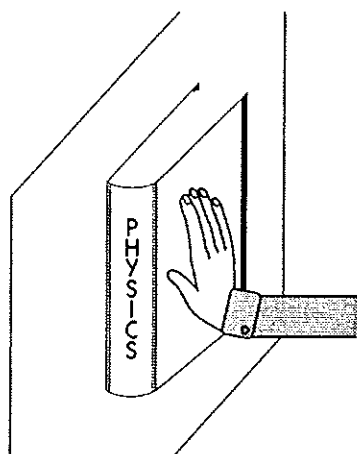


Diagram A

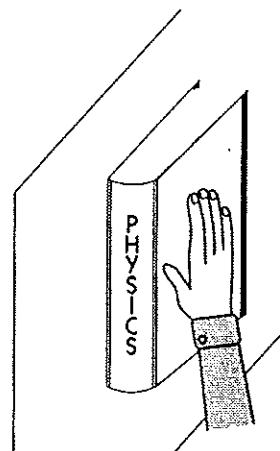


Diagram B

Using principles of physics, show that the situation in Diagram A is reasonable. (4 marks)

END OF EXAMINATION

JAN -- 2000

Insert Personal Education Number (PEN) here.

Insert only pre-printed PEN label here.

STUDENT INSTRUCTIONS

1. Insert the stickers with your Personal Education Number (PEN) in the allotted spaces above. **Under no circumstance is your name or identification, other than your Personal Education Number, to appear on this booklet.**
2. Ensure that in addition to this examination booklet, you have an **Examination Response Form**. Follow the directions on the front of the Response Form.
3. **Disqualification** from the examination will result if you bring books, paper, notes or unauthorized electronic devices into the examination room.
4. When instructed to open this booklet, **check the numbering of the pages** to ensure that they are numbered in sequence from page one to the last page, which is identified by
END OF EXAMINATION.
5. At the end of the examination, place your Response Form inside the front cover of this booklet and return the booklet and your Response Form to the supervisor.

PHYSICS 12

JUNE 2000

COURSE CODE = PH

Insert only hand-printed PEN here.

Ministry use only.



**BRITISH
COLUMBIA**
© 2000 Ministry of Education

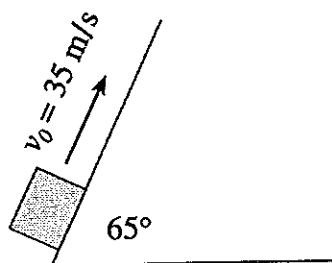
PART A: MULTIPLE CHOICE

Value: 60 marks (2 marks per question)

Suggested Time: 60 minutes

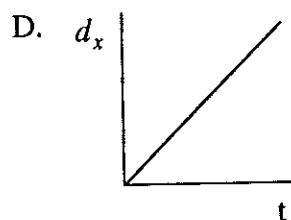
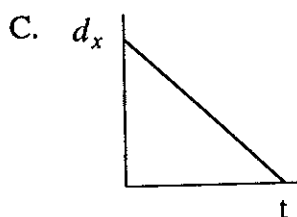
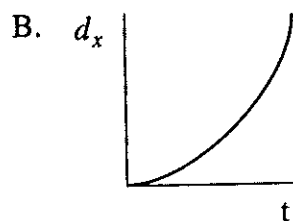
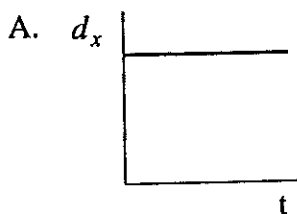
INSTRUCTIONS: For each question, select the **best** answer and record your choice on the Response Form provided. Using an HB pencil, completely fill in the circle that has the letter corresponding to your answer.

- Which of the following contains scalar quantities only?
 - speed, energy
 - velocity, energy
 - speed, displacement
 - velocity, momentum
- An object is fired up a frictionless ramp as shown in the diagram.



If the initial velocity is 35 m/s, how long does the object take to return to the starting point?

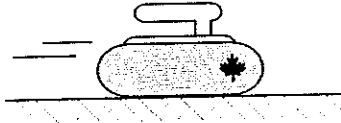
- 3.6 s
 - 3.9 s
 - 7.9 s
 - 17 s
- Which of the following graphs best illustrates the horizontal displacement of a projectile as a function of time? Ignore friction.



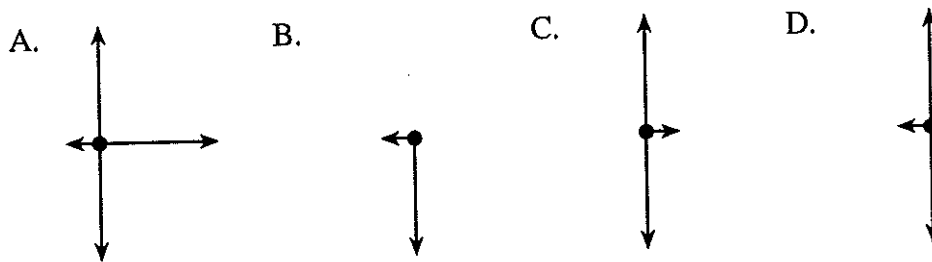
JUN -- 2000
OVER

4. A constant net force acting on an object results in the object having a constant
- A. velocity.
 - B. momentum.
 - C. acceleration.
 - D. kinetic energy.

5. A curling rock is travelling to the right across the ice as shown in the diagram.



Which of the following best represents the forces acting on the curling rock?



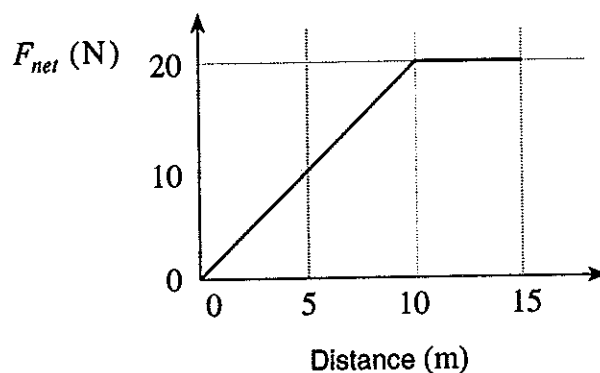
6. A change in kinetic energy is equivalent to

- A. work.
- B. power.
- C. impulse.
- D. momentum.

7. A 16 kg object is dropped from a height of 25 m and strikes the ground with a speed of 18 m/s. How much heat energy was produced during the fall?

- A. 0 J
- B. 1 300 J
- C. 2 600 J
- D. 3 900 J

8. A force is applied to an 8.0 kg object initially at rest. The magnitude of the net force varies with distance as shown.



What is the speed of the object after moving 15 m?

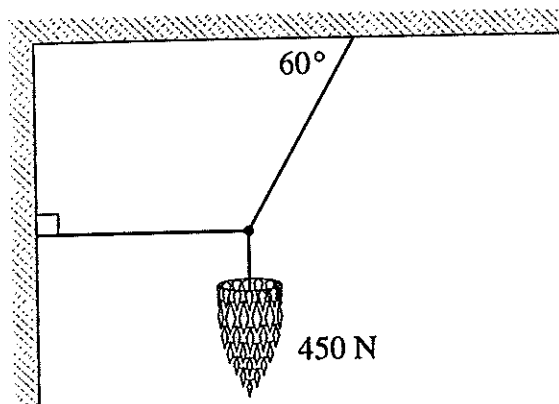
- A. 5.0 m/s
 B. 6.1 m/s
 C. 7.1 m/s
 D. 8.7 m/s
9. A machine rated at 1 500 W lifts a 100 kg object 36 m vertically in 45 s. What is the efficiency of this machine?
- A. 0.053
 B. 0.48
 C. 0.52
 D. 0.65
10. Two cars collide head-on and come to a complete stop immediately after the collision. Which of the following is correct?

	TOTAL MOMENTUM	TOTAL ENERGY
A.	is conserved	is conserved
B.	is conserved	is not conserved
C.	is not conserved	is conserved
D.	is not conserved	is not conserved

JUN - - 2000

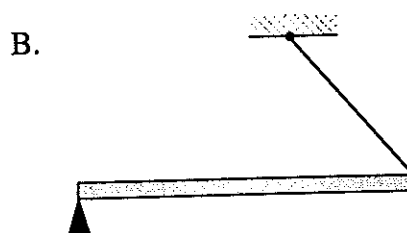
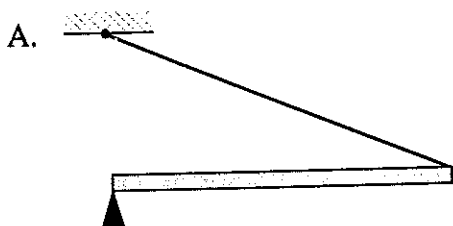
OVER

11. A 450 N chandelier is supported by three cables as shown in the diagram.



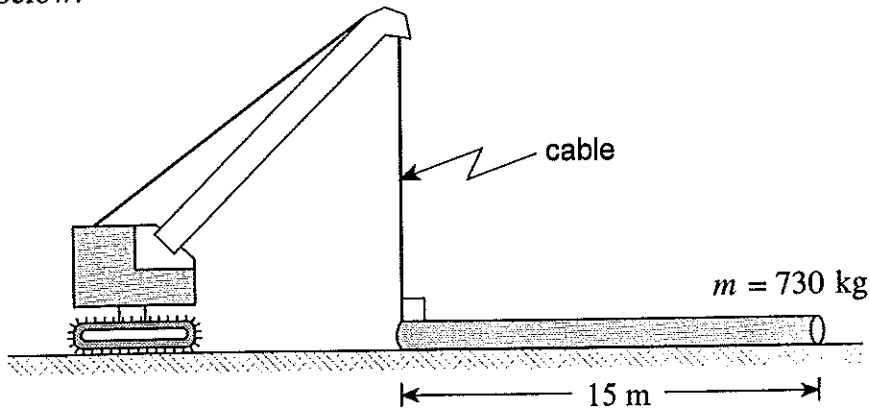
What is the tension in the horizontal cable?

- A. 46 N
B. 260 N
C. 450 N
D. 520 N
12. A beam is to be kept horizontal by a cord. In which of the four situations shown below will the tension in the cord be least?



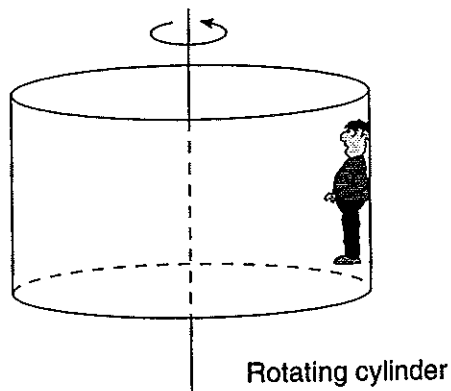
JUN - 2000

13. A crane is used to lift one end of a uniform 15 m long pipe with a mass of 730 kg as shown in the diagram below.



What is the minimum force of tension in the crane cable to just lift the end of the pipe off the ground?

- A. $3.7 \times 10^2 \text{ N}$
 - B. $4.8 \times 10^2 \text{ N}$
 - C. $3.6 \times 10^3 \text{ N}$
 - D. $7.2 \times 10^3 \text{ N}$
14. In a popular amusement park ride, a large cylinder is set in rotation. The floor then drops away leaving the riders suspended against the wall in a vertical position as shown.



Which of the following is the correct free-body diagram for the person at the position shown?

- A.
- B.
- C.
- D.

JUN - 2000

OVER

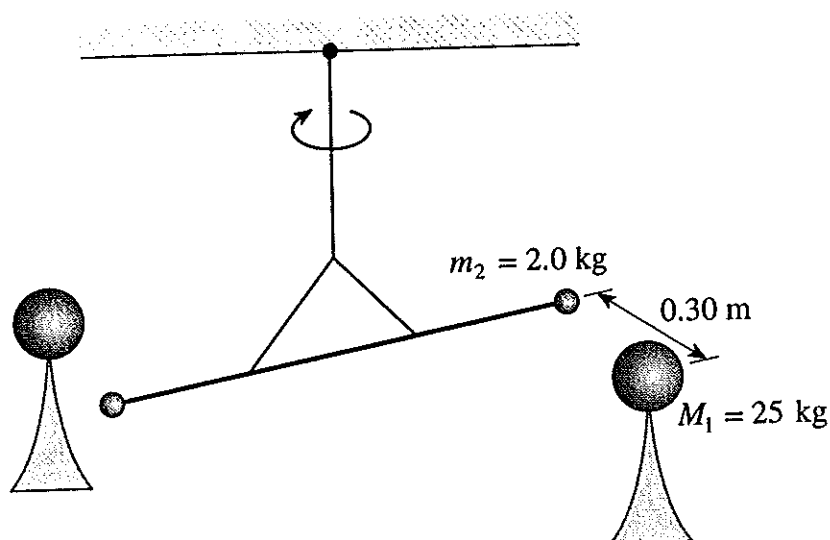
15. A 0.500 kg ball is swung in a horizontal circle of radius 1.20 m with a period of 1.25 s. What is the centripetal force on the ball?

A. 0.384 N
B. 15.2 N
C. 18.9 N
D. 30.3 N

16. A rock drops from a very high altitude towards the surface of the moon. Which of the following is correct about the changes that occur in the rock's mass and weight?

	MASS	WEIGHT
A.	decreases	decreases
B.	decreases	increases
C.	remains constant	decreases
D.	remains constant	increases

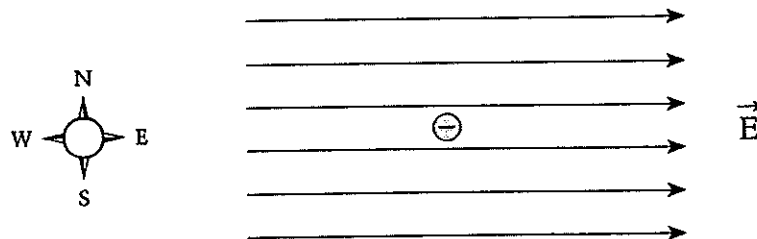
17. Cavendish's historic experiment is set up as shown to determine the force between two identical sets of masses. What would be the net force of attraction between **one** set of masses?



A. 1.1×10^{-8} N
B. 1.9×10^{-8} N
C. 2.2×10^{-8} N
D. 3.7×10^{-8} N

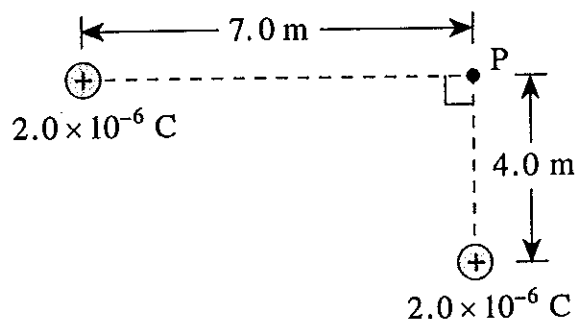
JUN ~ ~ 2000

18. An electron in the electric field has an electric force acting on it in what direction?



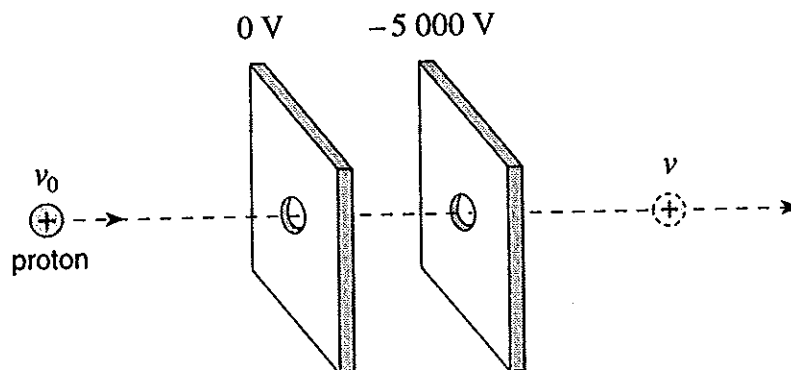
- A. North
- B. South
- C. East
- D. West

19. What is the electric potential at point P due to the two fixed charges as shown?



- A. 1 200 V
- B. 1 500 V
- C. 5 200 V
- D. 7 100 V

20. A moving proton has 6.4×10^{-16} J of kinetic energy. The proton is accelerated by a potential difference of 5 000 V between parallel plates.



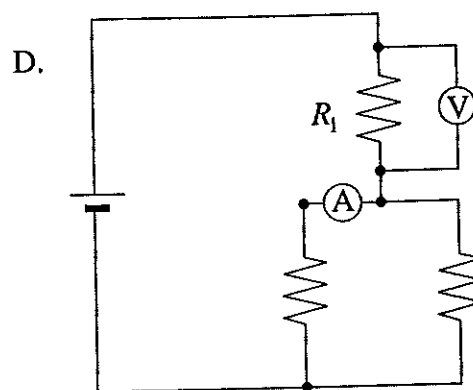
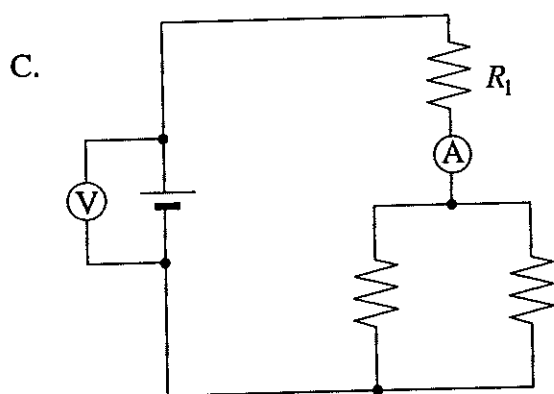
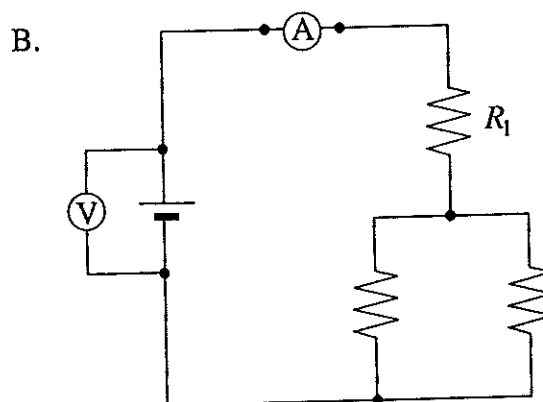
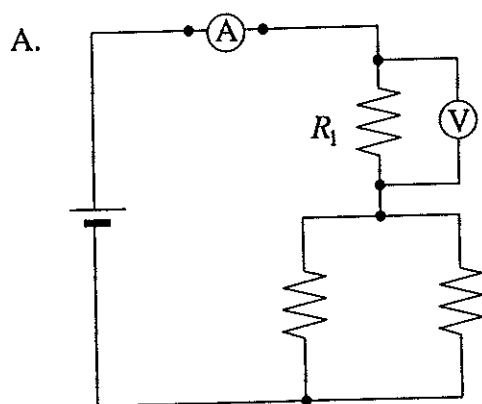
The proton emerges from the parallel plates with what speed?

- A. 8.8×10^5 m/s
- B. 9.8×10^5 m/s
- C. 1.3×10^6 m/s
- D. 1.8×10^6 m/s

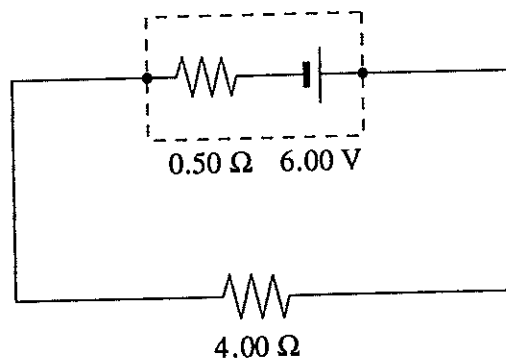
JUN - - 2000

OVER

21. Which one of the following shows the correct placement of an ammeter and a voltmeter to determine the power output of resistor R_1 ?



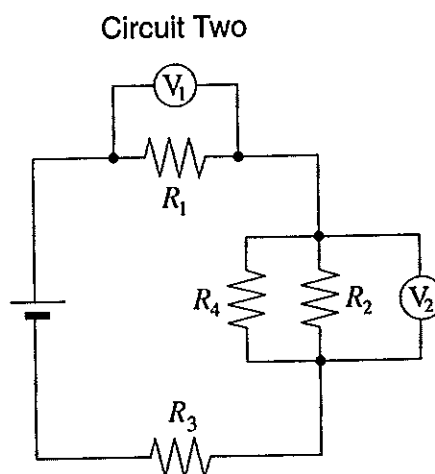
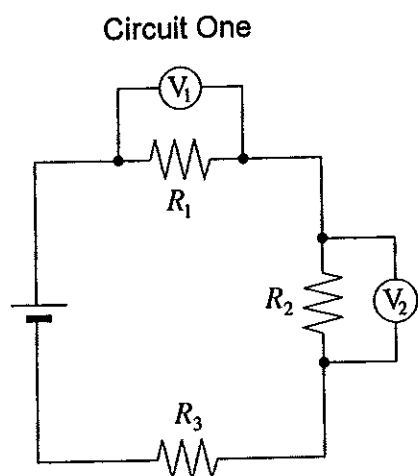
22. What is the terminal voltage of the battery in the circuit shown below?



- A. 5.25 V
B. 5.33 V
C. 6.00 V
D. 6.67 V

JUN -- 2000

23. In circuit one, resistors and voltmeters are connected as shown. In circuit two, an additional resistor R_4 is placed in parallel with resistor R_2 .



How have the values of V_1 and V_2 in circuit two changed compared to those in circuit one?

	V_1	V_2
A.	no change	decreased
B.	decreased	increased
C.	increased	decreased
D.	increased	no change

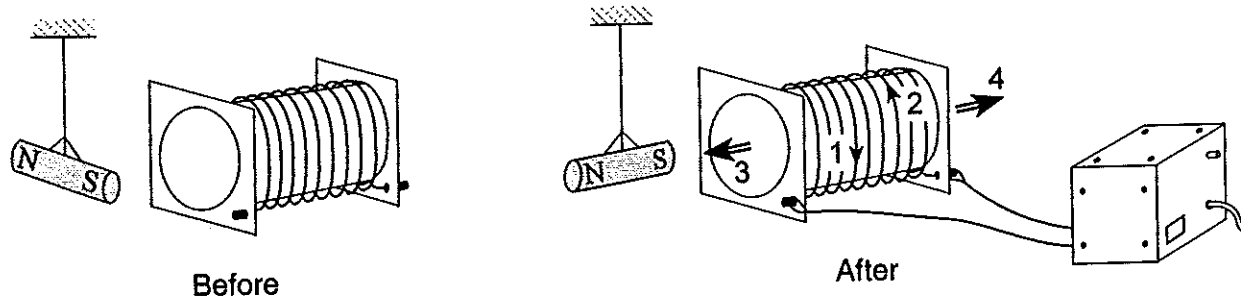
24. What are the units of magnetic flux?

- A. T
- B. Wb
- C. $T \cdot m/A$
- D. $N \cdot m/C^2$

JUN -- 2000

OVER

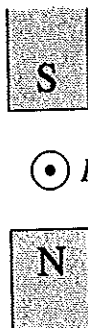
25. The diagram shows a magnet suspended near a solenoid. After the solenoid has been connected to a power supply, the magnet rotates to a new position with its south pole pointing towards the solenoid.



Which arrows show the direction of the current in the solenoid and the direction of the magnetic field caused by this current?

	DIRECTION OF CURRENT	DIRECTION OF MAGNETIC FIELD
A.	1	3
B.	1	4
C.	2	3
D.	2	4

26. The diagram shows a conductor between a pair of magnets. The current in the conductor flows out of the page.



In what direction will the magnetic force act on the conductor?

- A. up the page
- B. down the page
- C. towards the left
- D. towards the right

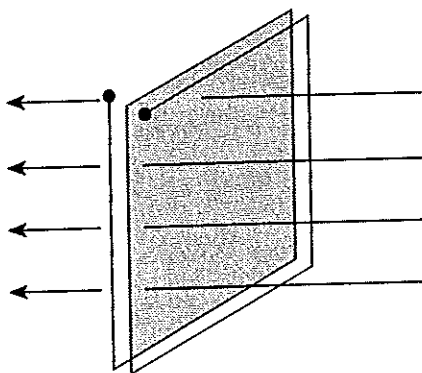
JUN - - 2000

27. A charged particle travels in a circular path in a magnetic field. What changes to the magnetic field and to the velocity of the particle would both cause the radius of its path to decrease?

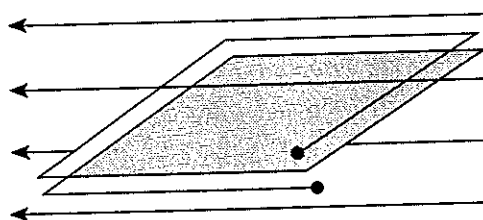
	CHANGE TO THE MAGNETIC FIELD	CHANGE TO THE VELOCITY
A.	increase	increase
B.	increase	decrease
C.	decrease	increase
D.	decrease	decrease

28. The diagram below shows two coils in a magnetic field.

Coils perpendicular to magnetic field



Coils parallel to magnetic field



An electric current can be induced in the coil oriented with its plane

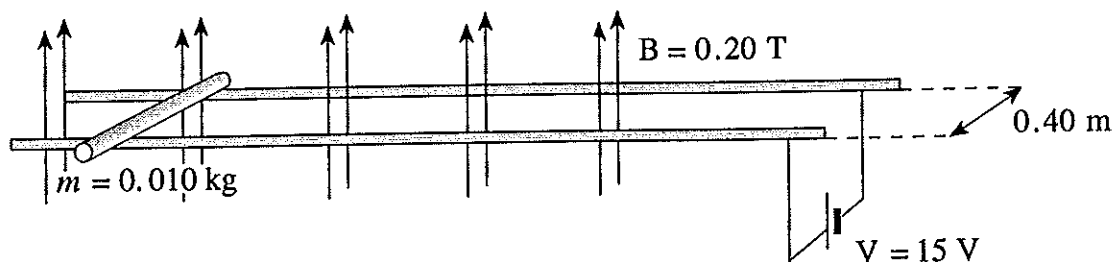
- parallel to a constant magnetic field.
 - parallel to a changing magnetic field.
 - perpendicular to a constant magnetic field.
 - perpendicular to a changing magnetic field.
29. An electric motor is connected to a 12.0 V power supply. When the armature is prevented from rotating, the current is 8.0 A. When the motor is running at normal speed, the current is 2.0 A. What is the back emf in each case?

	BACK EMF WHEN STATIONARY	BACK EMF WHEN RUNNING
A.	0 V	9.0 V
B.	0 V	3.0 V
C.	12 V	9.0 V
D.	12 V	3.0 V

JUN -- 2000

OVER

30. The diagram shows a 0.010 kg metal rod resting on two long horizontal frictionless rails which remain 0.40 m apart. The circuit has a resistance of 3.0Ω and is located in a uniform 0.20 T magnetic field.



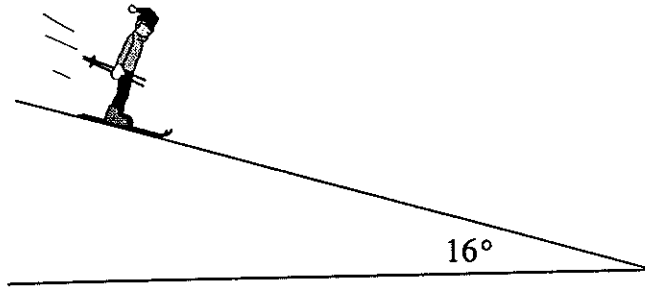
Find the initial acceleration and maximum velocity for the rod.

	INITIAL ACCELERATION	MAXIMUM VELOCITY
A.	40 m/s^2	190 m/s
B.	40 m/s^2	300 m/s
C.	120 m/s^2	190 m/s
D.	120 m/s^2	300 m/s

JUN - 2000

This is the end of the multiple-choice section.
Answer the remaining questions directly in this examination booklet.

1. A 75 kg Olympic skier takes 20 s to reach a speed of 25 m/s from rest while descending a uniform 16° slope.

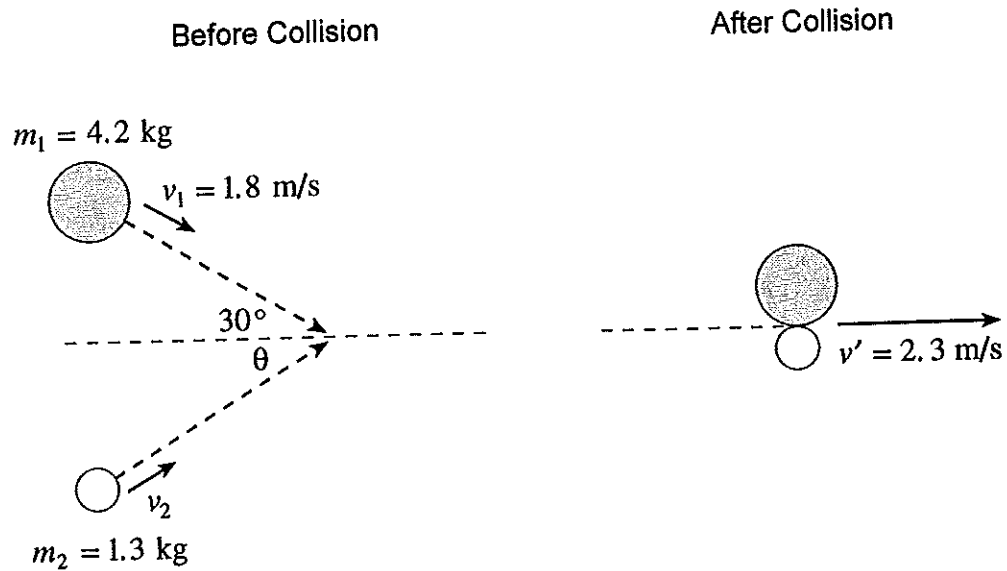


What is the coefficient of friction between the skis and the slope surface?

(7 marks)

JUN -- 2000

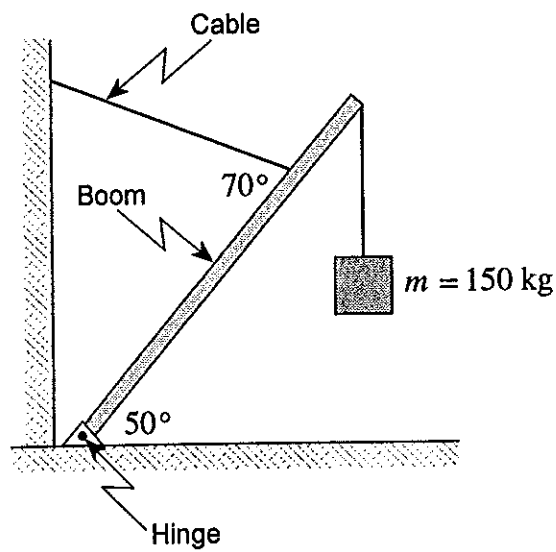
2. Two steel pucks are moving as shown in the diagram. They collide inelastically.



Determine the speed and direction (angle θ) of the 1.3 kg puck before the collision. (7 marks)

JUN - - 2000

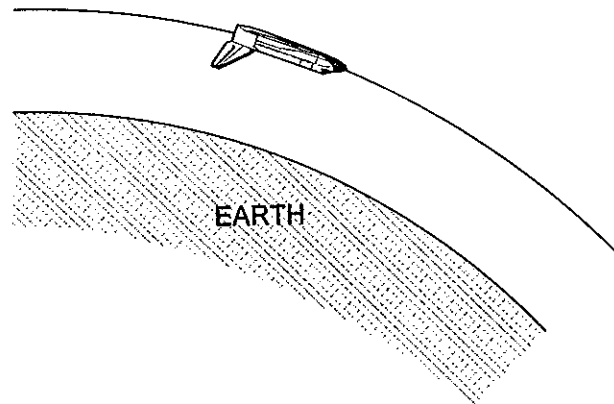
3. A uniform 6.0 m-long boom has a mass of 55 kg. It is kept in position by a restraining cable attached three-quarters of the way along the boom.



What is the tension in this cable when the boom supports a 150 kg mass as shown? (7 marks)

JUN - - 2000

4. A space shuttle is placed in a circular orbit at an altitude of 3.00×10^5 m above Earth's surface.



- a) What is the shuttle's orbital speed?

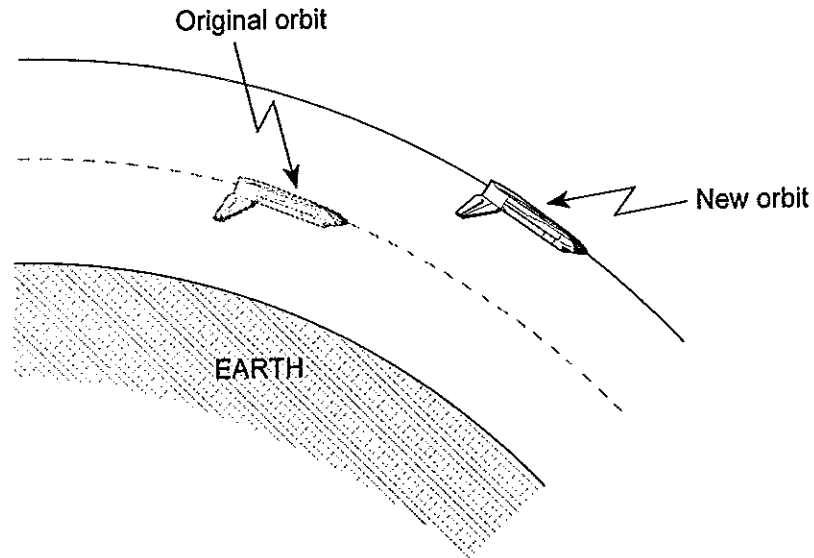
(5 marks)

JUN -- 2000

ANSWER:

a) orbital speed: _____

- b) The space shuttle is then moved to a higher orbit in order to capture a satellite.



The shuttle's speed in this new higher orbit will have to be

- ☐ greater than in the lower orbit.
- ☐ less than in the lower orbit.
- ☐ the same as in the lower orbit.

(Check one response.)

(1 mark)

- c) Using principles of physics, explain your answer to b).

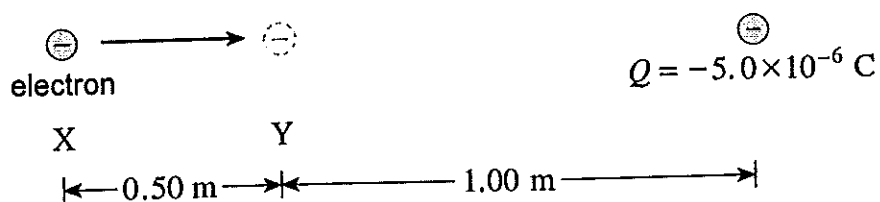
(3 marks)

JUN -- 2000

OVER

5. a) How much work is done in moving an electron from point X to point Y?

(5 marks)



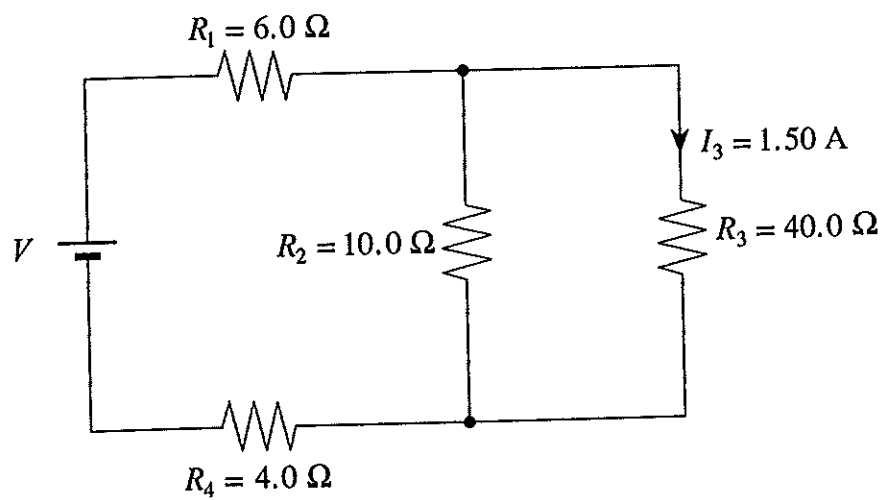
b) What is the potential difference between point X and point Y? (2 marks)

JUN -- 2000

ANSWER:

a) work: _____

6. A current of 1.50 A flows through the $40.0\ \Omega$ resistor.



What is the potential difference of the power supply?

(7 marks)

JUN - 2000

7. A transformer has 840 primary and 56 secondary windings. The primary coil is connected to a 110 V ac power supply which delivers a 0.30 A current to the transformer.

a) Find the secondary voltage.

(4 marks)

b) Find the secondary current. (3 marks)

JUN -- 2000

ANSWER:

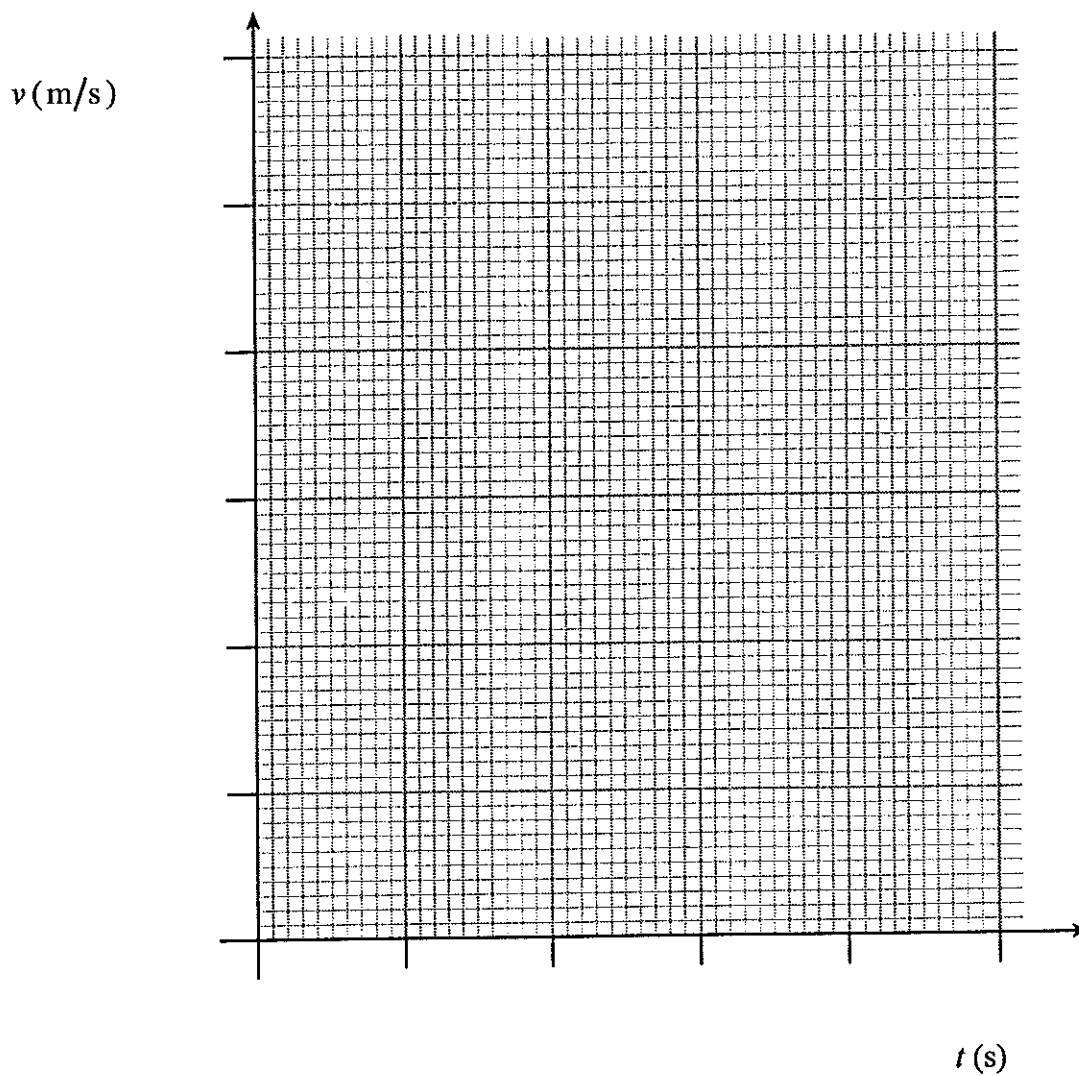
a) secondary voltage: _____

8. The data table shows the velocity of a car during a 5.0 s interval.

t (s)	0.0	1.0	2.0	3.0	4.0	5.0
v (m/s)	12	15	15	18	20	21

a) Plot the data and draw a best-fit straight line.

(2 marks)



JUN -- 2000

- b) Calculate the area bounded by the graph and the time axis between $t = 0.0$ s and $t = 5.0$ s. (2 marks)

- c) What does this area represent? (1 mark)

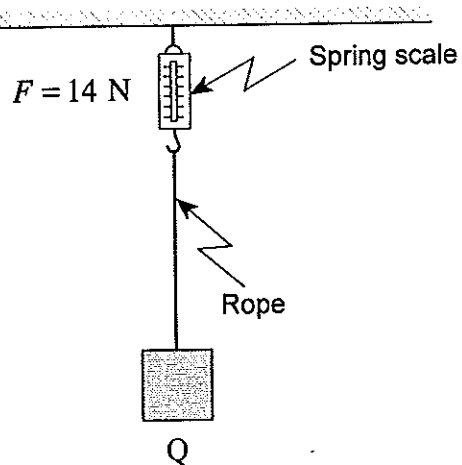
JUN - - 2000

ANSWER:

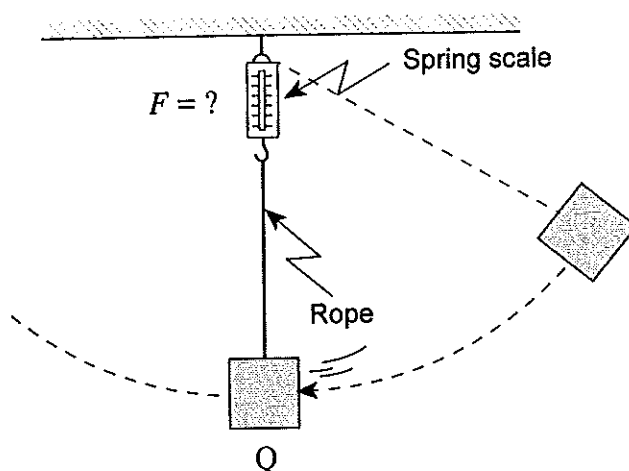
b) area: _____

OVER

9. A mass is suspended by a string attached to a spring scale that initially reads 14 N as shown in Diagram 1.



The mass is pulled to the side and then released as shown in Diagram 2.



As the mass passes point Q, how will the reading on the spring scale compare to the previous value of 14 N? Using principles of physics, explain your answer. (4 marks)

END OF EXAMINATION

Insert Personal Education Number (PEN) here.

Insert **only** pre-printed PEN label here.

STUDENT INSTRUCTIONS

1. Insert the stickers with your Personal Education Number (PEN) in the allotted spaces above. **Under no circumstance is your name or identification, other than your Personal Education Number, to appear on this booklet.**
2. Ensure that in addition to this examination booklet, you have an **Examination Response Form**. Follow the directions on the front of the Response Form.
3. **Disqualification** from the examination will result if you bring books, paper, notes or unauthorized electronic devices into the examination room.
4. When instructed to open this booklet, **check the numbering of the pages** to ensure that they are numbered in sequence from page one to the last page, which is identified by

END OF EXAMINATION.

5. At the end of the examination, place your Response Form inside the front cover of this booklet and return the booklet and your Response Form to the supervisor.

PHYSICS 12

AUGUST 2000

COURSE CODE = PH

Insert **only** hand-printed PEN here.

Ministry use only.

PART A: MULTIPLE CHOICE

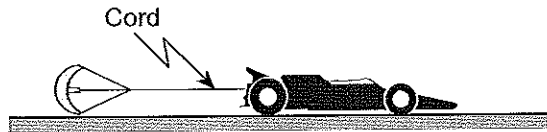
Value: 60 marks (2 marks per question)

Suggested Time: 60 minutes

INSTRUCTIONS: For each question, select the **best** answer and record your choice on the Response Form provided. Using an HB pencil, completely fill in the circle that has the letter corresponding to your answer.

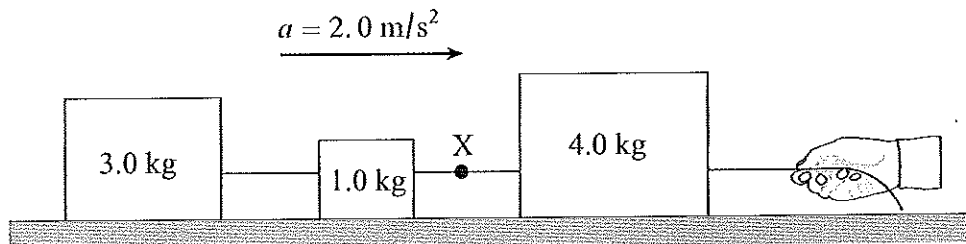
1. A book is at rest on a desk. Which of the following statements concerning the book is correct?
- A. The desk exerts no force on the book.
 - B. The book exerts no force on the desk.
 - C. There are no forces acting on the book.
 - D. The forces acting on the book are balanced.

2. An 810 kg dragster is being decelerated by a parachute at 2.5 m/s^2 as shown in the diagram.



What is the tension in the cord at this moment?

- A. 0 N
 - B. $2.0 \times 10^3 \text{ N}$
 - C. $5.9 \times 10^3 \text{ N}$
 - D. $7.9 \times 10^3 \text{ N}$
3. The system of blocks on a frictionless surface in the diagram below is accelerating at 2.0 m/s^2 .

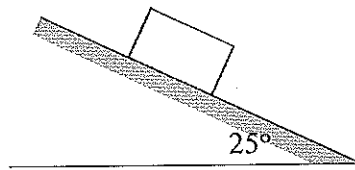


What is the tension in the cord at X?

- A. 2.0 N
- B. 6.0 N
- C. 8.0 N
- D. 16 N

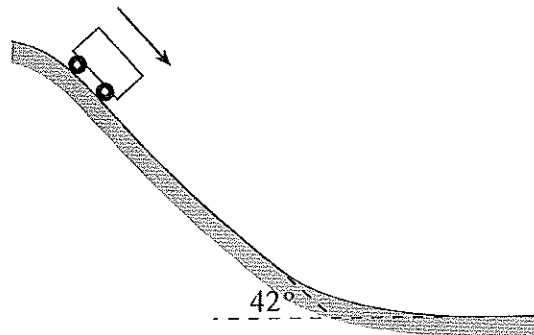
AUG 2000

4. A 5.0 kg block remains stationary on an inclined surface.

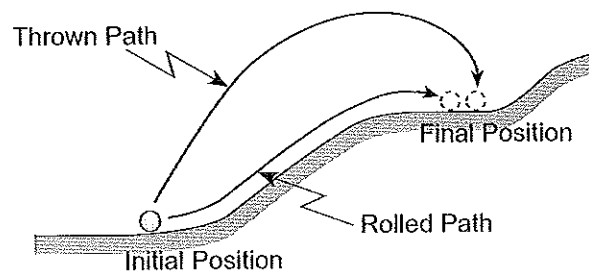


What is the friction force acting on the block?

- A. 21 N
 - B. 23 N
 - C. 44 N
 - D. 49 N
5. What is the acceleration of the roller coaster car in the diagram below? Ignore friction.



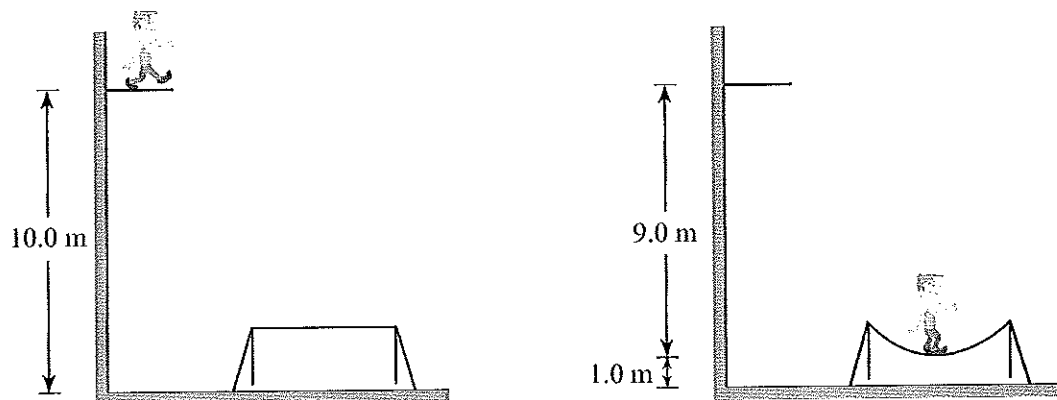
- A. 6.6 m/s^2
 - B. 7.3 m/s^2
 - C. 8.8 m/s^2
 - D. Depends on car's mass.
6. A child rolls a ball up a hill as shown. The same child then throws an identical ball up the hill.



When both balls end up in the same location on the hill, which of the following correctly describes the potential energy change for each ball?

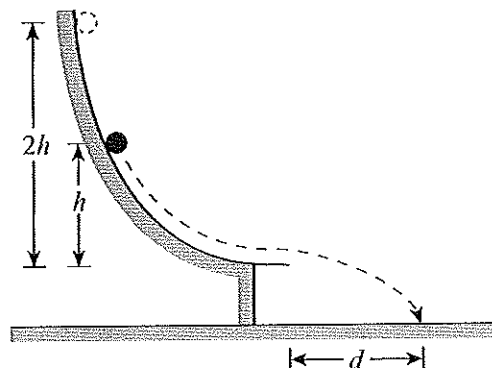
- A. Both balls have the same potential energy change.
- B. There is no potential energy change for either ball.
- C. The thrown ball has a greater potential energy change than the rolled ball.
- D. The thrown ball has a smaller potential energy change than the rolled ball.

7. A 950 kg elevator ascends a vertical height of 410 m with an average speed of 9.1 m/s. What average power must the lifting motor supply?
- A. 8.6×10^3 W
 B. 8.5×10^4 W
 C. 4.2×10^5 W
 D. 3.8×10^6 W
8. A 55.0 kg athlete steps off a 10.0 m high platform and drops onto a trampoline. As the trampoline stretches, it brings him to a stop 1.00 m above the ground.



How much energy must have been momentarily stored in the trampoline when he came to rest?

- A. 0 J
 B. 539 J
 C. 4 850 J
 D. 5 390 J
9. An object starts from rest and slides down a frictionless track as shown. It leaves the track horizontally, striking the ground at a distance d as shown.



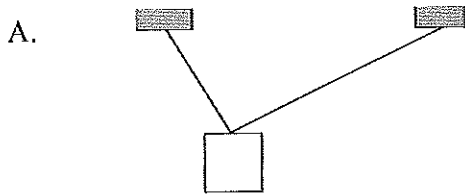
The same object is now released from twice the height, $2h$. How far away will it land?

- A. d
 B. $\sqrt{2} d$
 C. $2d$
 D. $4d$

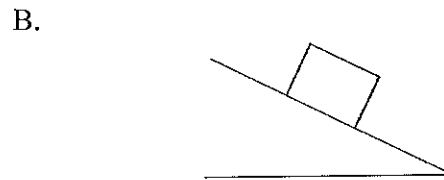
AUG 2000

OVER

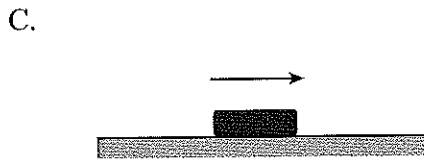
10. Which of the four problems shown requires the application of torque?



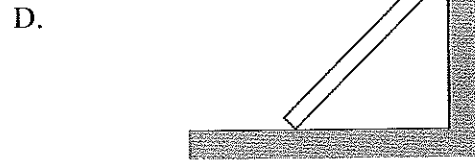
What is the tension in the supporting cables?



What is the friction force acting on the block?

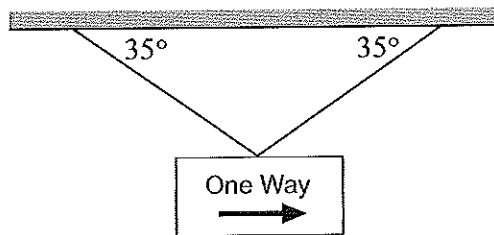


What is the acceleration of the puck?



What force does the wall exert on the board?

11. A traffic sign hangs from two cables as shown.



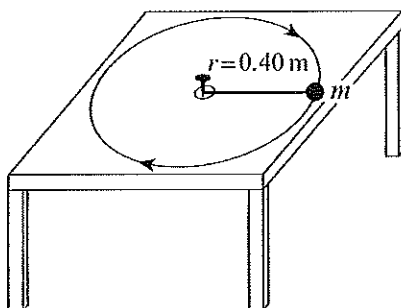
If the tension in each cable is 220 N, what is the weight of the sign?

- A. 130 N
- B. 250 N
- C. 360 N
- D. 440 N

12. A car travels at a uniform speed through a level circular curve in the road. Which of the following correctly describes the magnitude of the acceleration, velocity and force acting on the car?

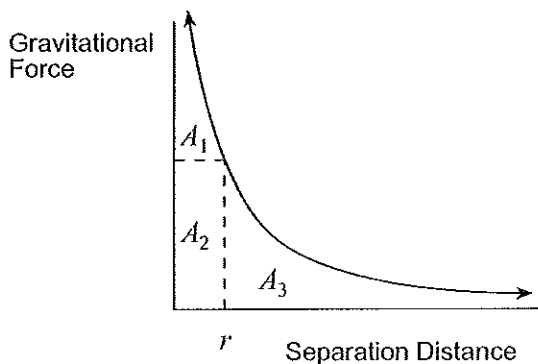
	MAGNITUDE OF ACCELERATION	MAGNITUDE OF VELOCITY	MAGNITUDE OF FORCE
A.	constant	constant	constant
B.	constant	changing	changing
C.	constant	changing	constant
D.	changing	changing	changing

13. An object is attached to a string that can withstand a maximum tension force of 6.3 N. The object travels in a circular path of radius 0.40 m with a period of 2.1 s.



What is the maximum mass of the object?

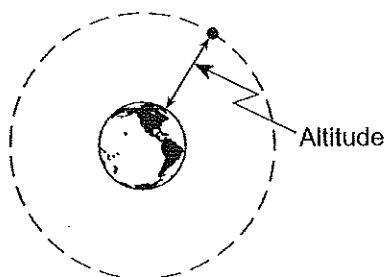
- A. 0.57 kg
 B. 0.64 kg
 C. 1.8 kg
 D. 3.6 kg
14. A 65 kg pilot in a stunt plane performs a vertical loop with a 700 m radius. The plane reaches a speed of 210 m/s at the bottom of the loop. What is the upward force on the pilot at the bottom of the loop?
- A. 640 N
 B. 3 500 N
 C. 4 100 N
 D. 4 700 N
15. Which of the indicated areas of the graph represent the work needed to send an object from separation distance r to infinity?



- A. $A_1 + A_2$
 B. A_2
 C. $A_2 + A_3$
 D. A_3

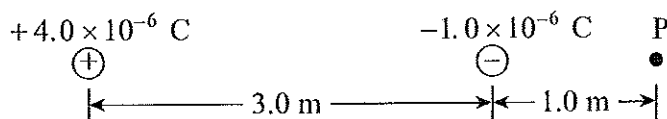
AUG 2000

16. A satellite experiences a gravitational force of 228 N at an altitude of 4.0×10^7 m above Earth.



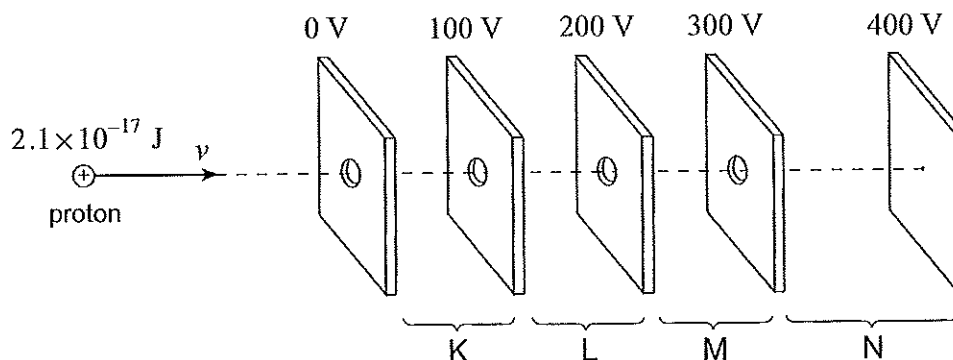
What is the mass of this satellite?

- A. 23 kg
 B. 650 kg
 C. 910 kg
 D. 1 200 kg
17. A 1 570 kg satellite orbits a planet in a circle of radius 5.94×10^6 m. Relative to zero at infinity the gravitational potential energy of this satellite is -9.32×10^{11} J. What is the mass of the planet?
- A. 5.29×10^{25} kg
 B. 8.31×10^{28} kg
 C. 3.14×10^{31} kg
 D. 4.93×10^{34} kg
18. The electric field is uniform between
- A. two positive point charges.
 B. two negative point charges.
 C. two opposite point charges.
 D. two oppositely charged parallel plates.
19. What is the magnitude and direction of the electric field at point P due to the two fixed charges?

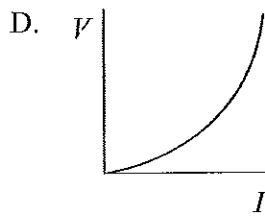
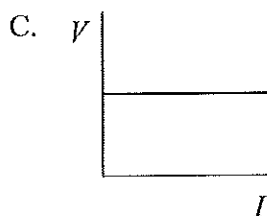
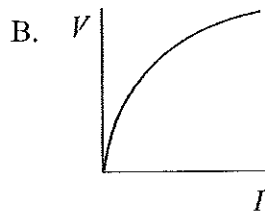
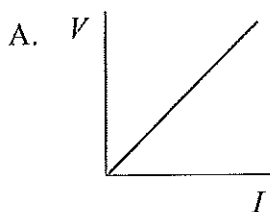


ELECTRIC FIELD AT POINT P		
	MAGNITUDE	DIRECTION
A.	6 800 N/C	Right
B.	6 800 N/C	Left
C.	11 000 N/C	Right
D.	11 000 N/C	Left

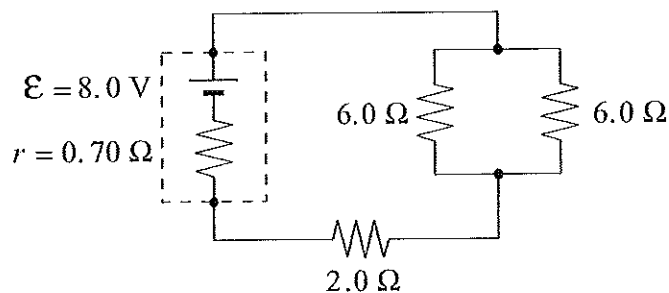
20. A proton with kinetic energy of $2.1 \times 10^{-17} \text{ J}$ is moving into a region of charged parallel plates. The proton will be stopped momentarily in what region?



- A. Region K
B. Region L
C. Region M
D. Region N
21. Which of the following graphs illustrates Ohm's law?



22. In the following circuit, what is the terminal voltage of the battery?

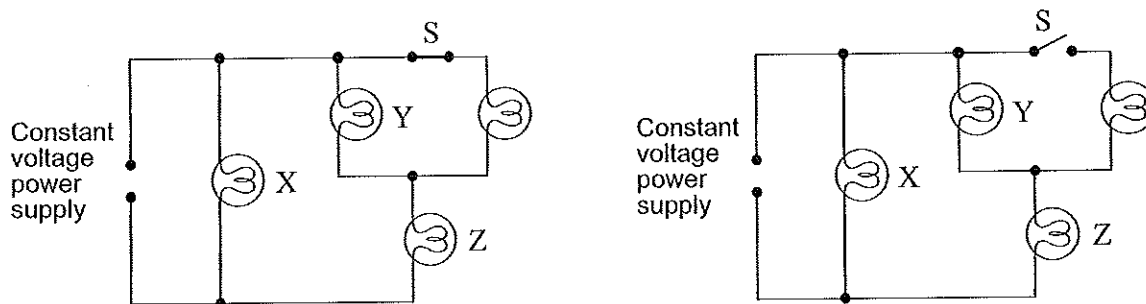


- A. 6.9 V
B. 7.0 V
C. 8.0 V
D. 9.0 V

AUG , 2000

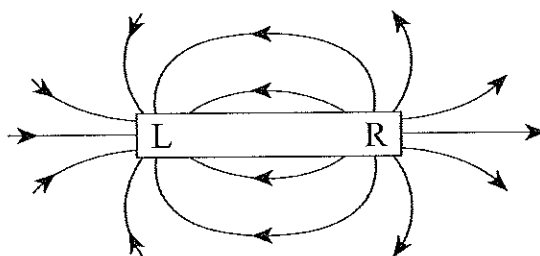
OVER

23. If switch S is opened, how does the brightness of each bulb (X, Y, and Z) compare to the situation when the switch was closed?



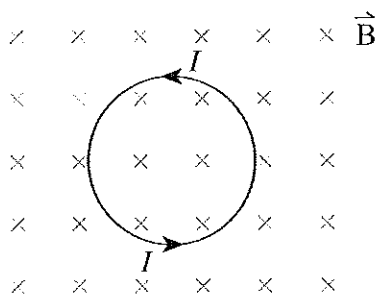
	BULB X	BULB Y	BULB Z
A.	same	same	same
B.	same	dimmer	brighter
C.	same	brighter	dimmer
D.	dimmer	dimmer	dimmer

24. Identify the magnetic poles labelled L and R in the diagram shown.



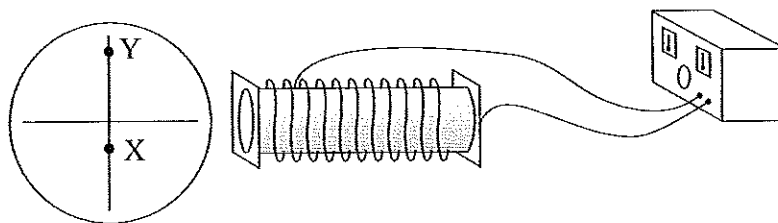
	POLE L	POLE R
A.	North	North
B.	North	South
C.	South	North
D.	South	South

25. The diagram shows current I flowing in a circular coil located in a magnetic field.



The magnetic force acting on the coil will tend to cause it to

- A. expand.
 - B. contract.
 - C. move up the page.
 - D. move down the page.
26. An aircraft whose wingspan is 15 m carries a static charge of 0.60 C. It travels at 240 m/s perpendicular to a 1.5×10^{-4} T magnetic field. What magnetic force does the aircraft experience?
- A. 0.022 N
 - B. 0.060 N
 - C. 0.54 N
 - D. 9.6×10^5 N
27. An undeflected electron beam strikes the centre of a cathode ray tube. A solenoid placed beside a cathode ray tube causes the electron beam to strike the screen at position X.



What changes to the magnitude and direction of the current in the solenoid would cause the electron beam to strike the screen at Y?

	CHANGE TO CURRENT MAGNITUDE	CHANGE TO CURRENT DIRECTION
A.	Increases	Remains the same
B.	Increases	Reverses
C.	Decreases	Remains the same
D.	Decreases	Reverses

28. A coil having 150 turns and a cross-sectional area of 0.042 m^2 is oriented with its plane perpendicular to a 0.12 T magnetic field. If the field increases to 0.66 T in 0.25 s , what emf is induced in the coil?

A. 9.8 V
 B. 14 V
 C. 20 V
 D. 320 V

29. An electric motor rotates at various speeds and the current through the armature changes accordingly. Which pair of conditions occurs when the motor generates the greatest back emf?

	SPEED	CURRENT THROUGH THE ARMATURE
A.	Fastest	Largest
B.	Fastest	Smallest
C.	Slowest	Largest
D.	Slowest	Smallest

30. A transformer connected to a 120 V ac supply has $7\,000$ primary and 350 secondary windings. It delivers a secondary current of 2.4 A . Find the primary current and secondary voltage.

	PRIMARY CURRENT	SECONDARY VOLTAGE
A.	0.12 A	6.0 V
B.	0.12 A	$2\,400 \text{ V}$
C.	48 A	6.0 V
D.	48 A	$2\,400 \text{ V}$

This is the end of the multiple-choice section.
 Answer the remaining questions directly in this examination booklet.

1. An aircraft heads due south with a speed relative to the air of 44 m/s. Its resultant speed over the ground is 47 m/s. The wind blows from the west.

a) What is the speed of the wind?

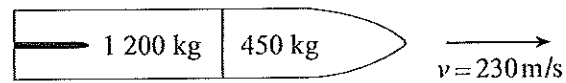
(4 marks)

b) What is the direction of the aircraft's path over the ground? (3 marks)

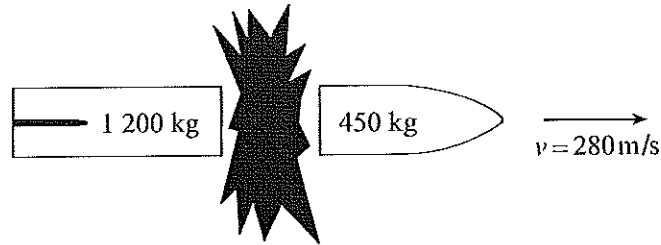
ANSWER:

a) speed of the wind: _____

2. A space vehicle made up of two parts is travelling at 230 m/s as shown.



An explosion causes the 450 kg part to separate and travel with a final velocity of 280 m/s as shown.



- a) What was the momentum of the space vehicle before the explosion? (2 marks)

ANSWER:

a) momentum: _____



- b) What was the magnitude of the impulse on the 1 200 kg part during the separation? (3 marks)

- c) Using principles of physics, explain what changes occur, if any, to the

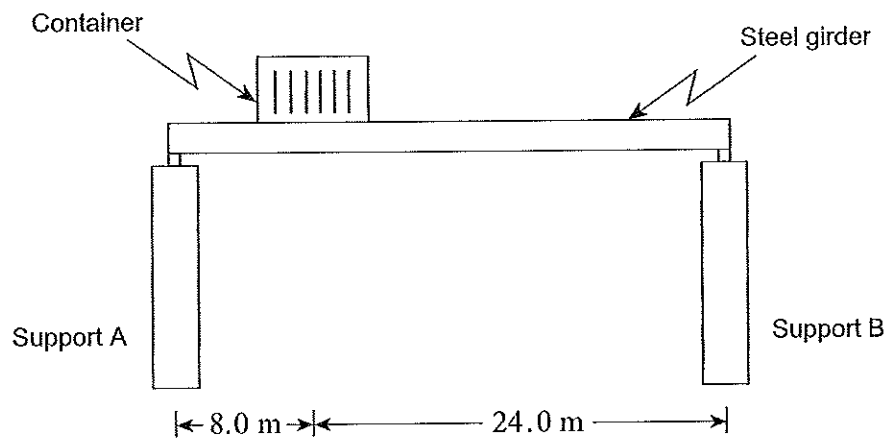
- i) momentum of the system as a result of the explosion. (2 marks)

- ii) kinetic energy of the system as a result of the explosion. (2 marks)

ANSWER:

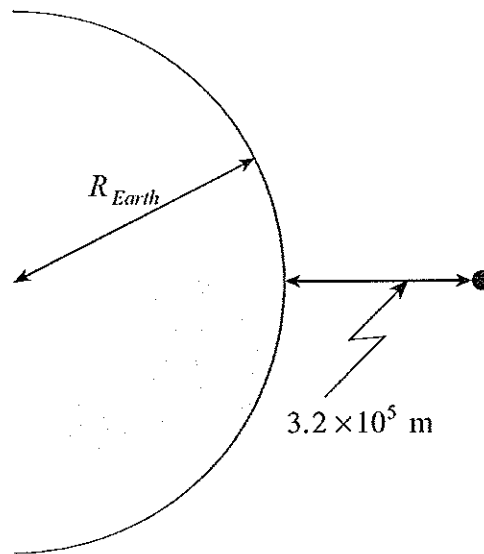
b) magnitude: _____

3. A uniform 1 200 kg steel girder is supported horizontally at its endpoints as shown in the diagram.



What are the upward forces at the girder end points when it is bearing a 3 700 kg shipping container 8.0 m from support A? (7 marks)

4. A 4.00×10^3 kg object is lifted from the earth's surface to an altitude of 3.2×10^5 m.
How much work does this require? (7 marks)



(Diagram not to scale.)

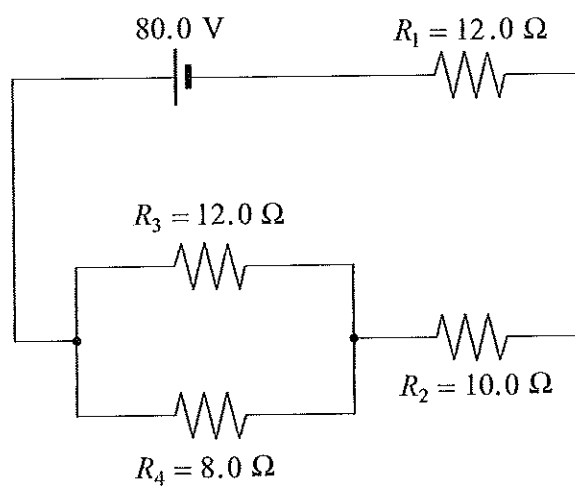
5. A proton, initially at rest at point X, will have what speed at point Y?

(7 marks)



6. What is the power dissipated in the $8.0\ \Omega$ resistor in the circuit as shown?

(7 marks)



7. The magnetic field at the centre of a solenoid of length 0.25 m is 1.2×10^{-2} T. The current in the windings is 7.5 A.

a) How many windings does the solenoid have?

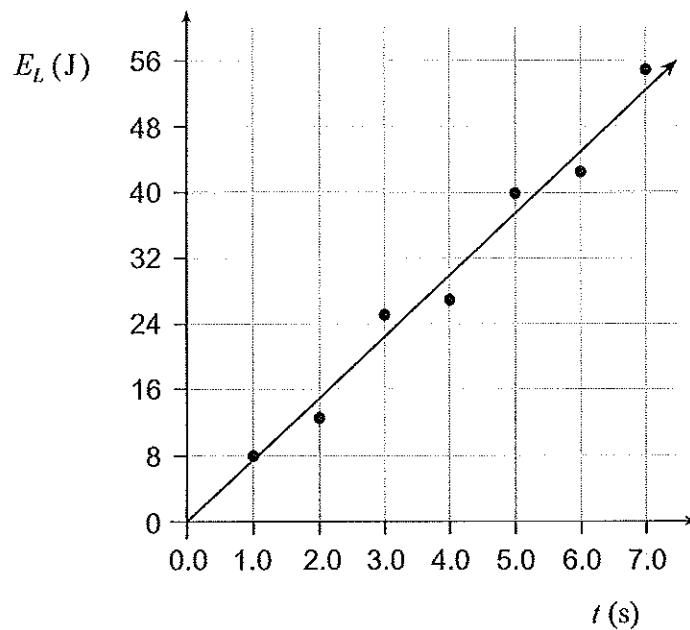
(4 marks)

b) If the cross-sectional area of the solenoid is $8.5 \times 10^{-4} \text{ m}^2$, what is the flux through it? (3 marks)

ANSWER:

a) number of windings: _____

8. The graph shows the light energy E_L emitted by a bulb versus time t .



- a) Find the power output of the bulb.

(2 marks)

- b) If the bulb is 20% efficient, find the power delivered to the bulb.

ANSWER:

a) power output: _____

9. In your summer job with the Ministry of Transportation and Highways your supervisor has told you that street signs should no longer be suspended as shown in Diagram A. In order to save money, he would prefer a shorter, perfectly horizontal cable, as shown in Diagram B.

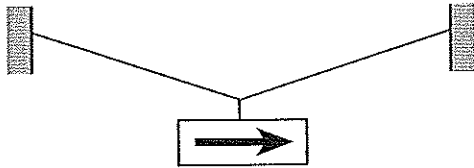


Diagram A

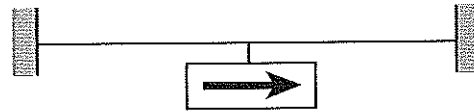


Diagram B

Using principles of physics, argue that the situation in Diagram B is not reasonable. (4 marks)

END OF EXAMINATION

MINISTRY USE ONLY

MINISTRY USE ONLY

Place Personal Education Number (PEN) here.

Place Personal Education Number (PEN) here.



BRITISH
COLUMBIA

© 2001 Ministry of Education

MINISTRY USE ONLY

Physics 12

JANUARY 2001

Course Code = PH

Student Instructions

1. Place the stickers with your Personal Education Number (PEN) in the allotted spaces above. **Under no circumstance is your name or identification, other than your Personal Education Number, to appear on this booklet.**
2. Ensure that in addition to this examination booklet, you have an **Examination Response Form**. Follow the directions on the front of the Response Form.
3. **Disqualification** from the examination will result if you bring books, paper, notes or unauthorized electronic devices into the examination room.
4. When instructed to open this booklet, **check the numbering of the pages** to ensure that they are numbered in sequence from page one to the last page, which is identified by **END OF EXAMINATION**.
5. At the end of the examination, place your Response Form inside the front cover of this booklet and return the booklet and your Response Form to the supervisor.

JAN 2001

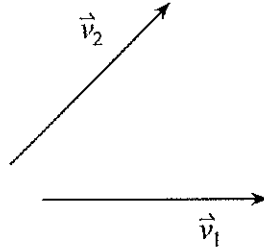
PART A: MULTIPLE CHOICE

Value: 60 marks (2 marks per question)

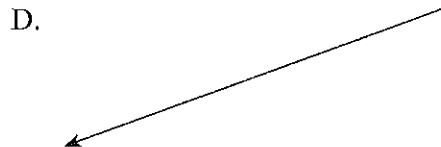
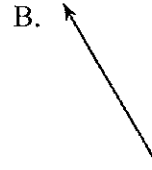
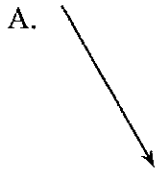
Suggested Time: 60 minutes

INSTRUCTIONS: For each question, select the **best** answer and record your choice on the Response Form provided. Using an HB pencil, completely fill in the circle that has the letter corresponding to your answer.

1. Two velocity vectors, v_1 and v_2 are shown.



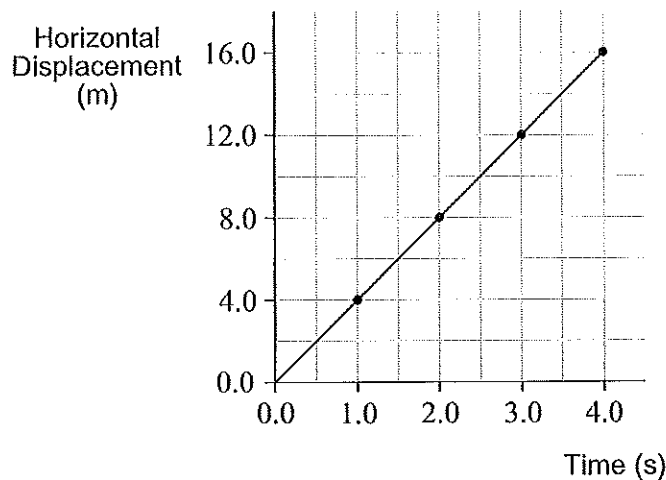
Which of the following best represents the resultant of the addition of the two velocity vectors?



2. In landing, a jet plane decelerates uniformly and comes to a stop in 38 s, covering a distance of 1 500 m along the runway. What was the jet's landing speed when it first touched the runway?
- A. 2.1 m/s
B. 39 m/s
C. 79 m/s
D. 170 m/s

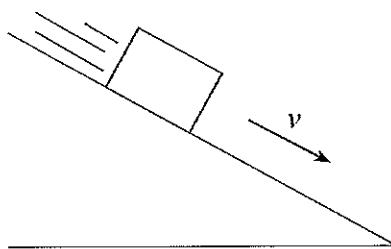
JAN , 2001

3. A projectile is fired into the air at some angle above the horizontal. The horizontal displacement of the projectile is measured against time in flight and the collected data is shown as a horizontal displacement versus time graph.



Based on this graph, the horizontal velocity of the projectile during this time interval is

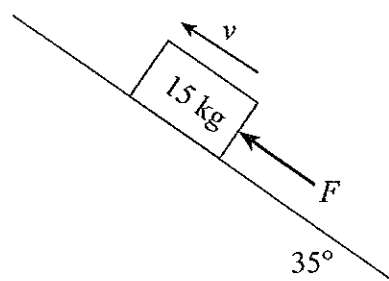
- A. constant.
 - B. increasing.
 - C. decreasing.
 - D. equal to zero.
4. An object is sliding down an inclined plane at a constant speed.



Which of the following represents the free-body diagram for the object?

- A.
- B.
- C.
- D.

5. A 45 kg woman is standing in an elevator that is accelerating downwards at 2.0 m/s^2 . What force (normal force) does the elevator floor exert on the woman's feet during this acceleration?
- A. 90 N
B. 350 N
C. 440 N
D. 530 N
6. A 15 kg block is pushed up a 35° incline. A friction force of 110 N exists between the block and the incline.



- What minimum force F , would be necessary to move the block up the incline at a constant speed?
- A. 26 N
B. 84 N
C. 150 N
D. 190 N
7. A crane lifts a 3 900 kg shipping container through a vertical height of 45 m in 8.0 s. What is the minimum average power that the crane motor must supply?
- A. $2.7 \times 10^3 \text{ W}$
B. $7.7 \times 10^3 \text{ W}$
C. $2.1 \times 10^5 \text{ W}$
D. $1.7 \times 10^6 \text{ W}$

JAN , 2001

8. Identify momentum and kinetic energy as scalar or vector quantities.

	MOMENTUM	KINETIC ENERGY
A.	scalar	scalar
B.	scalar	vector
C.	vector	scalar
D.	vector	vector

9. A 1.0 kg cart moves to the right at 6.0 m/s and strikes a stationary 2.0 kg cart. After the head-on collision, the 1.0 kg cart moves back to the left at 2.0 m/s and the 2.0 kg cart moves to the right at 4.0 m/s. In this collision

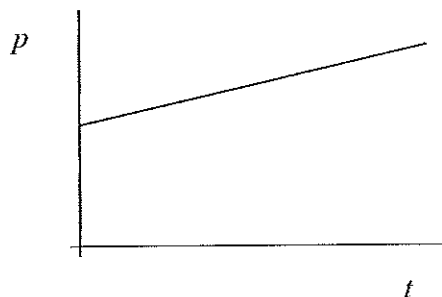
- A. only momentum is conserved.
- B. only kinetic energy is conserved.
- C. both momentum and kinetic energy are conserved.
- D. neither momentum nor kinetic energy is conserved.

10. A 12.0 kg shopping cart rolls due south at 1.50 m/s. After striking the bumper of a car, it travels at 0.80 m/s, 30° E of S. What is the magnitude of the change in momentum sustained by the shopping cart?

- A. 8.4 kg · m/s
- B. 9.7 kg · m/s
- C. 11 kg · m/s
- D. 27 kg · m/s

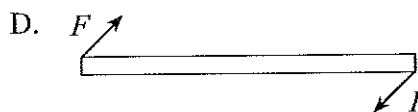
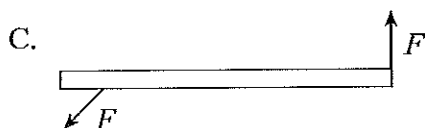
JAN , 2001

11. The graph below shows momentum, p , versus time, t , for a spacecraft while it is firing its rocket engines in space.

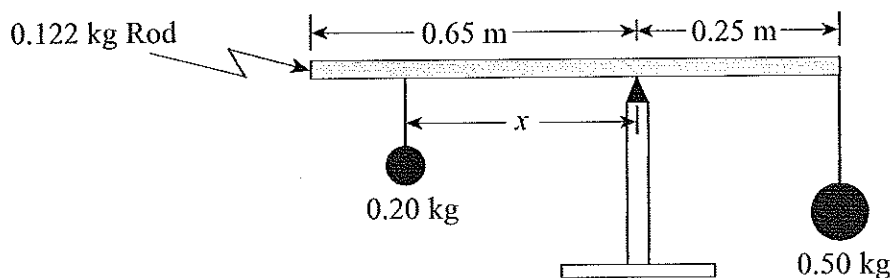


What does the slope of this graph represent?

- A. the mass of the spacecraft
 - B. the velocity of the spacecraft
 - C. the net force on the spacecraft
 - D. the work done on the spacecraft
12. A metre stick, as seen from above, is sitting on a table and is then subjected to two forces of equal magnitude as shown. In which case would the metre stick be in rotational equilibrium?



13. A uniform 0.122 kg rod of 0.90 m length is used to suspend two masses as shown below.

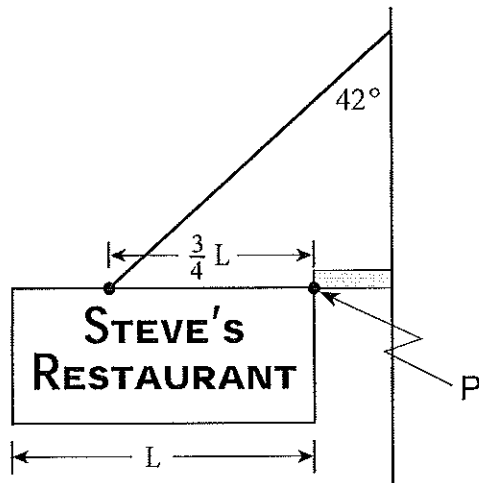


At what distance x should the 0.20 kg mass be placed to achieve static equilibrium?

- A. 0.30 m
- B. 0.50 m
- C. 0.63 m
- D. 0.75 m

14. **DELETED**

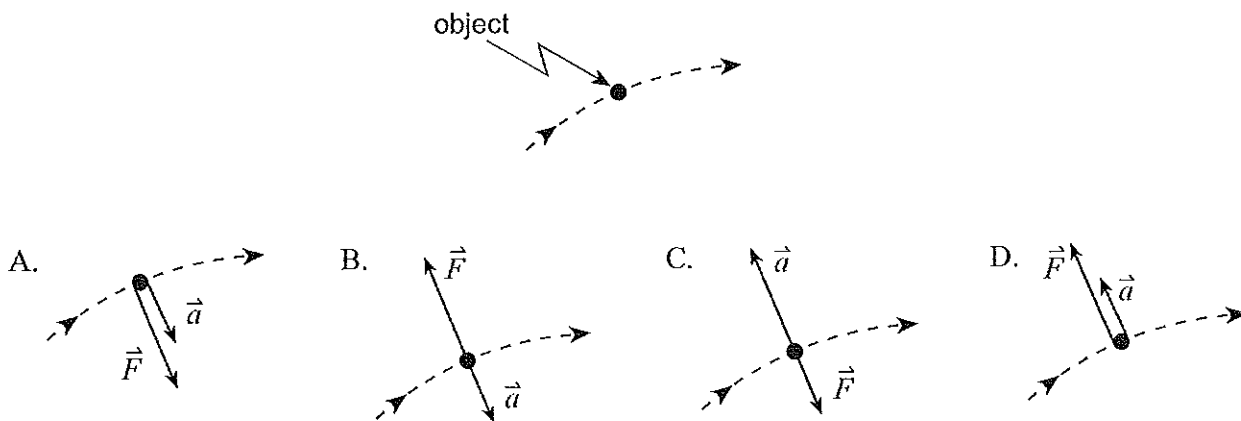
A 7.8 kg restaurant sign is suspended as shown.



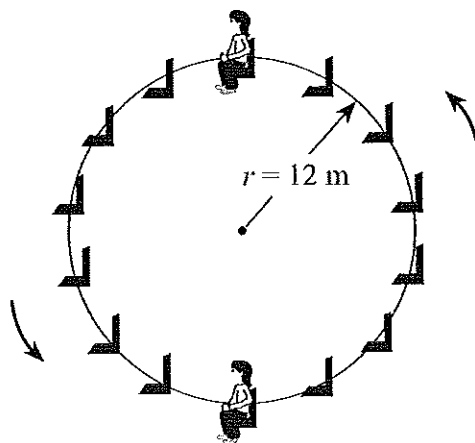
What are the magnitude and direction of the vertical force acting at point P?

	MAGNITUDE OF THE VERTICAL FORCE	DIRECTION OF THE VERTICAL FORCE
A.	25 N	up
B.	25 N	down
C.	51 N	up
D.	51 N	down

15. Which vector diagram best represents the acceleration, \vec{a} , and force, \vec{F} , for an object travelling along a circular path?



16. An object travels along a circular path with a constant speed v when a force F acts on it. How large a force is required for this object to travel along the same path at twice the speed ($2v$)?
- A. $\frac{1}{2}F$
 B. F
 C. $2F$
 D. $4F$
17. The diagram shows a 52 kg child riding on a Ferris wheel of radius 12 m and period 18 s. What force (normal force) does the seat exert on the child at the top and bottom of the ride?

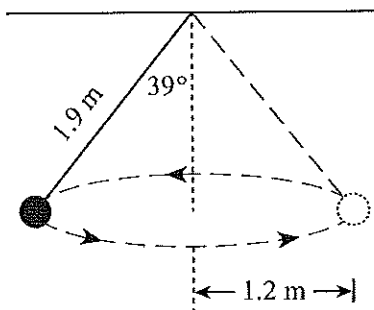


	TOP	BOTTOM
A.	76 N	76 N
B.	430 N	590 N
C.	510 N	510 N
D.	590 N	430 N

18. The equation $E_p = mgh$, in which g is 9.8 m/s^2 , can not be used for calculating the gravitational potential energy of an orbiting Earth satellite because
- A. the Earth is rotating.
 B. of the influence of other astronomical bodies.
 C. the Earth's gravity disappears above the atmosphere.
 D. the Earth's gravitational field strength varies with distance.

JAN , 2001

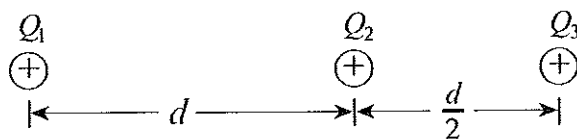
19. The diagram shows an object of mass 3.0 kg travelling in a circular path of radius 1.2 m while suspended by a piece of string of length 1.9 m. What is the centripetal force on the mass?



- A. 19 N
B. 23 N
C. 24 N
D. 29 N
20. Which of the following best describes how electric potential varies with distance in the region around a point charge?

- A. $V \propto r$
B. $V \propto \frac{1}{r}$
C. $V \propto r^2$
D. $V \propto \frac{1}{r^2}$

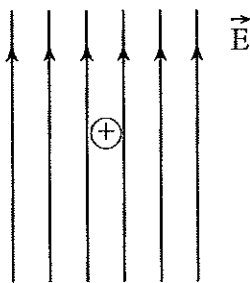
21. Three identical positive electric charges are fixed as shown in the diagram below.



What is the direction of the net electric force on Q_2 due to Q_1 and Q_3 ?

- A. to the left
B. to the right
C. the net force is zero
D. cannot be determined

22. In an experiment, a positively charged oil droplet weighing 6.5×10^{-15} N is held stationary by a vertical electric field as shown in the diagram.



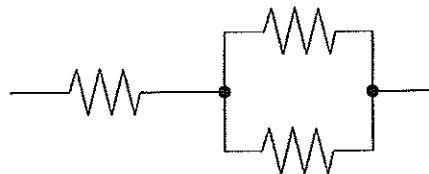
If the electric field strength is 5.3×10^3 N/C, what is the charge on the oil droplet?

- A. 1.2×10^{-18} C
 B. 3.4×10^{-11} C
 C. 4.1×10^4 C
 D. 8.2×10^{17} C
23. Which of the following combinations of three identical resistors has the least equivalent resistance?

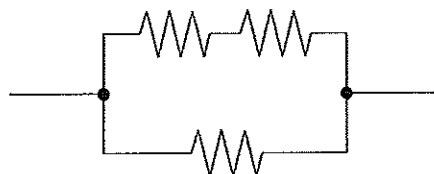
A.



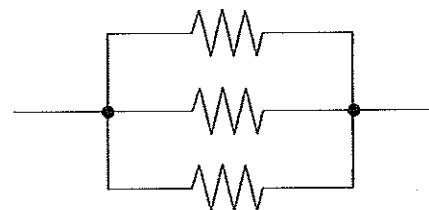
B.



C.



D.



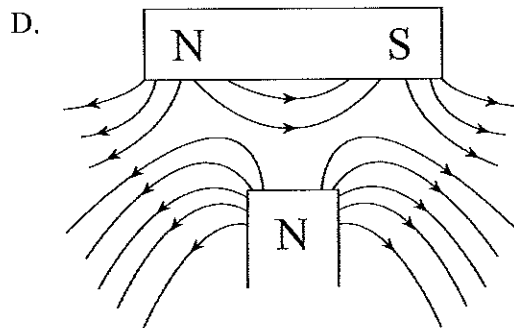
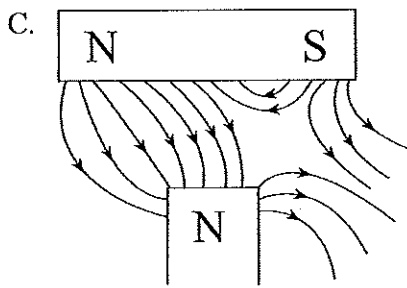
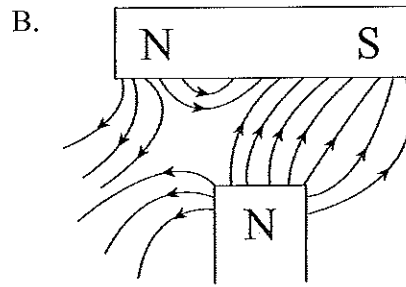
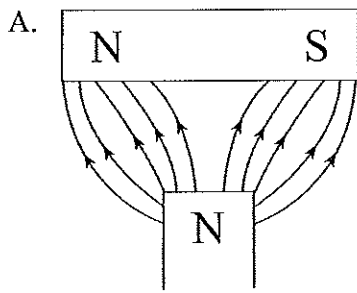
24. An electrical device with a constant resistance draws 0.75 A when connected to a 4.8 V source. What are the current and power for this device when it is connected to a 6.0 V source?

	CURRENT (A)	POWER (W)
A.	0.75	3.6
B.	0.75	5.6
C.	0.94	3.6
D.	0.94	5.6

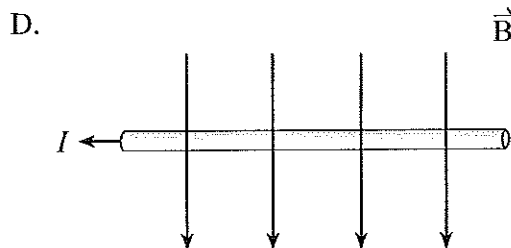
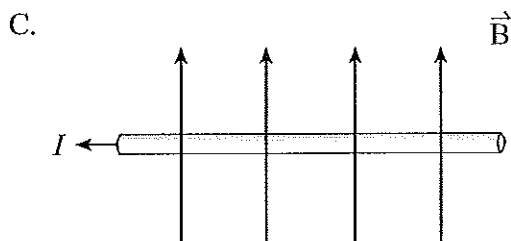
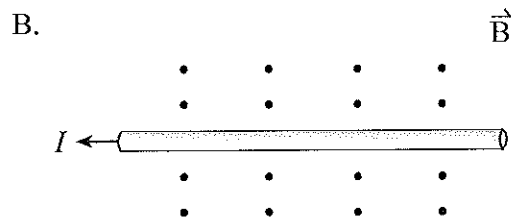
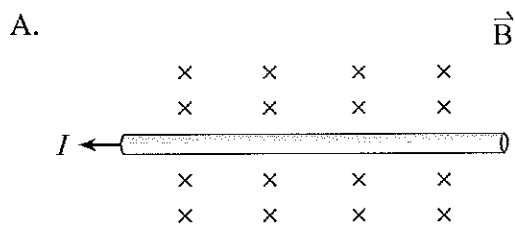
JAN , 2001

OVER

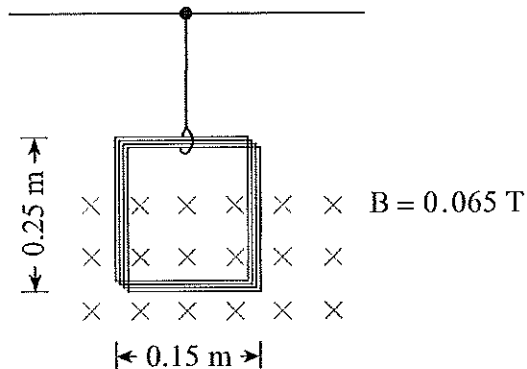
25. Which of the following diagrams best represents the magnetic field in the region between the two permanent magnets?



26. In which diagram would the current-carrying conductor experience a magnetic force out of the page?



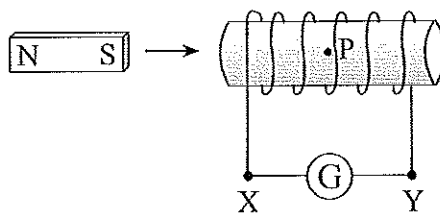
27. A coil of 25 turns of wire is suspended by a thread. When a current flows through the coil, the tension in the thread is reduced by 4.0×10^{-2} N.



What are the magnitude and direction of the current?

	MAGNITUDE OF CURRENT	DIRECTION OF CURRENT
A.	0.16 A	clockwise
B.	0.16 A	counter-clockwise
C.	4.1 A	clockwise
D.	4.1 A	counter-clockwise

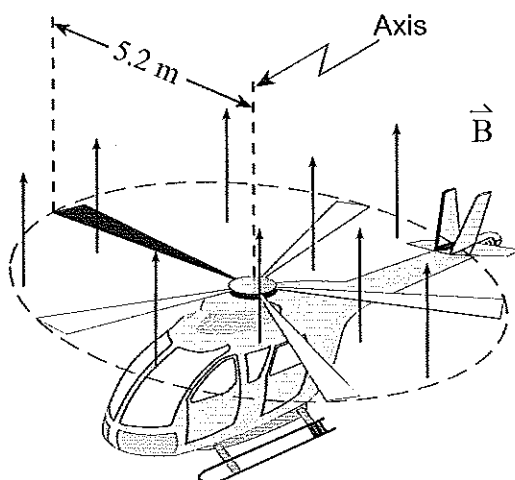
28. A bar magnet is moving toward a solenoid.



What is the direction of the current through the galvanometer and what is the direction of the magnetic field produced by this current at location P inside the solenoid?

	DIRECTION OF THE CURRENT THROUGH THE GALVANOMETER	DIRECTION OF THE MAGNETIC FIELD AT P
A.	From X to Y	Right
B.	From X to Y	Left
C.	From Y to X	Right
D.	From Y to X	Left

29. A dc motor has a resistance of $2.0\ \Omega$. When connected to a 12 V source, with the motor rotating at its operational speed, a back emf of 5.5 V is generated. What is the current in the motor at operational speed?
- A. 2.8 A
B. 3.3 A
C. 6.0 A
D. 8.8 A
30. The 5.2 m long metal rotor blades of a helicopter spin at 6.0 revolutions per second perpendicular to the earth's magnetic field of $4.7 \times 10^{-5}\ \text{T}$.

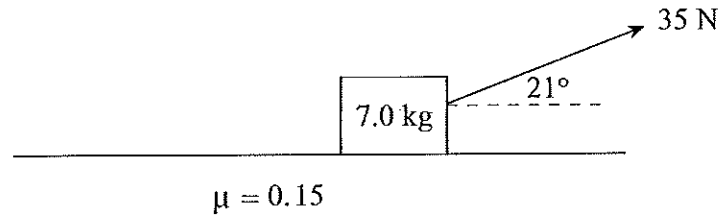


What is the magnetic flux swept out by the rotor blades in one revolution and what is the emf induced between the axis and tip of a rotor blade?

	MAGNETIC FLUX	EMF INDUCED
A.	$4.0 \times 10^{-3}\ \text{Wb}$	$2.4 \times 10^{-2}\ \text{V}$
B.	$4.0 \times 10^{-3}\ \text{Wb}$	$4.0 \times 10^{-3}\ \text{V}$
C.	$2.4 \times 10^{-2}\ \text{Wb}$	$2.4 \times 10^{-2}\ \text{V}$
D.	$2.4 \times 10^{-2}\ \text{Wb}$	$4.0 \times 10^{-3}\ \text{V}$

This is the end of the multiple-choice section.
Answer the remaining questions directly in this examination booklet.

1. A 35 N force applied at 21° to the horizontal is used to pull a mass as shown.

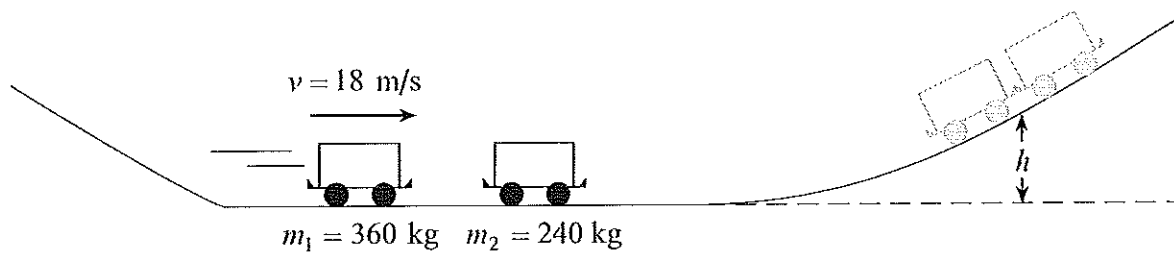


The coefficient of friction between the floor and the mass is 0.15.

- a) Draw and label a free body diagram showing the forces acting on the mass. (2 marks)

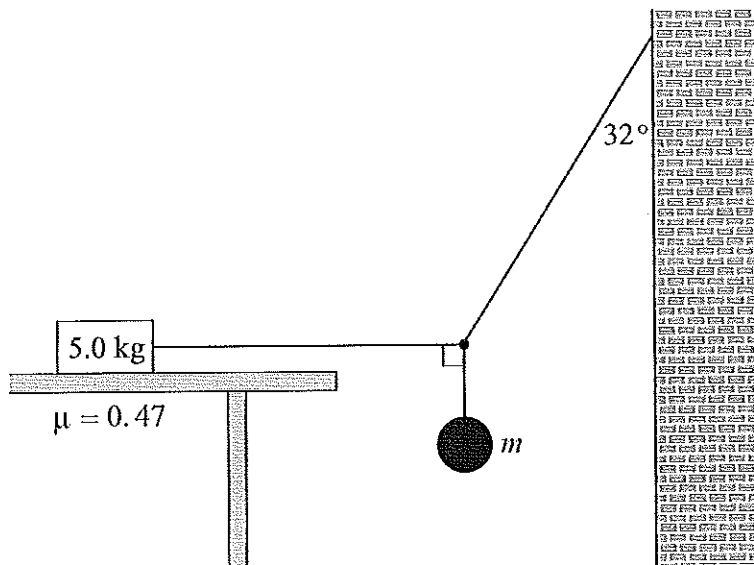
- b) What is the acceleration of the mass? (5 marks)

2. A 360 kg roller coaster car travelling at 18 m/s collides inelastically with a stationary 240 kg car on a section of horizontal track as shown in the diagram below.



To what maximum height, h , do the combined cars travel before rolling back down the hill?
(Assume no friction.) (7 marks)

3. An object of mass, m , is suspended by two cords connected to a wall and to a 5.0 kg block resting on a table as shown.



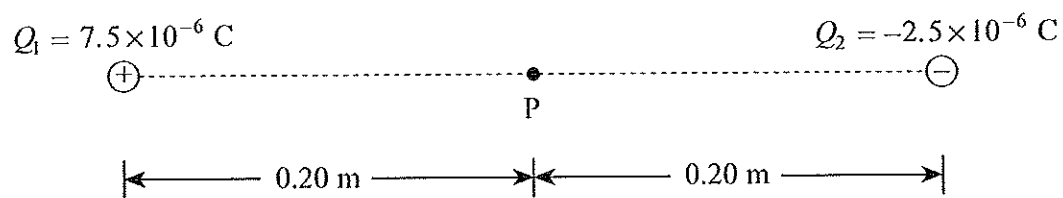
A coefficient of friction of 0.47 exists between the 5.0 kg block and the table. What is the maximum mass, m , that can be hung from the cords before the 5.0 kg block begins to move? (7 marks)

JAN - 2001

4. a) Mars has a mass of 6.37×10^{23} kg and a radius of 3.43×10^6 m. What is the gravitational field strength on its surface? (4 marks)

b) What thrust force must the rocket engine of a Martian lander exert if the 87.5 kg spacecraft is to accelerate upward at $1.20 \frac{m}{s^2}$ as it leaves the surface of Mars?

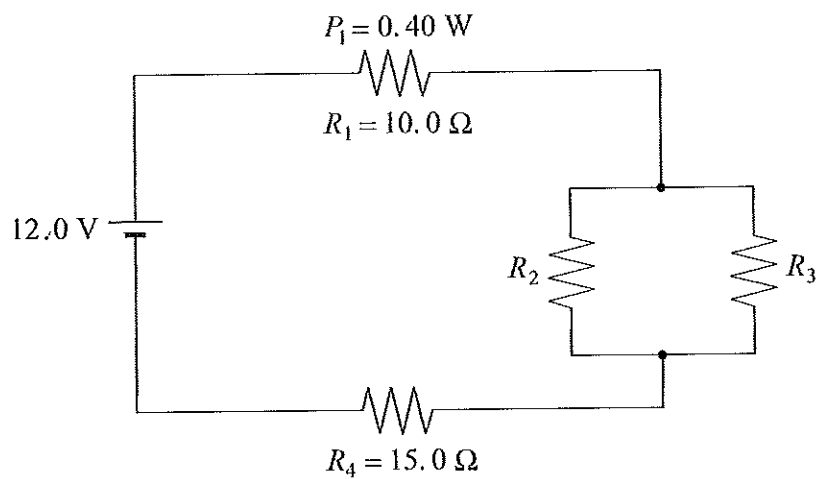
5. Electric charges are arranged as shown in the diagram below.



What is the electric field (magnitude and direction) at point P midway between the charges?
(7 marks)

JAN . 2001

6. In the circuit below, resistor R_1 dissipates 0.40 W . Resistors R_2 and R_3 are identical.



What is the resistance of R_2 ?

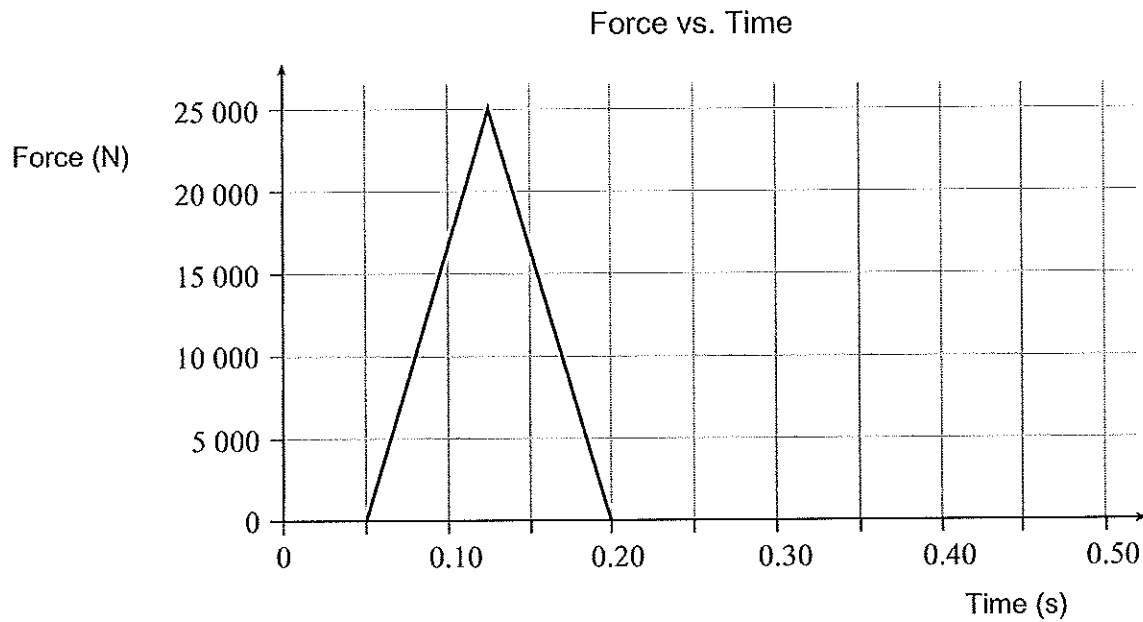
(7 marks)

7. a) A proton moves with a speed of 3.6×10^5 m/s at right angles to a uniform 5.0×10^{-5} T magnetic field. What is the radius of curvature for the motion of the proton? (5 marks)

b) Describe the path of the proton in the magnetic field and use principles of physics to explain the proton's motion. (4 marks)

JAN . 2001

8. During a motor vehicle accident an unbelted passenger experienced a force which varied with time as shown on the graph.



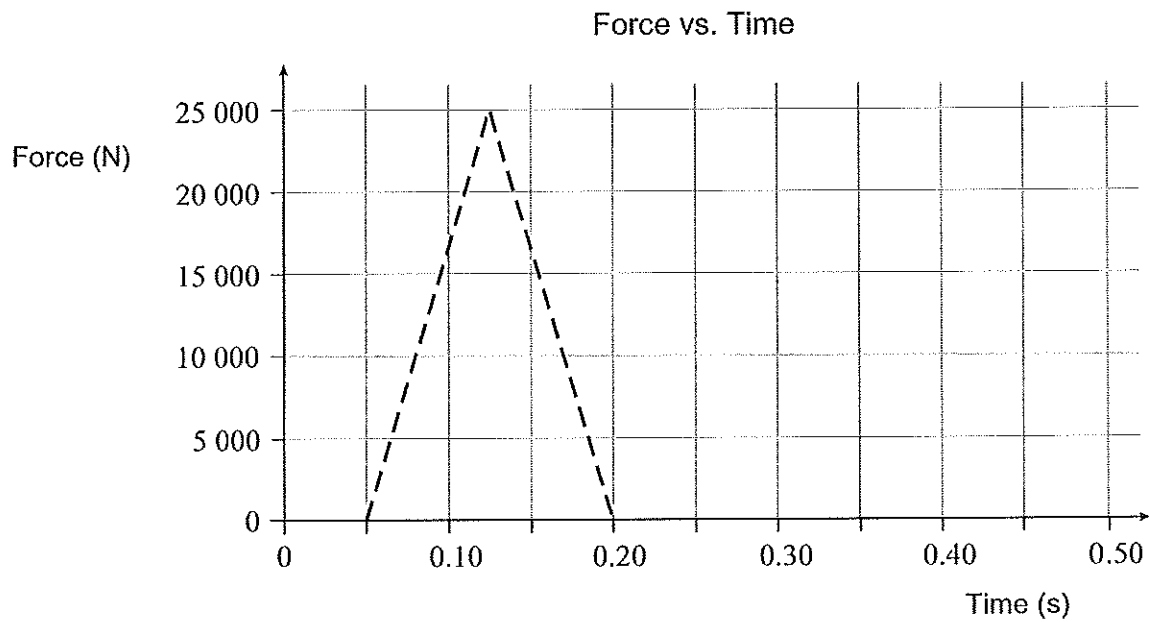
- a) Calculate the area of the shaded region in the graph.

(1 mark)

b) What does this area represent?

(2 marks)

c) If the passenger was wearing a seatbelt properly, the maximum force would have been one third the force experienced without the seatbelt. Sketch on the graph below how the force on the belted passenger might have varied with time. (2 marks)

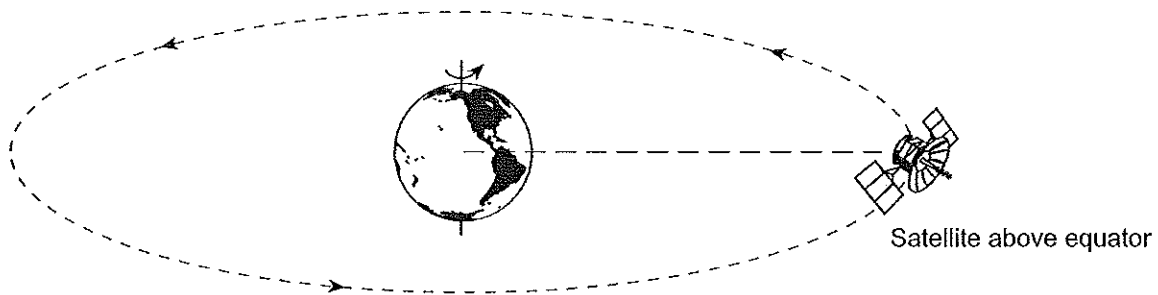


JAN , 2001

ANSWER:

a) area: _____

9. Geostationary satellites appear to remain stationary to an observer on Earth. Such satellites are placed in orbit far above the equator.

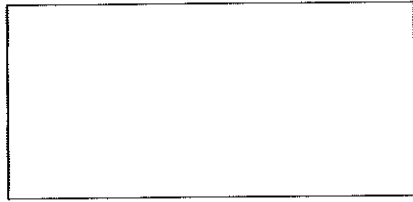


Using principles of physics, explain why such satellites all have the same orbital radius.

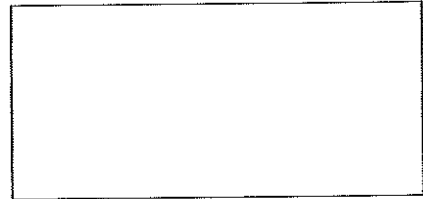
(4 marks)

END OF EXAMINATION

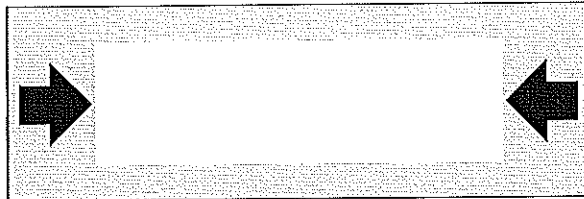
MINISTRY USE ONLY



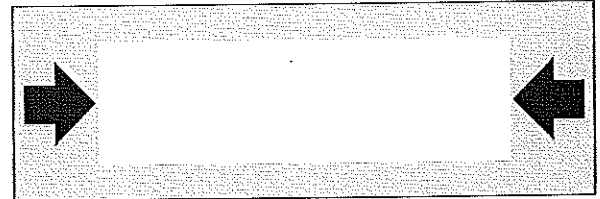
MINISTRY USE ONLY



Place Personal Education Number (PEN) here.



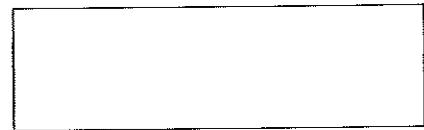
Place Personal Education Number (PEN) here.



BRITISH
COLUMBIA

© 2001 Ministry of Education

MINISTRY USE ONLY



Physics 12

JUNE 2001

Course Code = PH

Student Instructions

1. Place the stickers with your Personal Education Number (PEN) in the allotted spaces above. **Under no circumstance is your name or identification, other than your Personal Education Number, to appear on this booklet.**
2. Ensure that in addition to this examination booklet, you have an **Examination Response Form**. Follow the directions on the front of the Response Form.
3. **Disqualification** from the examination will result if you bring books, paper, notes or unauthorized electronic devices into the examination room.
4. When instructed to open this booklet, **check the numbering of the pages** to ensure that they are numbered in sequence from page one to the last page, which is identified by

END OF EXAMINATION

.
5. At the end of the examination, place your Response Form inside the front cover of this booklet and return the booklet and your Response Form to the supervisor.

JUN 2001

PART A: MULTIPLE CHOICE

Value: 60 marks (2 marks per question)

Suggested Time: 60 minutes

INSTRUCTIONS: For each question, select the **best** answer and record your choice on the Response Form provided. Using an HB pencil, completely fill in the circle that has the letter corresponding to your answer.

1. Which one of the following contains only vector quantities?
 - A. mass, time
 - B. force, velocity
 - C. time, momentum
 - D. acceleration, speed

2. A 35 kg object released from rest near the surface of a planet falls 7.3 m in 1.5 s. What is the acceleration due to gravity on this planet?
 - A. 4.9 m/s^2
 - B. 6.5 m/s^2
 - C. 9.7 m/s^2
 - D. 170 m/s^2

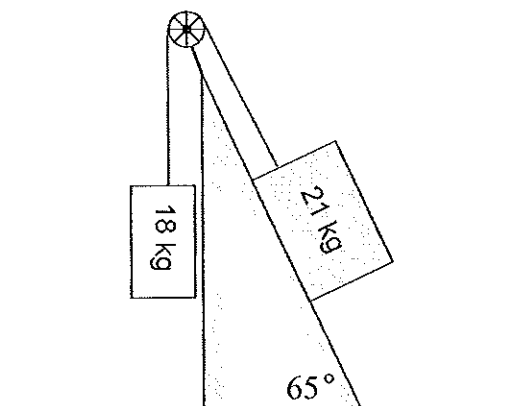
3. A projectile is fired with an initial velocity of 65 m/s at an angle of 23° above the horizontal. If air resistance is negligible, how much time elapses before the projectile reaches its maximum height?
 - A. 2.6 s
 - B. 2.8 s
 - C. 6.1 s
 - D. 6.6 s

4. A large mass, M , collides with a stationary small mass, m . During the collision, the forces exerted on each mass are measured. Which of the following is correct about the magnitude of the forces?
 - A. No force is exerted during the collision.
 - B. The large mass, M , exerts a greater force on the small mass, m .
 - C. The small mass, m , exerts a greater force on the large mass, M .
 - D. Both masses exert equal forces on each other during the collision.

JUN 2021

OVER

5. Two masses are connected together by a rope and pulley on a frictionless inclined plane as shown.



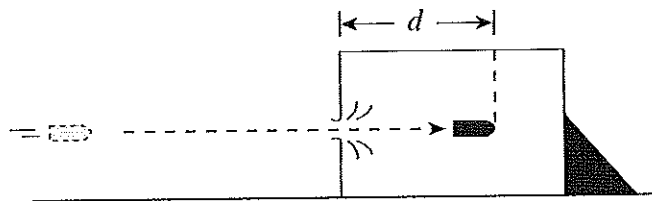
When the system is released, what is the initial acceleration of the 21 kg mass?

	MAGNITUDE OF THE ACCELERATION	DIRECTION THE MASS WILL TRAVEL
A.	0.26 m/s^2	up the incline
B.	0.26 m/s^2	down the incline
C.	0.48 m/s^2	up the incline
D.	0.48 m/s^2	down the incline

6. In order to use the joule as a unit of energy in an experiment, measurements must be converted to
- A. cm, g and s
 - B. m, kg and s
 - C. cm, N and s
 - D. m, g and min
7. Which of the following best represents the work done by an adult in ascending a typical flight of stairs in a home?
- A. 10^0 J
 - B. 10^1 J
 - C. 10^2 J
 - D. 10^3 J

JUN • 2001

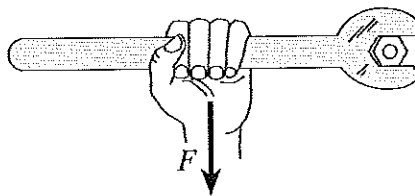
8. A 0.055 kg bullet was fired at 250 m/s into a block of wood as shown in the diagram below.



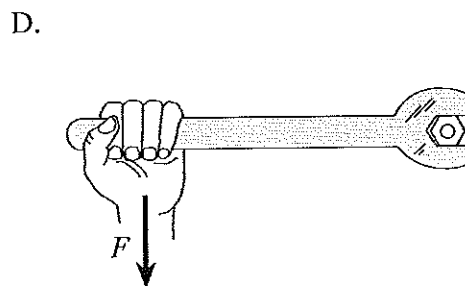
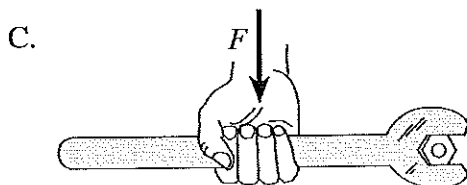
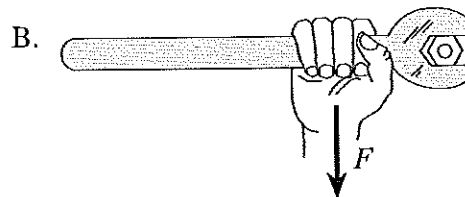
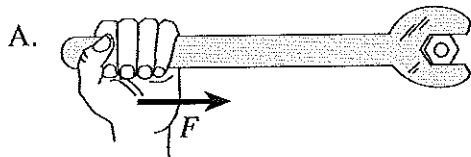
- Assuming an average force of 9 500 N brings the bullet to rest in the wood, what distance d did the bullet penetrate the block?
- A. 1.4×10^{-3} m
B. 1.4×10^{-2} m
C. 1.8×10^{-1} m
D. 3.6×10^{-1} m
9. An electric winch operates from a 120 V source at 3.5 A. The winch lifts a 360 kg object 2.5 m vertically in 45 s. What is the efficiency of the winch?
- A. 4.8%
B. 17%
C. 19%
D. 47%
10. A 0.40 kg ball rolls at 8.5 m/s towards a player. The player kicks the ball so that it then travels at 15.2 m/s in the opposite direction. What is the magnitude of the impulse that the ball sustained?
- A. 1.3 N·s
B. 2.7 N·s
C. 4.7 N·s
D. 9.5 N·s

JUN . 2001

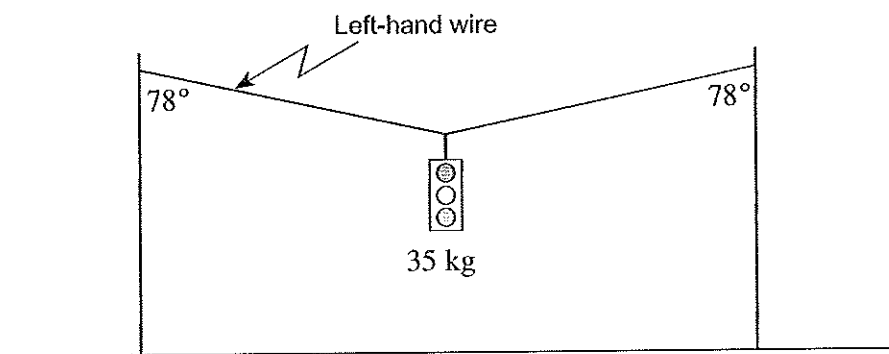
11. A student uses a wrench to loosen a very tight nut in the position shown.



In which of the following would the student have more success at loosening the nut?



12. A 35 kg traffic light is suspended by two wires as shown.

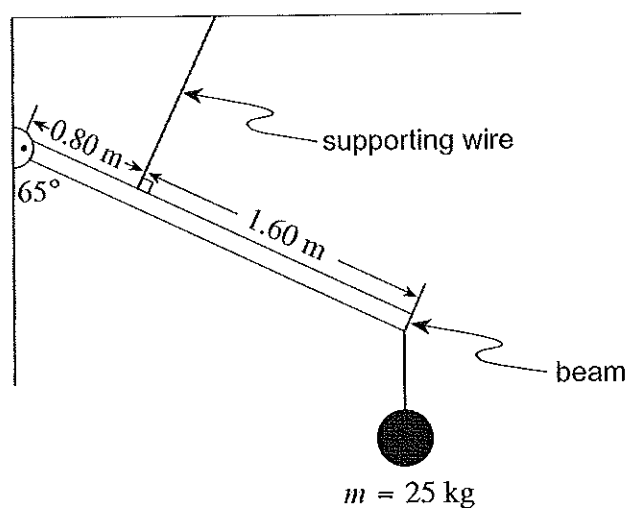


What is the tension in the left-hand wire?

- A. 84 N
B. 410 N
C. 820 N
D. 1 600 N

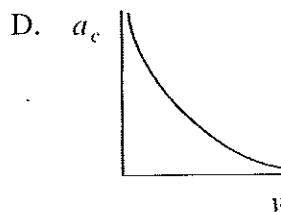
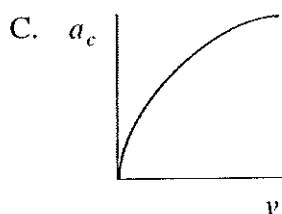
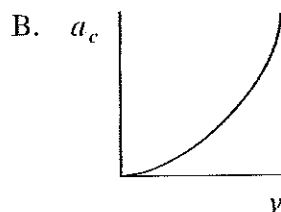
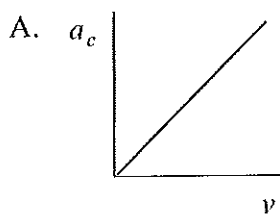
JUN , 2001

13. A 15 kg uniform beam 2.40 m long is suspended from a wall and a ceiling as shown.



What is the tension in the supporting wire?

- A. 670 N
 B. 740 N
 C. 870 N
 D. 960 N
14. A car travels at 25 m/s along a horizontal curve of radius 450 m. What minimum coefficient of friction is necessary between its tires and the road in order for the car not to skid?
- A. 0.14
 B. 0.54
 C. 0.72
 D. 1.4
15. In a series of test runs, a car travels around the same circular track at different velocities. Which graph best shows the relationship between its centripetal acceleration, a_c , and its velocity, v ?



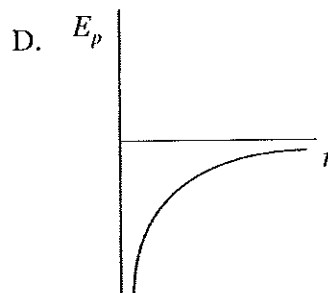
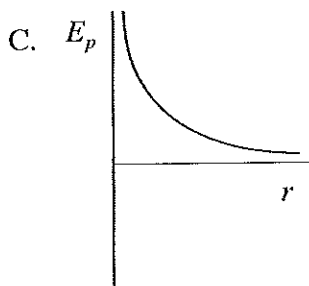
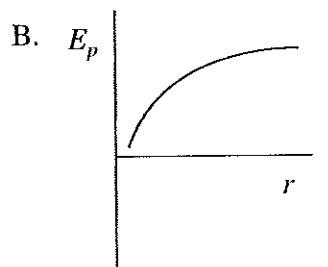
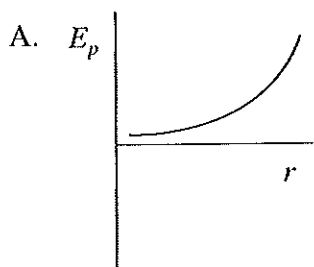
JUN , 2001

OVER

16. Tarzan, of mass 85 kg, holds on to a horizontal vine of length 8.0 m and jumps off a cliff. What is the tension force in the vine as Tarzan passes the lowest point of his circular path?

A. 830 N
B. 1 700 N
C. 2 500 N
D. 6 700 N

17. Which graph shows gravitational potential energy plotted as a function of distance r from the centre of the earth?

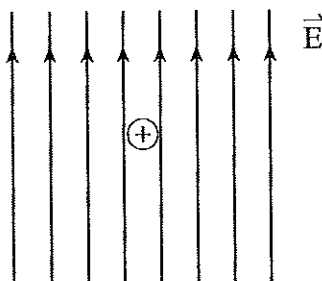


18. How much work must be done to lift a 4.00×10^4 kg object from Earth's surface to a height of 3.00×10^5 m?

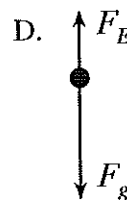
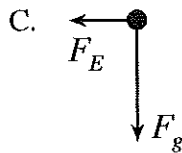
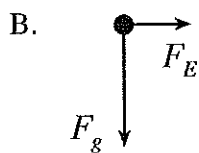
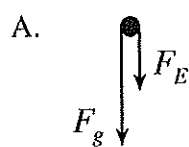
A. 1.12×10^{11} J
B. 1.18×10^{11} J
C. 2.39×10^{12} J
D. 5.32×10^{13} J

JUN . 2001

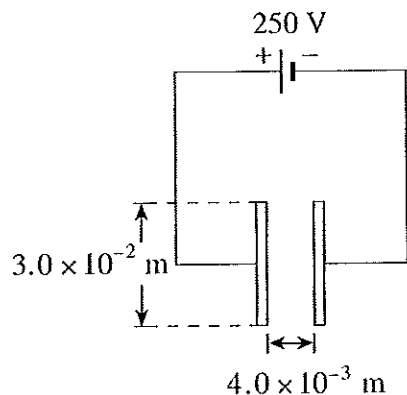
19. A positively charged oil droplet is in a vertical electric field.



Which of the following is a correctly labelled free-body diagram showing the forces acting on the oil droplet?



20. What are the magnitude and direction of the electric field between the plates in the situation shown below?



	DIRECTION OF FIELD	MAGNITUDE OF FIELD (V/m)
A.	left	8.3×10^3
B.	right	8.3×10^3
C.	left	6.3×10^4
D.	right	6.3×10^4

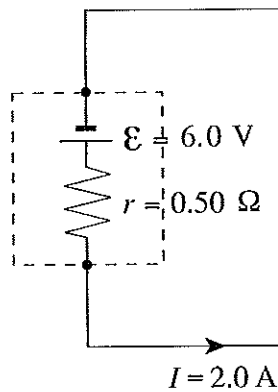
JUN . 2004

OVER

21. Current is a measure of

- A. the number of charges stored in a cell.
- B. the amount of energy given to a charged object.
- C. the charge passing a point in a circuit in a given time.
- D. the resistance to the flow of charged particles in a circuit.

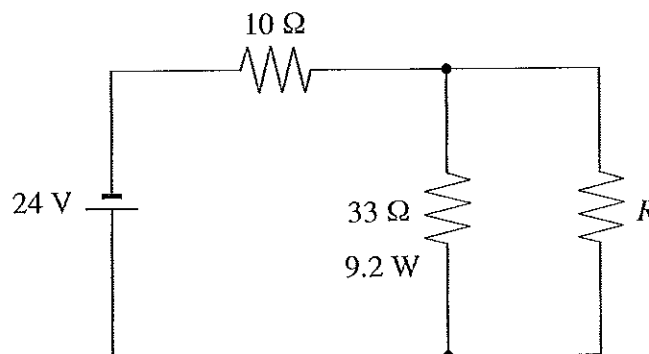
22. The battery in the diagram below is delivering a current of 2.0 A.



What will be the reading on a voltmeter connected to the battery terminals?

- A. 1.0 V
- B. 5.0 V
- C. 6.0 V
- D. 7.0 V

23. What is the total power dissipated by the three resistors in the circuit shown below?



- A. 12 W
- B. 16 W
- C. 23 W
- D. 30 W

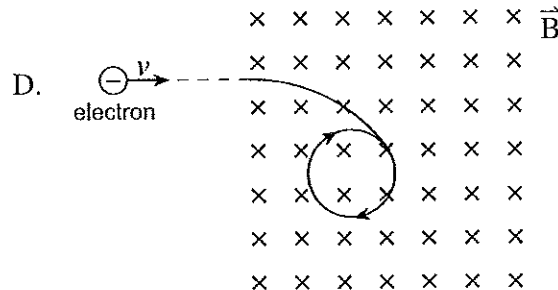
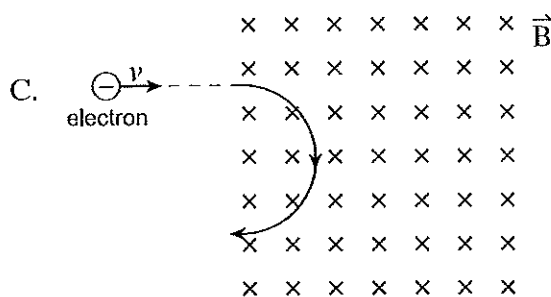
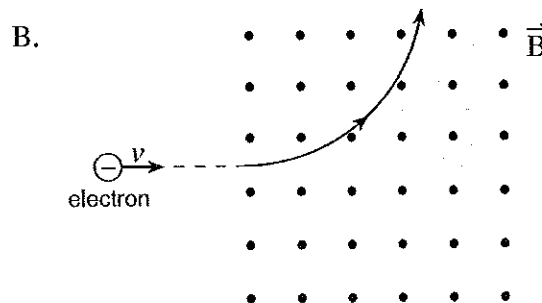
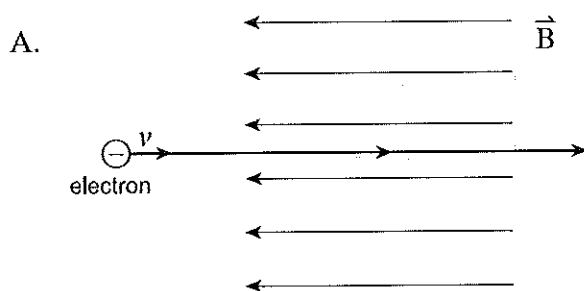
JUN , 2001

465

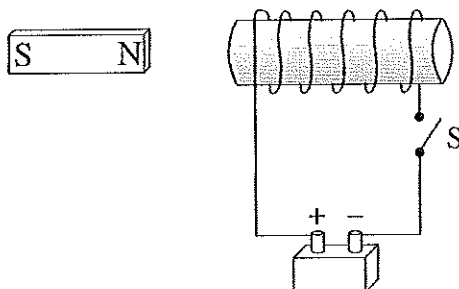
24. Which of the following devices commonly uses a solenoid?

- A. kettle
- B. battery
- C. television set
- D. incandescent bulb

25. An electron, travelling with a constant velocity, enters a region of uniform magnetic field. Which of the following is **not** a possible pathway?



26. A bar magnet is at rest, next to a fixed coil. When switch S is closed, the bar magnet will move

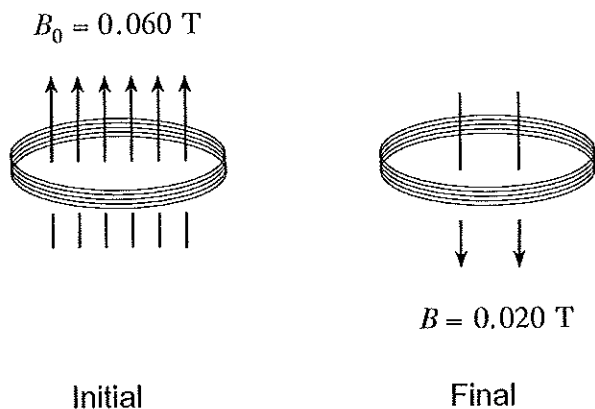


- A. to the left.
- B. to the right.
- C. up the page.
- D. down the page.

JUN . 2001

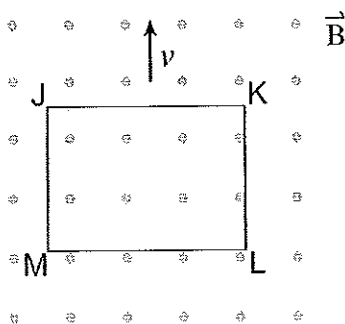
OVER

27. A 500-turn circular coil with an area of $1.54 \times 10^{-2} \text{ m}^2$ is perpendicular to a 0.060 T field. The magnetic field changes to 0.020 T in the opposite direction in 0.12 s.



What is the average emf induced in the coil?

- A. $5.1 \times 10^{-3} \text{ V}$
 - B. $1.0 \times 10^{-2} \text{ V}$
 - C. 2.6 V
 - D. 5.1 V
28. A metal block moves with a constant speed in a uniform magnetic field.



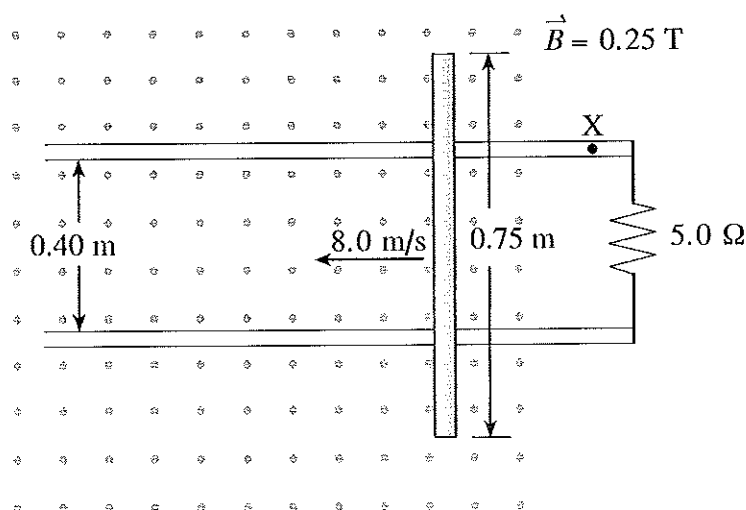
Which side of the block is positive?

- A. JK
- B. KL
- C. LM
- D. MJ

29. A 120 V dc motor has an armature resistance of $5.0\ \Omega$ and draws 6.0 A when it is operating normally. What is the starting current of the motor and the back emf when it is operating?

	STARTING CURRENT	BACK EMF WHEN OPERATING
A.	6.0 A	30 V
B.	6.0 A	90 V
C.	24 A	30 V
D.	24 A	90 V

30. A 0.75 m conducting rod is moved at 8.0 m/s across a 0.25 T magnetic field along metal rails. The electrical resistance of the system is $5.0\ \Omega$.



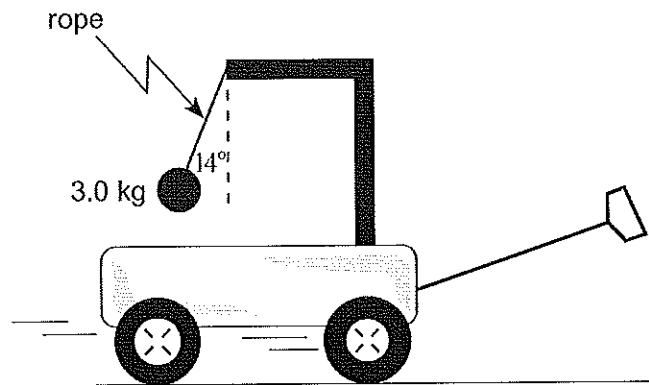
What are the magnitude and direction of the current through point X?

	MAGNITUDE OF CURRENT	DIRECTION OF CURRENT THROUGH X
A.	0.16 A	Left
B.	0.16 A	Right
C.	0.30 A	Left
D.	0.30 A	Right

JUN , 2001

This is the end of the multiple-choice section.
Answer the remaining questions directly in this examination booklet.

1. A 3.0 kg mass hangs at one end of a rope that is attached to a support on a child's wagon as shown in the diagram. The wagon is pulled to the right. (You may ignore air resistance.)



- a) Draw and label a free body diagram showing the forces acting on the mass. (2 marks)

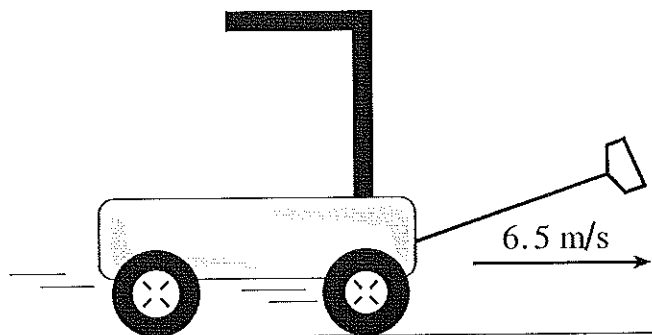
- b) What is the acceleration of the wagon? (3 marks)

JUN , 2001

ANSWER:

b) acceleration of the wagon: _____

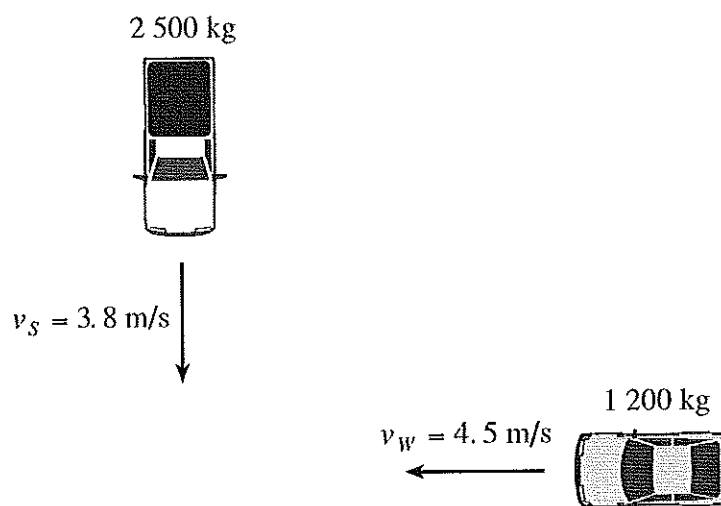
- c) On the diagram below, sketch the position of the mass when the cart reaches a constant velocity of 6.5 m/s . (1 mark)



- d) Using principles of physics, explain why the mass will be in this position. (3 marks)

JUN , 2001

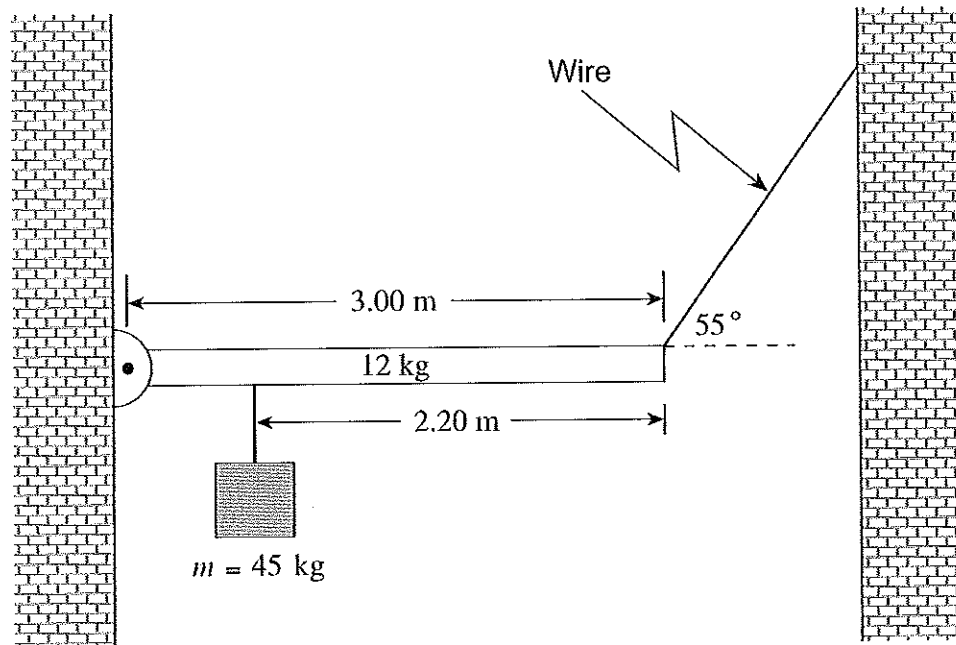
2. Sally is driving south in her 2 500 kg pickup truck at 3.8 m/s when she collides with Willy driving west in his 1 200 kg car at 4.5 m/s.



The two vehicles lock together and slide over the wet parking lot. Find the speed and direction of the damaged vehicles immediately after the collision. (7 marks)

JUN , 2001

3. A uniform 12 kg beam of length 3.00 m holding a 45 kg mass is attached by a wire to a wall as shown.



What is the tension in the wire?

(7 marks)

JUN , 2001

4. An 884 kg satellite in orbit around a planet has a gravitational potential energy of -5.44×10^{10} J.
The orbital radius of the satellite is 8.52×10^6 m and its speed is 7.84×10^3 m/s.

a) What is the mass of the planet?

(3 marks)

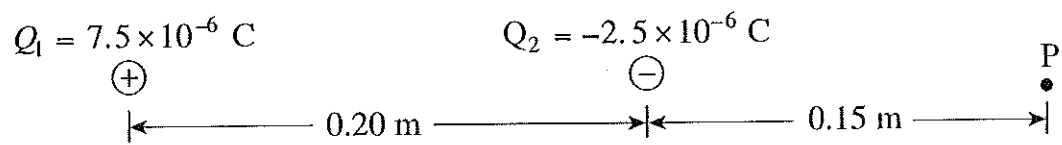
b) What is the kinetic energy of the satellite?
(2 marks)

c) What is the total energy of the satellite?
(2 marks)

ANSWER:

a) mass of the planet: _____

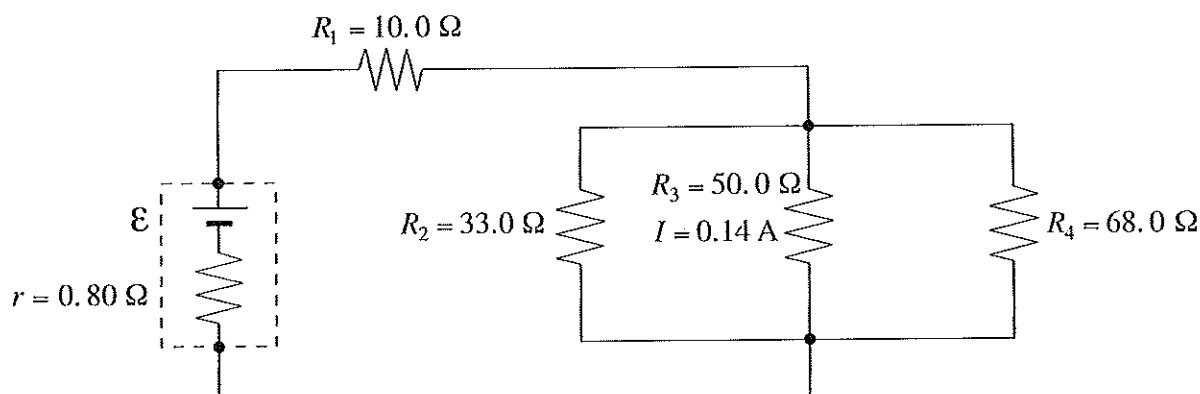
5. Electric charges Q_1 and Q_2 are arranged as shown in the diagram below.



What is the electric potential at point P?

(7 marks)

6. The current through the $50.0\ \Omega$ resistor in the circuit below is $0.14\ \text{A}$.



- a) Determine the emf of the battery.

(5 marks)

- b) Determine the power dissipated in the battery's internal resistance. (2 marks)

ANSWER:

a) emf of the battery: _____

7. Protons travelling at 2.2×10^5 m/s enter at right angles to a magnetic field. The field is produced by a 0.16 m long solenoid. A current of 5.3 A flows through the 820 turns of wire of the solenoid.

a) What is the magnetic field in the solenoid?

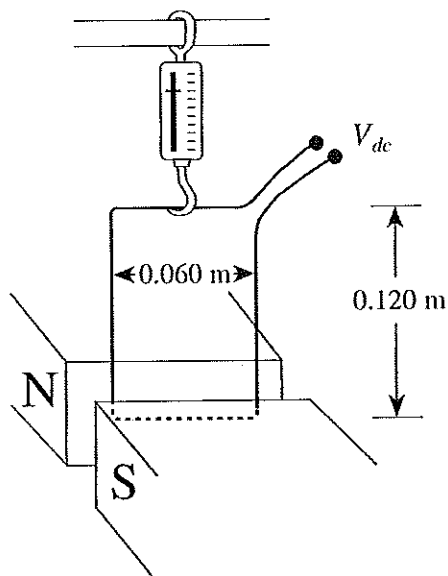
(3 marks)

b) *What is the radius of curvature of the proton beam in the magnetic field of the solenoid?*
(4 marks)

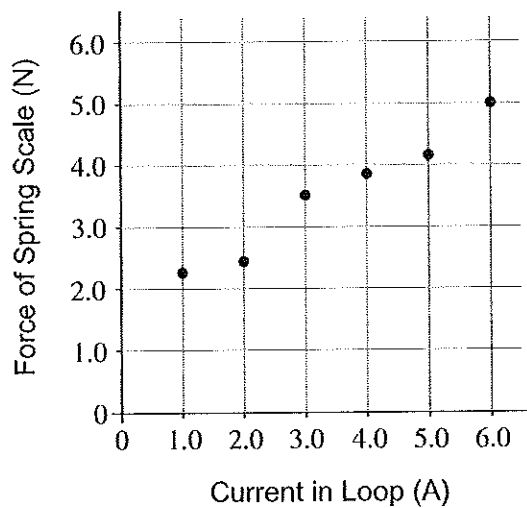
ANSWER:

a) magnetic field: _____

8. A rectangular loop is suspended by a spring scale between magnetic poles. The loop is 0.60 m wide by 0.120 m high.



As the current in the loop is varied, the readings of the spring scale and current are plotted on a graph.



- a) What is the weight, in newtons, of the loop?

(1 mark)

ANSWER:

a) weight of the loop: _____

b) What is the slope of the best fit line?

(2 marks)

ANSWER:

b) slope of the best fit line: _____

c) What is the magnitude of the magnetic field?

(2 marks)

ANSWER:

c) magnitude of the magnetic field: _____

JUN , 2001

9. A student decides to investigate how electric field varies along the line connecting two positive point charges. Charge Q_2 is greater than charge Q_1 .



Using principles of physics, describe the electric field along the line from Q_1 to Q_2 . (4 marks)

END OF EXAMINATION

JUN 2001

MINISTRY USE ONLY

MINISTRY USE ONLY

Place Personal Education Number (PEN) here.

Place Personal Education Number (PEN) here.



**BRITISH
COLUMBIA**
© 2001 Ministry of Education

MINISTRY USE ONLY

Physics 12

AUGUST 2001

Course Code = PH

Student Instructions

1. Place the stickers with your Personal Education Number (PEN) in the allotted spaces above. **Under no circumstance is your name or identification, other than your Personal Education Number, to appear on this booklet.**
2. Ensure that in addition to this examination booklet, you have an **Examination Response Form**. Follow the directions on the front of the Response Form.
3. **Disqualification** from the examination will result if you bring books, paper, notes or unauthorized electronic devices into the examination room.
4. When instructed to open this booklet, **check the numbering of the pages** to ensure that they are numbered in sequence from page one to the last page, which is identified by
END OF EXAMINATION.
5. At the end of the examination, place your Response Form inside the front cover of this booklet and return the booklet and your Response Form to the supervisor.

AUG 2001

PART A: MULTIPLE CHOICE

Value: 60 marks (2 marks per question)

Suggested Time: 60 minutes

INSTRUCTIONS: For each question, select the **best** answer and record your choice on the Response Form provided. Using an HB pencil, completely fill in the circle that has the letter corresponding to your answer.

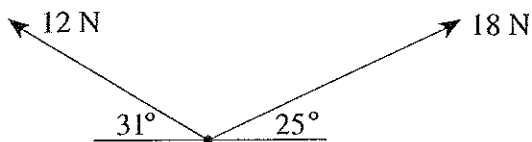
1. Newton's second law of motion is best shown by which of the following equations?

- A. $a = \frac{v}{t}$
- B. $a = \frac{F_{net}}{m}$
- C. $F_{net} = mv$
- D. $F_{net} = a\left(\frac{d}{t^2}\right)$

2. A 45 kg rock experiences a force of gravity of 168 N on the surface of Mars. What is the gravitational field strength on the surface of Mars?

- A. 1.6 N/kg
- B. 2.6 N/kg
- C. 3.7 N/kg
- D. 9.8 N/kg

3. Two forces act at a single point as shown.



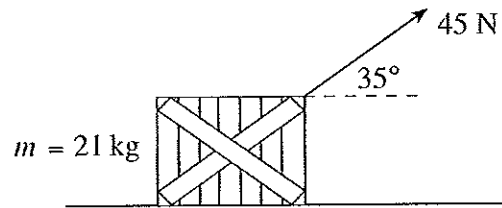
What is the magnitude of the resulting force?

- A. 15 N
- B. 22 N
- C. 27 N
- D. 30 N

AUG , 2001

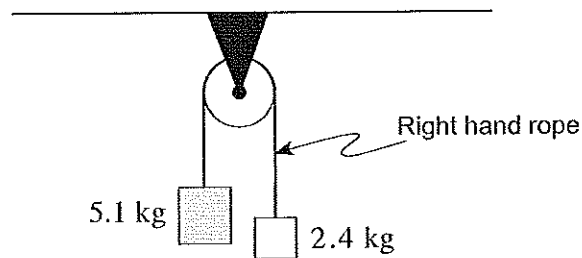
OVER

4. A force of 45 N is applied at an angle of 35° above the horizontal to pull a 21 kg crate across a floor as shown below.



What is the normal force on the crate?

- A. 26 N
 - B. 170 N
 - C. 180 N
 - D. 210 N
5. A frictionless pulley is set up with two hanging masses as shown below.

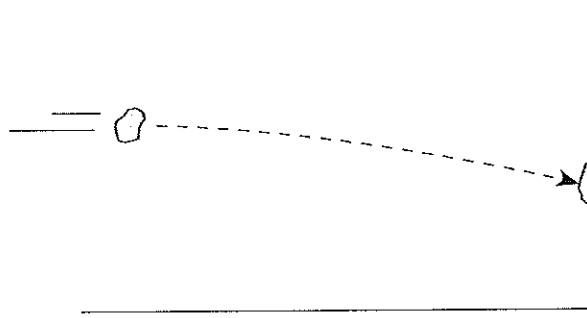


What is the tension in the right hand rope while the masses move freely?

- A. 8.5 N
 - B. 24 N
 - C. 26 N
 - D. 32 N
6. Which of the following best represents efficiency?
- A. Final time compared to initial time
 - B. Work output compared to work input
 - C. Final velocity compared to initial velocity
 - D. Momentum after compared to momentum before

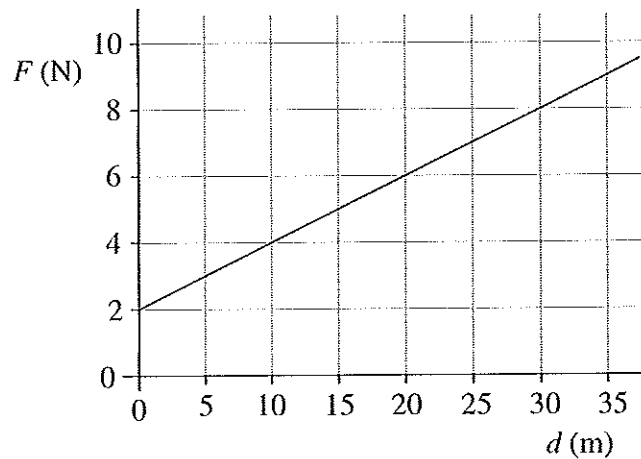
AUG , 2001

7. A wad of putty is thrown against a wall as shown. The wad of putty sticks against the wall.



Which of the following statements best applies the application of the law of conservation of energy to this collision?

- A. All energy has been lost.
 - B. Kinetic energy is converted to heat.
 - C. Kinetic energy is converted to momentum.
 - D. Kinetic energy is converted to potential energy.
8. The graph below shows how the force applied to an object varies with distance.

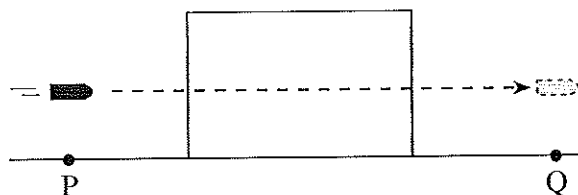


What is the work done to move the object from 10 m to 30 m?

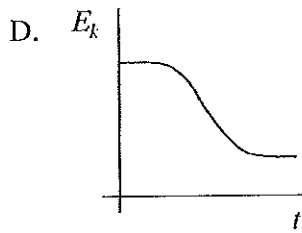
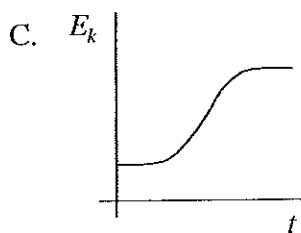
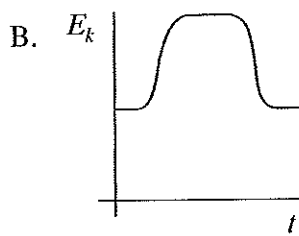
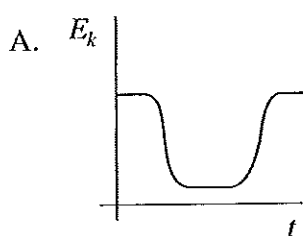
- A. 40 J
- B. 80 J
- C. 120 J
- D. 240 J

AUG , 2001

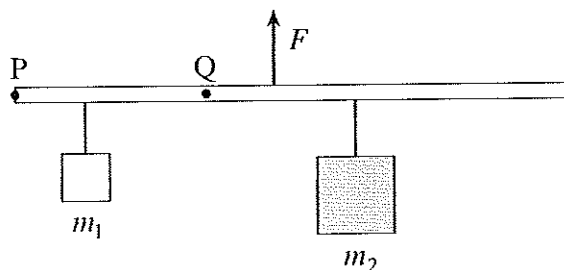
9. A projectile is fired through a fixed block of wood. The diagram shows the projectile above point P just before it enters the block and again above point Q just after leaving the block.



Which of the graphs best illustrates how the kinetic energy of the projectile varies over the time it takes to travel from P to Q?



10. A beam holding two masses is in static equilibrium.

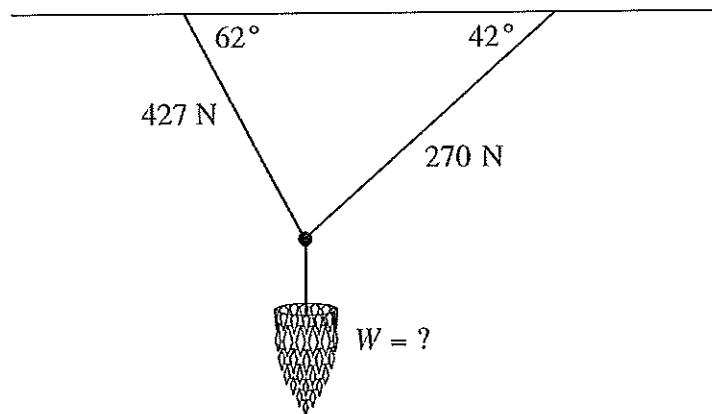


Compare the sum of the torques about point P to the sum of the torques about point Q.

- A. The sum of the torques is the same about both point P and point Q.
 B. You need to know the mass of the beam to compare the sum of the torques.
 C. The sum of the torques about point P is less than the sum of the torques about point Q.
 D. The sum of the torques about point P is greater than the sum of the torques about point Q.

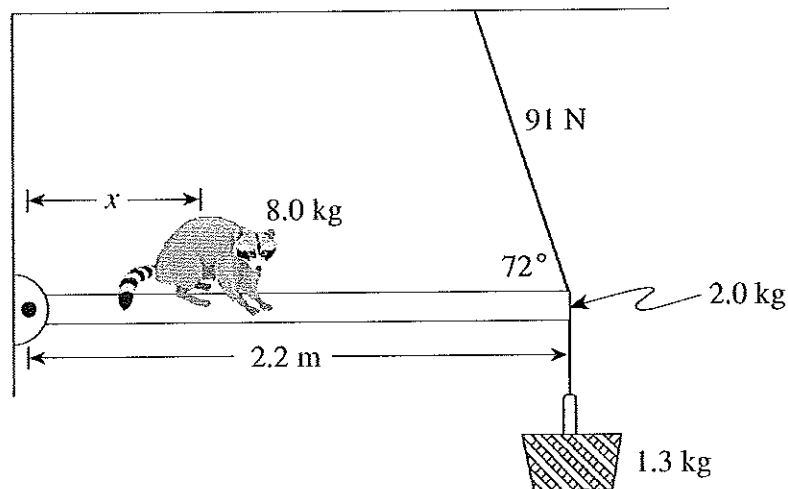
AUG , 2001

11. In the diagram below, the tension in each wire is shown.



What is the weight of the chandelier supported by these wires?

- A. 300 N
B. 510 N
C. 560 N
D. 620 N
12. A hungry 8.0 kg raccoon walks out on a 2.0 kg , 2.2 m long uniform beam in an attempt to reach a 1.3 kg food basket hanging at the end. A cord that can withstand 91 N is used to support the beam at the end as shown.



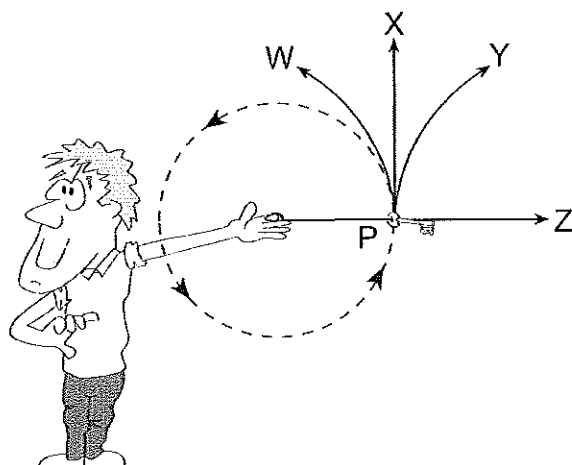
What is the maximum distance, x , the raccoon can walk out onto the beam before the cord breaks?

- A. 1.8 m
B. 1.9 m
C. 2.0 m
D. 2.2 m

AUG , 2001

OVER

13. The diagram shows a student “twirling” a car key in a circular path on the end of a string.



If the string snaps at P, which path will the keys follow?

- A. W
- B. X
- C. Y
- D. Z

14. An athlete runs, at a constant speed, around a circle of radius 5.0 m in 12 s. What are the athlete’s speed and acceleration?

	SPEED	MAGNITUDE OF ACCELERATION
A.	0.42 m/s	0.22 m/s ²
B.	0.42 m/s	1.4 m/s ²
C.	2.6 m/s	0.22 m/s ²
D.	2.6 m/s	1.4 m/s ²

AUG , 2001

15. A frictionless 3.0 kg cart rolls down an incline, and then “loops the loop.”

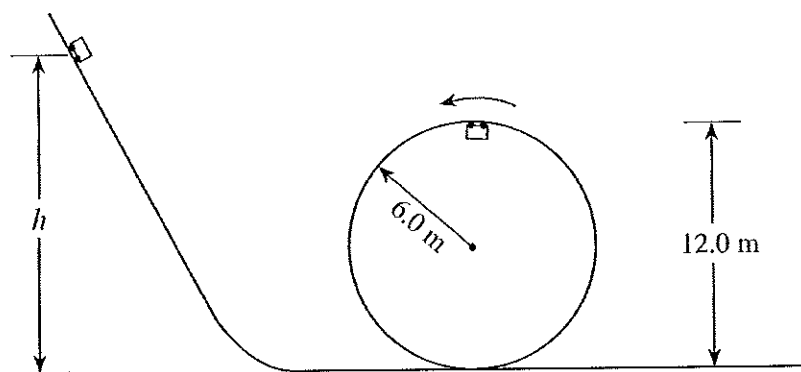
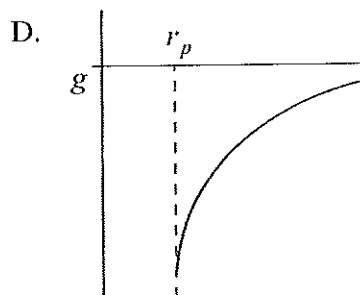
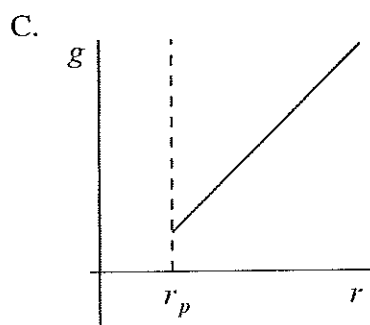
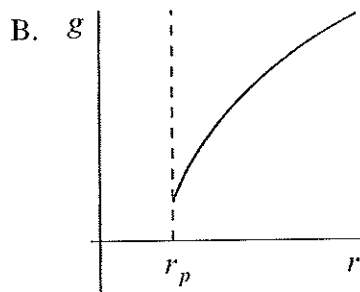
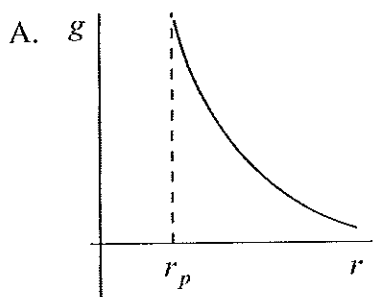


Diagram not to scale.

From what minimum height, h , should the cart be released so that it does not fall off the circular track?

- A. 12.0 m
 - B. 15.0 m
 - C. 18.0 m
 - D. 24.0 m
16. Which graph best shows how the gravitational field strength, g , varies with the distance, r , from the centre of a planet? (r_p is the radius of the planet.)



AUG , 2001

OVER

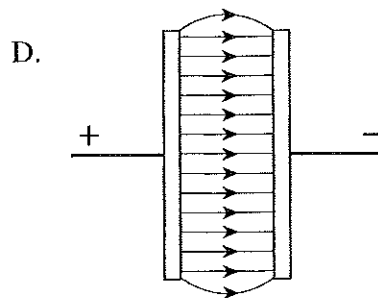
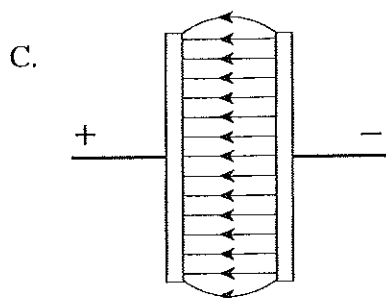
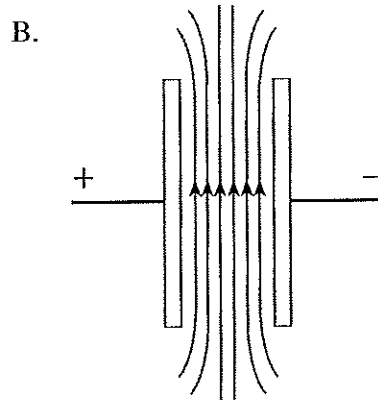
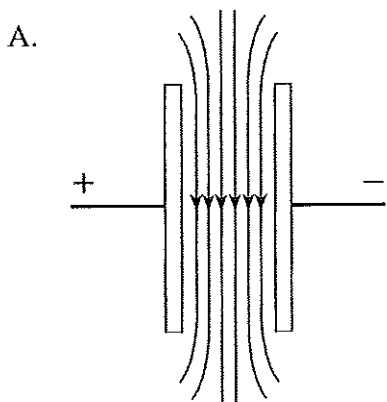
17. A satellite is in a stable circular orbit around the earth. Another satellite in a stable circular orbit at a greater altitude must have

- A. a smaller speed and a shorter period.
- B. a smaller speed and a longer period.
- C. a greater speed and a shorter period.
- D. a greater speed and a longer period.

18. Which of the following could represent the kinetic energy, the gravitational potential energy and the total energy for an orbiting satellite in a stable circular orbit?

	KINETIC ENERGY	GRAVITATIONAL POTENTIAL ENERGY	TOTAL ENERGY
A.	40 000 J	-80 000 J	-40 000 J
B.	40 000 J	40 000 J	80 000 J
C.	80 000 J	40 000 J	120 000 J
D.	80 000 J	-40 000 J	40 000 J

19. Which of the following best illustrates the electric field between parallel plates with opposite electric charges?



AUG , 2001

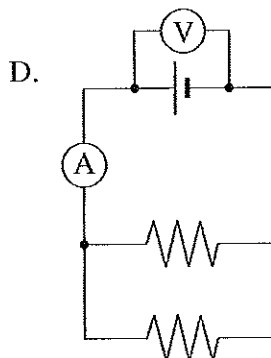
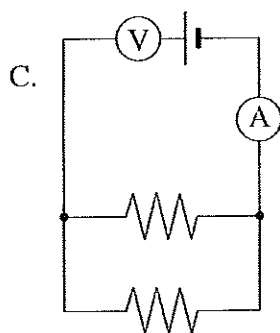
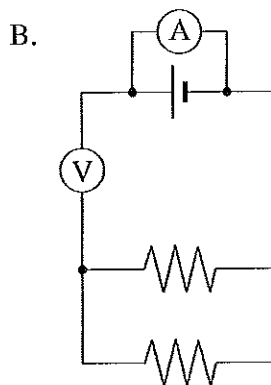
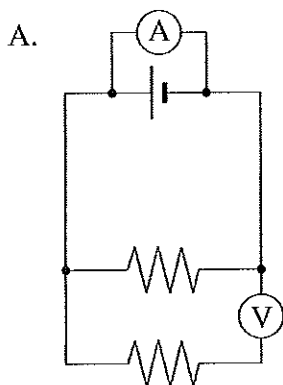
20. The atomic nucleus of uranium contains 92 protons. What is the direction and magnitude of the electric field 2.5×10^{-10} m from this nucleus?

	DIRECTION OF ELECTRIC FIELD	MAGNITUDE OF ELECTRIC FIELD
A.	towards nucleus	5.3×10^2 N/C
B.	away from nucleus	5.3×10^2 N/C
C.	towards nucleus	2.1×10^{12} N/C
D.	away from nucleus	2.1×10^{12} N/C

21. A 0.16 C charge is moved in an electric field from a point with a potential of 25 V to another point with a potential of 95 V. How much work was done to move this charge?

- A. 4.0 J
B. 11 J
C. 15 J
D. 19 J

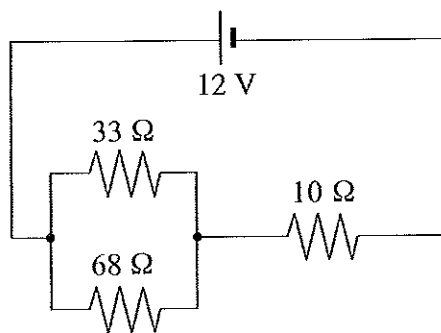
22. Which of the following diagrams shows an ammeter correctly placed to measure the circuit current and a voltmeter correctly placed to measure the potential difference across the battery?



AUG , 2001

OVER

23. What is the current through the $10\ \Omega$ resistor in the circuit shown below?

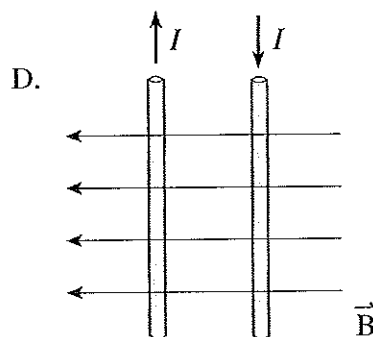
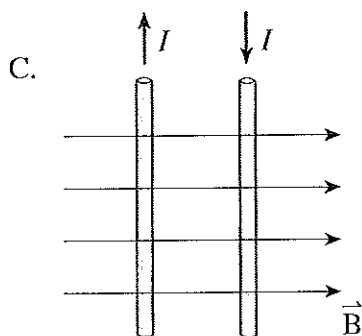
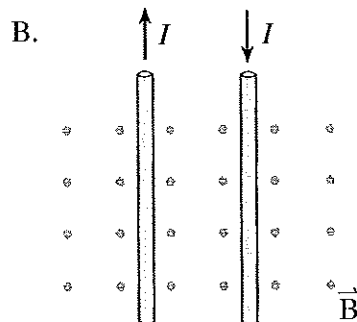
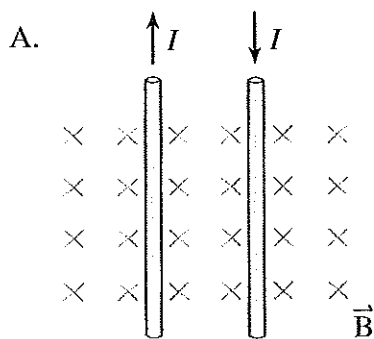


- A. 0.11 A
- B. 0.37 A
- C. 1.2 A
- D. 1.7 A

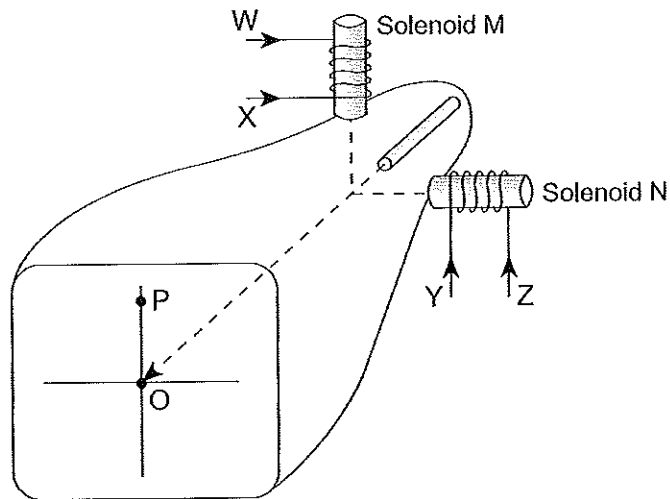
24. Transformers are commonly used in which electrical device?

- A. toaster
- B. television set
- C. electric kettle
- D. incandescent bulb

25. In which diagram would an external magnetic field, \vec{B} , cause two current-carrying wires to move towards one another?



26. When there is no current in the solenoids, the electron beam in the cathode ray tube strikes the screen at the origin O.



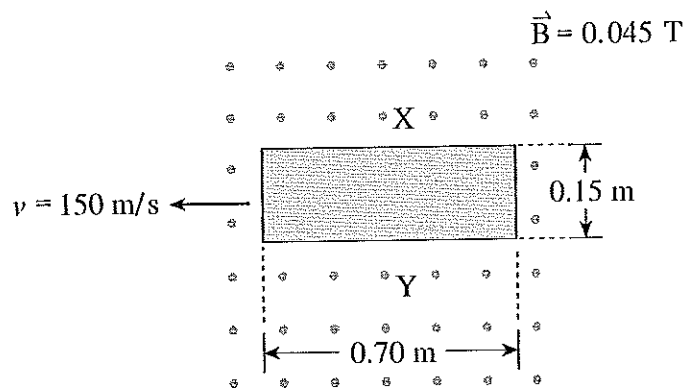
In order to move the beam to position P, which solenoid is used and what is the direction of the current applied?

	SOLENOID	CURRENT DIRECTION
A.	M	W.
B.	M	X
C.	N	Y
D.	N	Z

AUG , 2001

OVER

27. A solid conductor travels at 150 m/s across a uniform 0.045 T magnetic field. Which side is positively charged and what is the emf across this block?



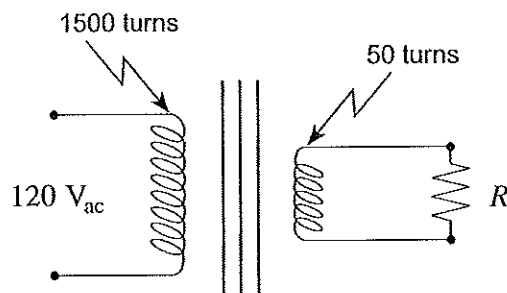
	POSITIVE SIDE	EMF
A.	X	1.0 V
B.	X	4.7 V
C.	Y	1.0 V
D.	Y	4.7 V

28. A motor operating at full speed draws a current of 4.0 A when connected to a 110 V source. The motor has an armature resistance of 3.5Ω . What is the back emf at full speed?

- A. 14 V
 B. 96 V
 C. 110 V
 D. 124 V

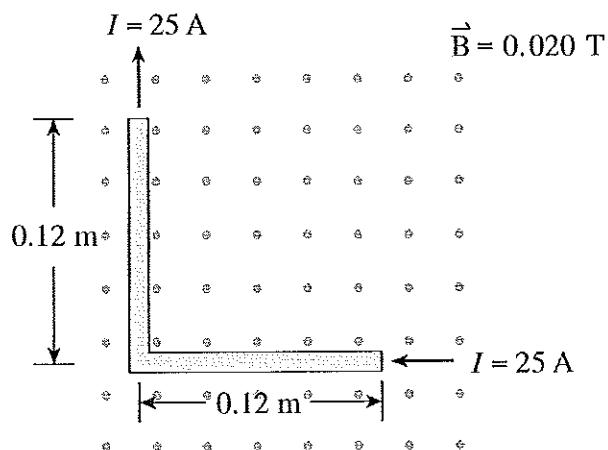
AUG , 2001

29. An ideal transformer with 120 V_{ac} on the primary coil supplies power to the resistor R . If this resistor dissipates 35 W , what is the current in the primary coil and in the secondary coil?



	CURRENT IN PRIMARY	CURRENT IN SECONDARY
A.	0.29 A	0.29 A
B.	0.29 A	8.8 A
C.	8.8 A	0.29 A
D.	8.8 A	8.8 A

30. What is the magnitude of the magnetic force on the L-shaped conductor?

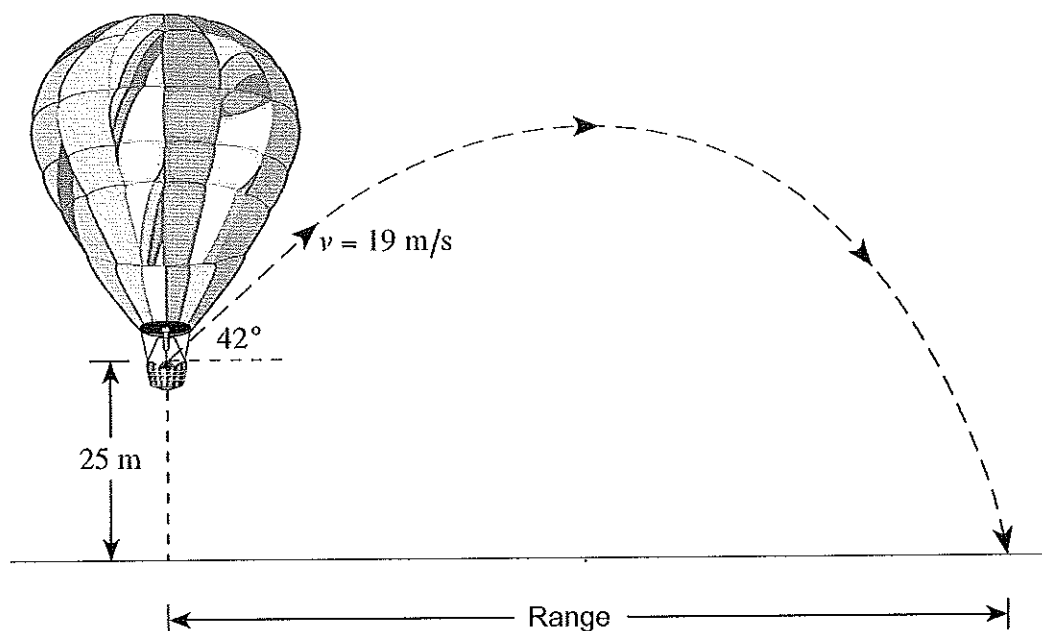


- A. 0 N
 B. $6.0 \times 10^{-2}\text{ N}$
 C. $8.5 \times 10^{-2}\text{ N}$
 D. $1.2 \times 10^{-1}\text{ N}$

AUG , 2001

This is the end of the multiple-choice section.
 Answer the remaining questions directly in this examination booklet.

1. A 0.50 kg ball is thrown at 42° above the horizontal at 19 m/s from a stationary hot air balloon 25 m above the ground.



What is the range?

(7 marks)

AUG , 2001

2. A rocket motor, capable of generating a $24 \text{ N} \cdot \text{s}$ impulse, is attached to a stationary frictionless 3.0 kg cart. The rocket motor is ignited.

a) What will the velocity of the cart be immediately after the rocket motor burns out?
(3 marks)

ANSWER:

a) velocity: _____

b) What is the resulting kinetic energy of the cart?
(2 marks)

ANSWER:

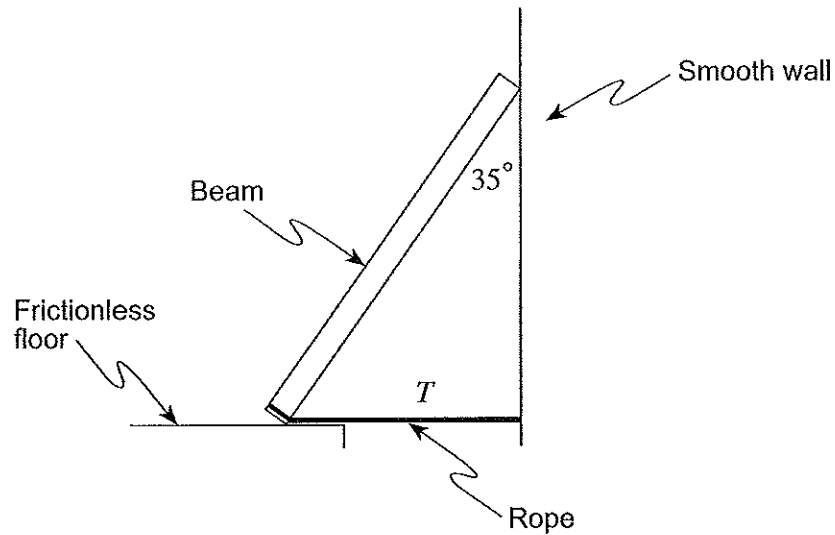
b) kinetic energy: _____

AUG , 2001

- c) A frictionless cart of larger mass will end up with less kinetic energy when powered by an identical rocket motor. Using principles of physics, explain this result. (4 marks)

AUG , 2001

3. A 24 kg beam of length 2.4 m leans against a smooth wall. A horizontal rope tied to the wall and the beam holds the beam on a frictionless floor as shown.



- a) Draw a labelled free-body diagram for the forces acting on the beam.

(2 marks)

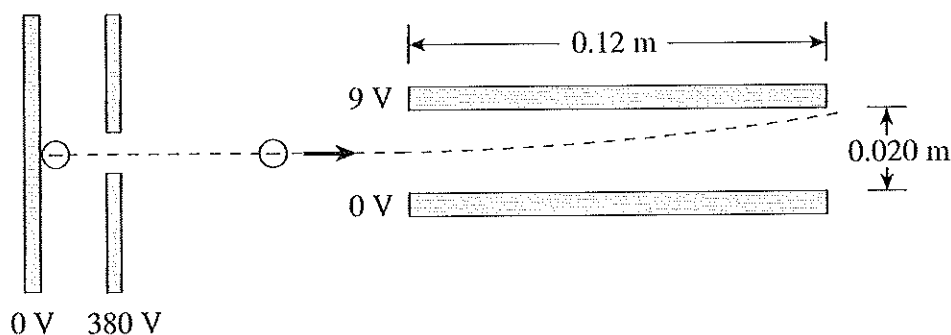
- b) *What is the tension in the rope? (5 marks)*

AUG , 2001

4. A spacecraft of mass 470 kg rests on the surface of an asteroid of radius 1 400 m and mass 2.0×10^{12} kg. How much energy must be expended so that the spacecraft may rise to a height of 2 800 m above the surface of the asteroid? (7 marks)

AUG , 2001

5. A beam of electrons is directed to a region between oppositely charged parallel plates as shown in the diagram below.



- a) The electron beam is produced by accelerating electrons through an electric potential difference of 380 V. What is the speed of the electrons as they leave the 380 V plate?
(3 marks)

- b) What is the electrostatic force on electrons in the region between the horizontal plates when they are connected to a 9.0 V potential difference? (4 marks)

ANSWER:

a) speed of the electrons: _____

AUG , 2001

OVER

6. A 12 V battery transfers 33 C of charge to an external circuit in 7.5 s.

a) What current flows through the circuit?

(2 marks)

ANSWER:

a) current: _____

b) What is the resistance of the circuit?

(2 marks)

c) *What is the power output of the battery?*

d) *The external circuit is most likely to consist of*

- ☐ *a bulb*
- ☐ *a kettle*
- ☐ *a calculator*

ANSWER:

b) resistance: _____

AUG , 2001

OVER

7. An electron travelling at 7.7×10^6 m/s enters at right angles into a uniform magnetic field. Inside the field the path of the electron has a radius of 3.5×10^{-2} m.

a) What is the magnitude of the magnetic field?

(4 marks)

b) If the magnetic field is produced at the center of a solenoid by a current of 0.62 A, what is the number of turns per unit length of the solenoid?

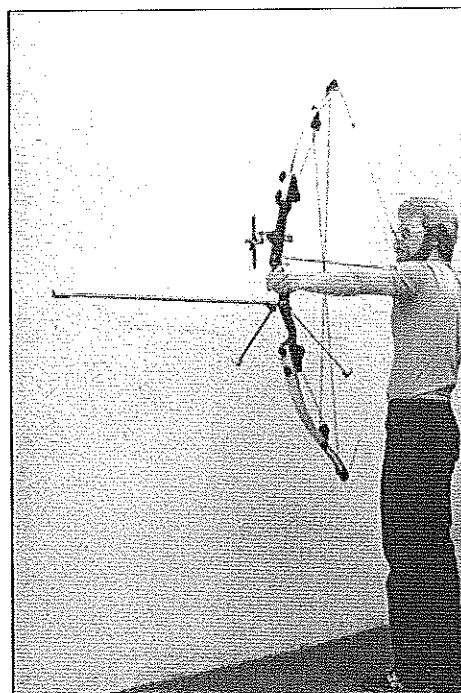
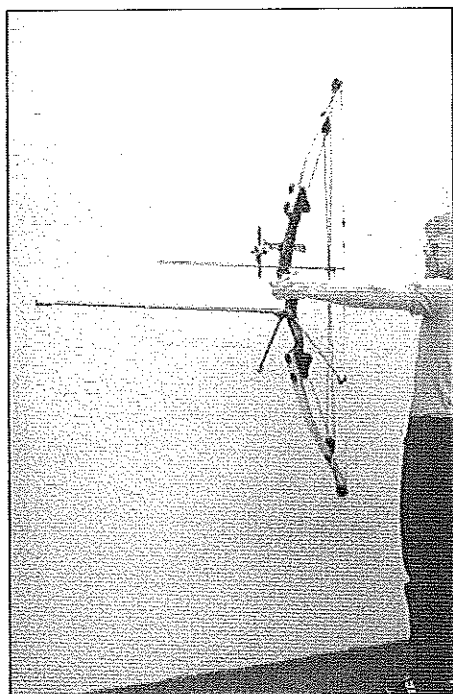
ANSWER:

a) magnitude of field: _____

AUG , 2001

OVER

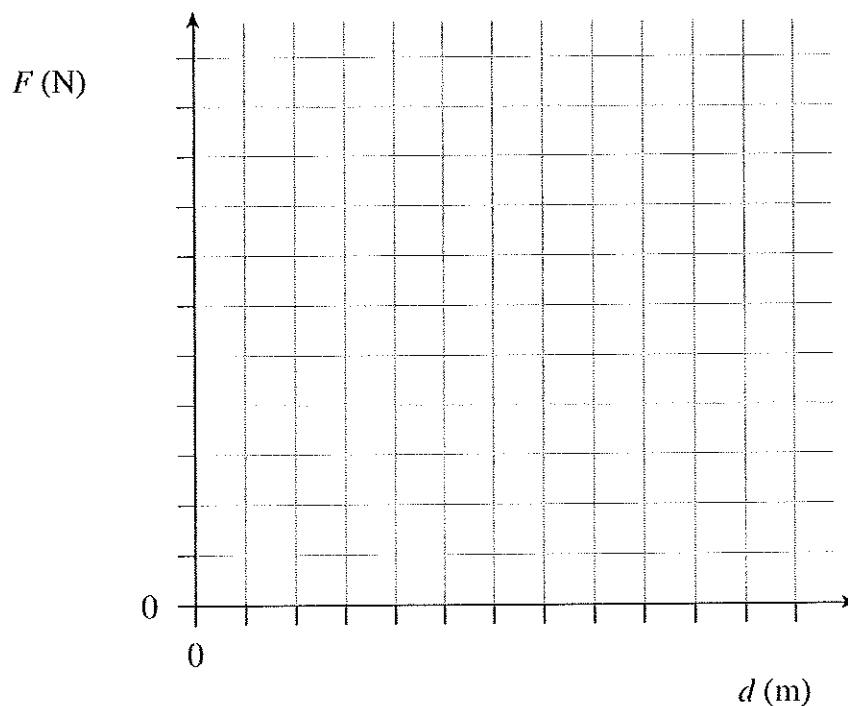
8. As a compound bow was drawn back, the applied forces and displacements were recorded.



F (N)	0	31	65	84	122	160	186	180	175	184	180
d (m)	0	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50

- a) Plot a force vs. displacement graph below.

(2 marks)



- b) How much energy was stored in this compound bow?
(3 marks)

AUG , 2001

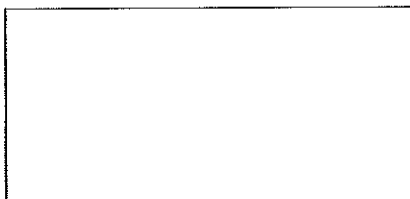
OVER

9. Two identical light bulbs, wired in parallel to a battery, are equally bright. When one of the bulbs burns out, however, the other bulb is observed to glow brighter. Using principles of physics, explain why the battery causes the remaining bulb to glow more brightly. (4 marks)

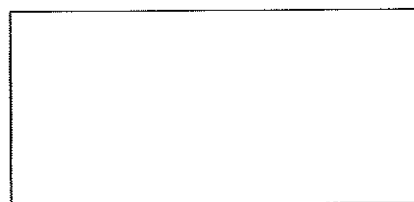
END OF EXAMINATION

AUG , 2001

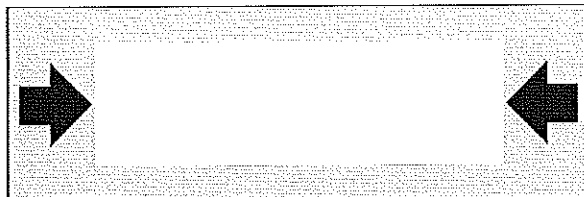
MINISTRY USE ONLY



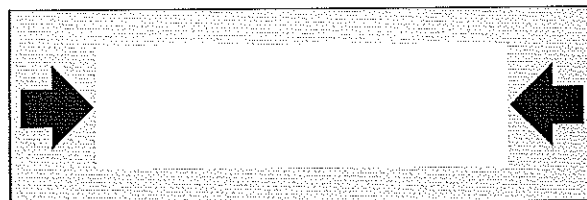
MINISTRY USE ONLY



Place Personal Education Number (PEN) here.



Place Personal Education Number (PEN) here.



**BRITISH
COLUMBIA**
© 2002 Ministry of Education

MINISTRY USE ONLY



Physics 12

JANUARY 2002

Course Code = PH

Student Instructions

1. Place the stickers with your Personal Education Number (PEN) in the allotted spaces above. **Under no circumstance is your name or identification, other than your Personal Education Number, to appear on this booklet.**
2. Ensure that in addition to this examination booklet, you have an **Examination Response Form**. Follow the directions on the front of the Response Form.
3. **Disqualification** from the examination will result if you bring books, paper, notes or unauthorized electronic devices into the examination room.
4. When instructed to open this booklet, **check the numbering of the pages** to ensure that they are numbered in sequence from page one to the last page, which is identified by

END OF EXAMINATION

.
5. At the end of the examination, place your Response Form inside the front cover of this booklet and return the booklet and your Response Form to the supervisor.

JAN , 2002

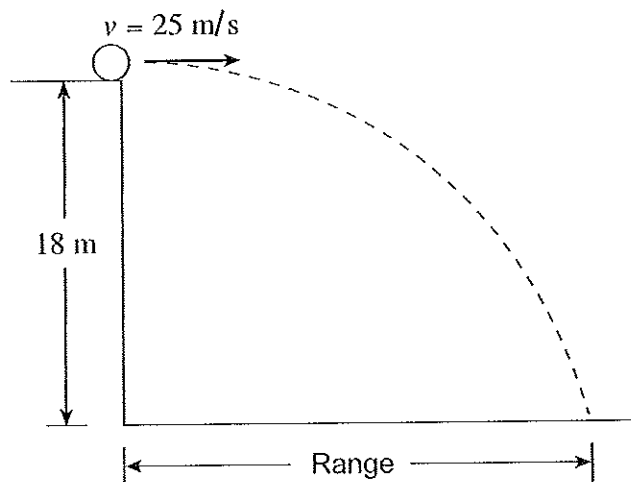
PART A: MULTIPLE CHOICE

Value: 60 marks (2 marks per question)

Suggested Time: 60 minutes

INSTRUCTIONS: For each question, select the best answer and record your choice on the Response Form provided. Using an HB pencil, completely fill in the circle that has the letter corresponding to your answer.

- Which of the following contains only scalar quantities?
 - mass, speed
 - mass, velocity
 - displacement, speed
 - displacement, velocity
- An airplane heads due north with an airspeed of 75 m/s. The wind is blowing due west at 18 m/s. What is the airplane's speed relative to the ground?
 - 57 m/s
 - 73 m/s
 - 77 m/s
 - 93 m/s
- What is the range of the projectile launched horizontally at 25 m/s from the 18 m-high cliff edge as shown in the diagram below?

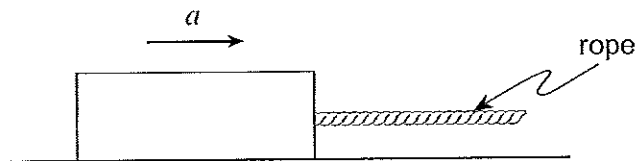


- 18 m
- 30 m
- 46 m
- 48 m


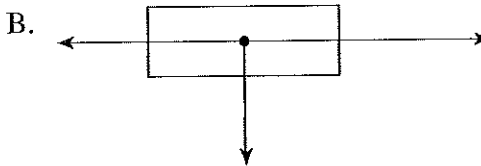

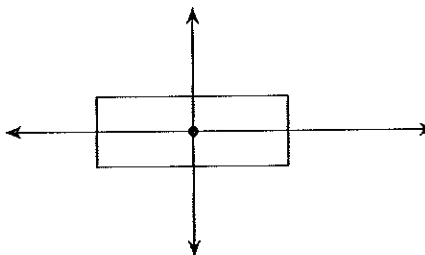
JAN , 2002

OVER

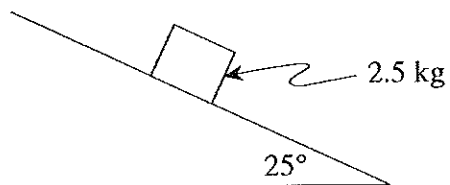
4. The block in the diagram below is being accelerated to the right across a rough surface by a force applied through the rope.



Which of the following best represents a free-body diagram for the block?

- A. 
- B. 
- C. 
- D. 

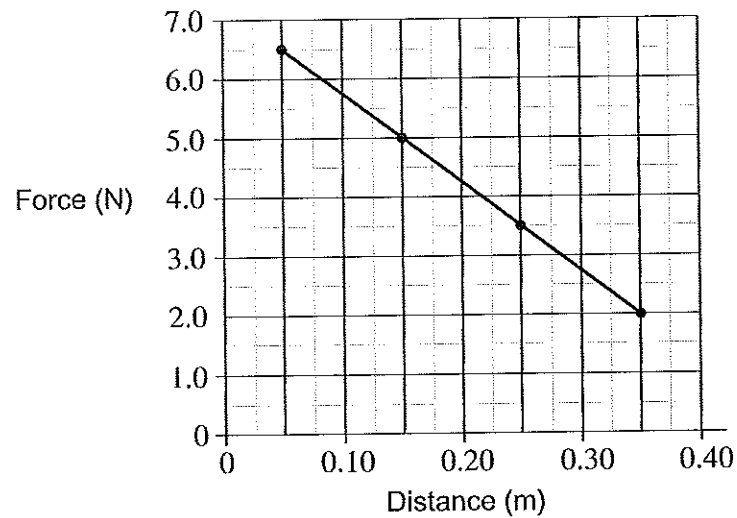
5. What is the normal force on the block in the diagram below?



- A. 0.0 N
B. 10 N
C. 22 N
D. 25 N

JAN , 2002

6. A student records the force used to move a block. The graph of his force and distance data is shown below.



What is the work done in moving the block from 0.050 m to 0.35 m?

- A. 0.68 J
 - B. 0.98 J
 - C. 1.3 J
 - D. 2.0 J
7. Which are correct units for change in momentum?

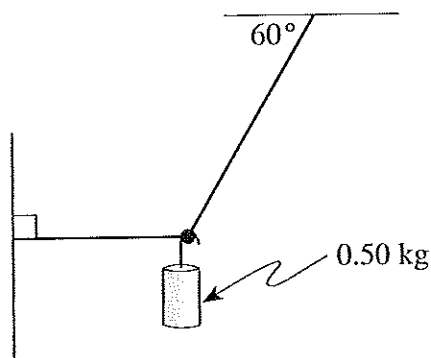
- A. $\text{N} \cdot \text{m}$
- B. $\text{N} \cdot \text{s}$
- C. $\text{kg} \cdot \frac{\text{s}}{\text{m}}$
- D. $\text{kg} \cdot \frac{\text{m}}{\text{s}^2}$

JAN , 2002

8. A 2.3 kg object moving due north at 17 m/s made contact with a barrier for 0.75 s, resulting in a final velocity of 12 m/s due east. What was the impulse on the object?

	MAGNITUDE OF IMPULSE	DIRECTION OF IMPULSE
A.	12 N·s	35° E of N
B.	12 N·s	35° E of S
C.	48 N·s	35° E of N
D.	48 N·s	35° E of S

9. A 0.50 kg mass is suspended as shown in the diagram.

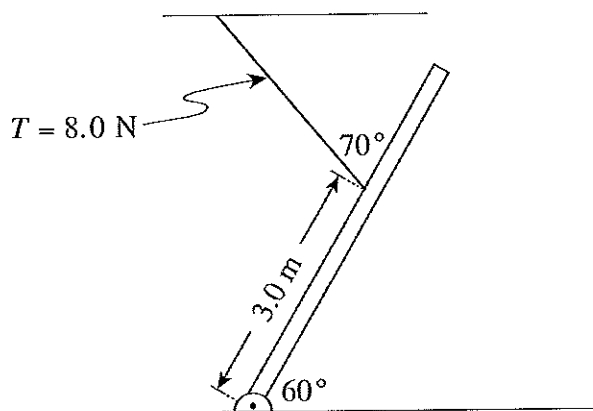


What is the tension in the horizontal string?

- A. 2.5 N
- B. 2.8 N
- C. 4.2 N
- D. 4.9 N

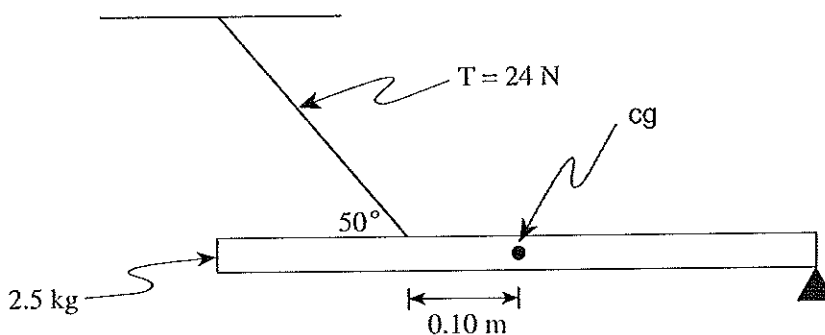
JAN , 2002

10. A 5.0 m-long uniform beam is held in position by a cord as shown in the diagram.



If the tension in the cord is 8.0 N, what is the weight of the beam?

- A. 4.8 N
B. 8.0 N
C. 9.6 N
D. 18 N
11. A uniform 2.5 kg beam, pivoted at its right end, is held in a horizontal position by a cable as shown in the diagram.



If the cable is attached 0.10 m to the left of the beam's centre of gravity, how long is the beam?

- A. 0.34 m
B. 0.60 m
C. 1.2 m
D. 9.6 m

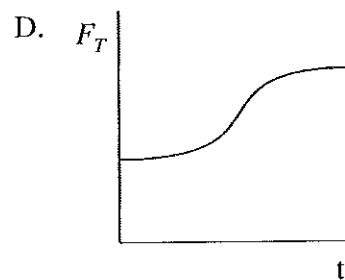
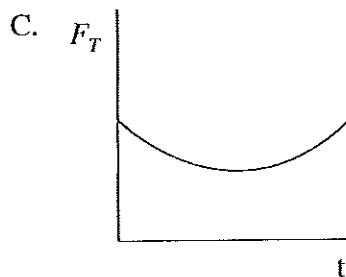
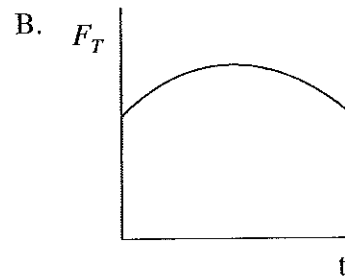
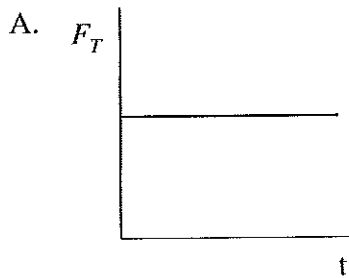
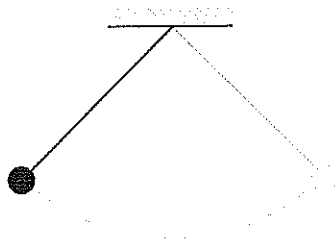
JAN , 2002

OVER

12. Which of the following best describes uniform circular motion?

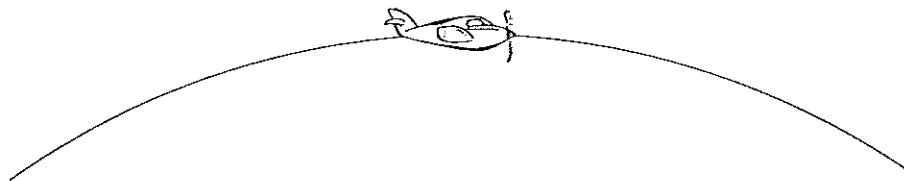
	SPEED	VELOCITY	ACCELERATION
A.	constant	constant	constant
B.	constant	constant	changing
C.	constant	changing	changing
D.	changing	changing	changing

13. As a simple pendulum swings from one side to the other, the tension in the supporting thread is best represented by which graph?



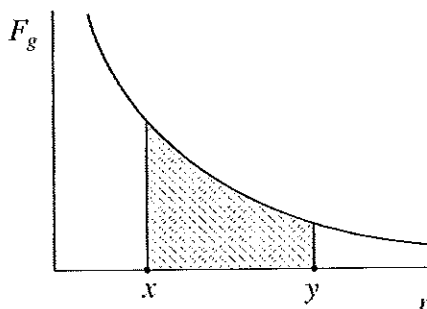
JAN , 2002

14. An aircraft flies in a vertical circular path of radius 2000 m. At the top of this path the 71 kg pilot feels lighter and experiences a 200 N upward force from the seat.



What is the speed of the aircraft?

- A. 75 m/s
 - B. 120 m/s
 - C. 140 m/s
 - D. 160 m/s
15. As an object moves from x to y , the shaded area below the graph of gravitational force versus distance of separation represents



- A. the gain in kinetic energy.
 - B. the energy released into space.
 - C. the work required to move the object.
 - D. the average force required to move the object.
16. A 75 kg astronaut stands on the surface of a planetoid with a mass of 5.8×10^{21} kg and a radius of 7.3×10^5 m. What is the gravitational field strength at the surface?
- A. 0.73 N/kg
 - B. 1.6 N/kg
 - C. 9.8 N/kg
 - D. 54 N/kg

JAN , 2002

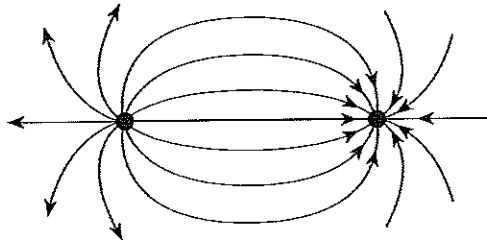
OVER

17. What minimum energy is required to raise a 1.7×10^3 kg vehicle from the surface of the Moon to a height of 5.22×10^6 m?

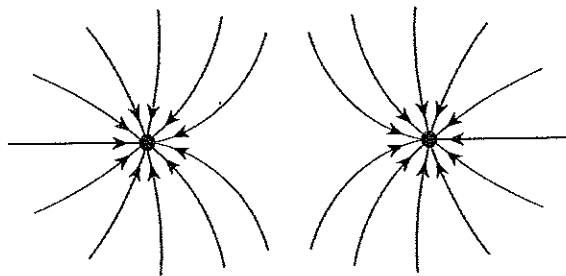
- A. 1.6×10^9 J
- B. 3.6×10^9 J
- C. 4.8×10^9 J
- D. 1.4×10^{10} J

18. Which of the following shows the electric field for two opposite unequal point charges?

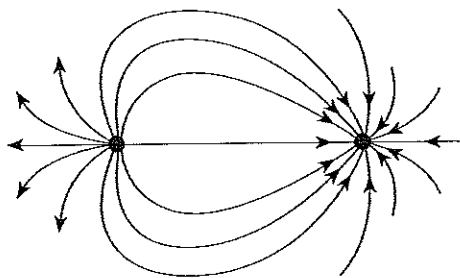
A.



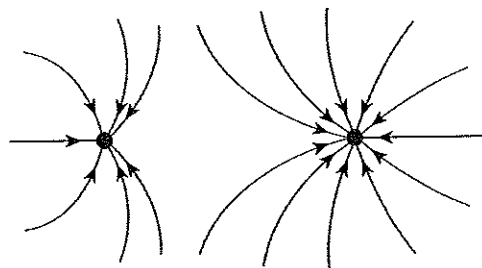
B.



C.

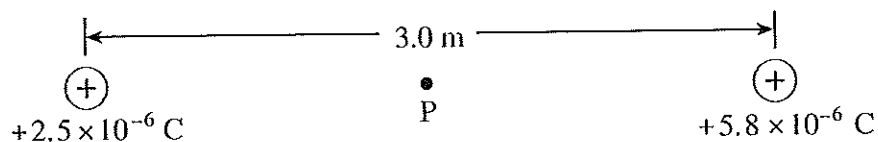


D.



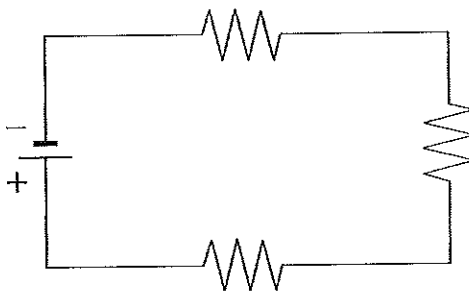
JAN , 2002

19. Two positive point charges are placed 3.0 m apart as shown.



What is the magnitude of the electric field at point P midway between the two charges?

- A. 0 N/C
 - B. 3 300 N/C
 - C. 13 000 N/C
 - D. 33 000 N/C
20. Examine the electric circuit below.



What is the direction of conventional current and electron flow in this circuit?

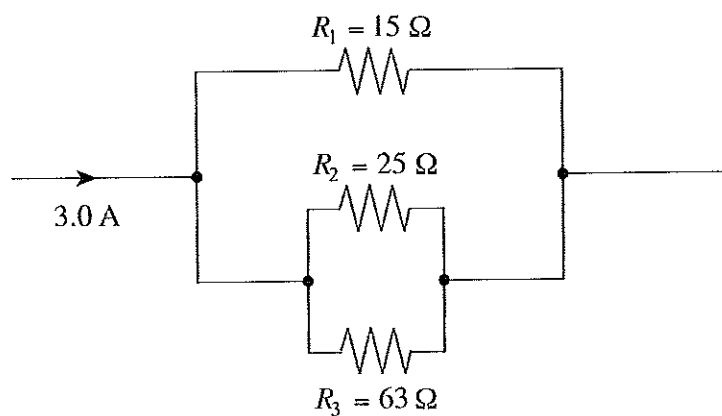
	CONVENTIONAL CURRENT	ELECTRON FLOW
A.	clockwise	clockwise
B.	clockwise	counter-clockwise
C.	counter-clockwise	clockwise
D.	counter-clockwise	counter-clockwise

JAN , 2002

21. A potential difference of 12 V causes 0.35 C of electric charge to pass through a resistor in 2.6 s. What power does the resistor dissipate?

A. 1.6 W
B. 4.2 W
C. 11 W
D. 89 W

22. The diagram below shows part of an electric circuit.



What is the current through resistor R_1 ?

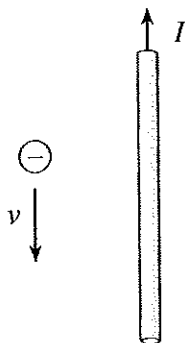
A. 1.0 A
B. 1.4 A
C. 1.6 A
D. 3.0 A

23. The direction of the magnetic field is the direction of force on a

A. north magnetic pole.
B. south magnetic pole.
C. positively charged particle.
D. negatively charged particle.

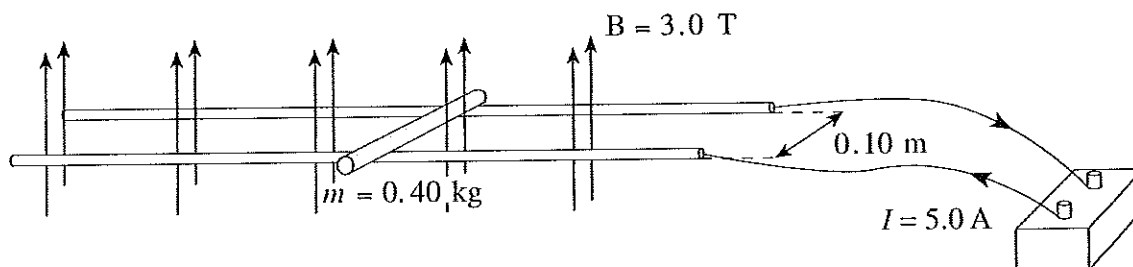
JAN , 2002

24. What is the direction of the magnetic force on an electron moving near a current-carrying wire as shown?



- A. left
- B. right
- C. into the page
- D. out of the page

25. A 0.40 kg metal slider is sitting on smooth conducting rails as shown below.



What is the magnitude and direction of the acceleration of the slider? (Ignore friction.)

	MAGNITUDE	DIRECTION
A.	0.42 m/s ²	left
B.	0.42 m/s ²	right
C.	3.8 m/s ²	left
D.	3.8 m/s ²	right

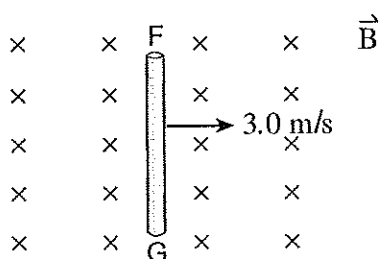
JAN , 2002

OVER

26. A 0.20 m long solenoid has 750 turns of copper wire and the magnetic field near its centre is measured to be 3.0×10^{-2} T. What is the current flowing through the solenoid?

- A. 1.6 A
- B. 6.4 A
- C. 32 A
- D. 160 A

27. A 0.050 m long conducting wire is moved through a 1.5 T magnetic field as shown below.

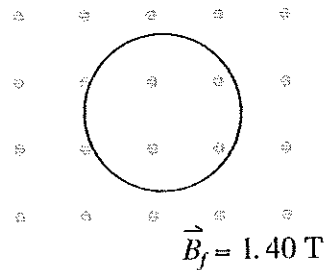
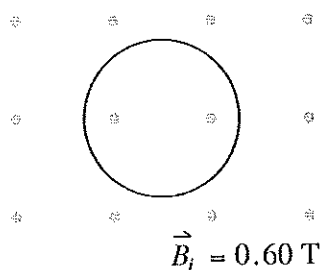


What is the magnitude of the emf generated between its ends, and in what direction do the electrons in the conductor initially move?

	EMF (V)	DIRECTION OF ELECTRON MOVEMENT
A.	0.23 V	towards F
B.	0.23 V	towards G
C.	4.5 V	towards F
D.	4.5 V	towards G

JAN , 2002

28. The circular loop of wire shown below has an area of 0.40 m^2 and is in a 0.60 T magnetic field. This field is increased to 1.40 T in 0.25 s .



Determine the emf produced in the loop and the direction of current.

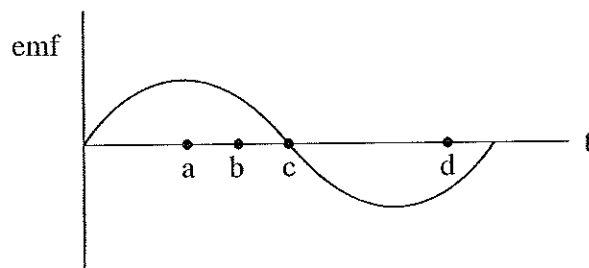
	EMF (V)	DIRECTION OF CURRENT
A.	1.3 V	clockwise
B.	1.3 V	counter-clockwise
C.	3.2 V	clockwise
D.	3.2 V	counter-clockwise

29. The load on an electric motor is gradually increased. Which one of the following quantities decreases? (Input voltage remains constant.)

- A. current
- B. back emf
- C. armature resistance
- D. heat produced by armature

JAN , 2002

30. The graph below shows how the emf produced by an ac generator varies with time. At which point in time is the rate of flux change in the generator the greatest?

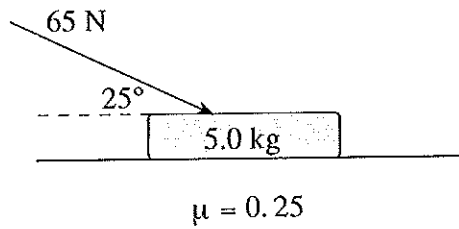


- A. a
- B. b
- C. c
- D. d

JAN , 2002

This is the end of the multiple-choice section.
Answer the remaining questions directly in this examination booklet.

1. A 65 N force is applied to a 5.0 kg object as shown.



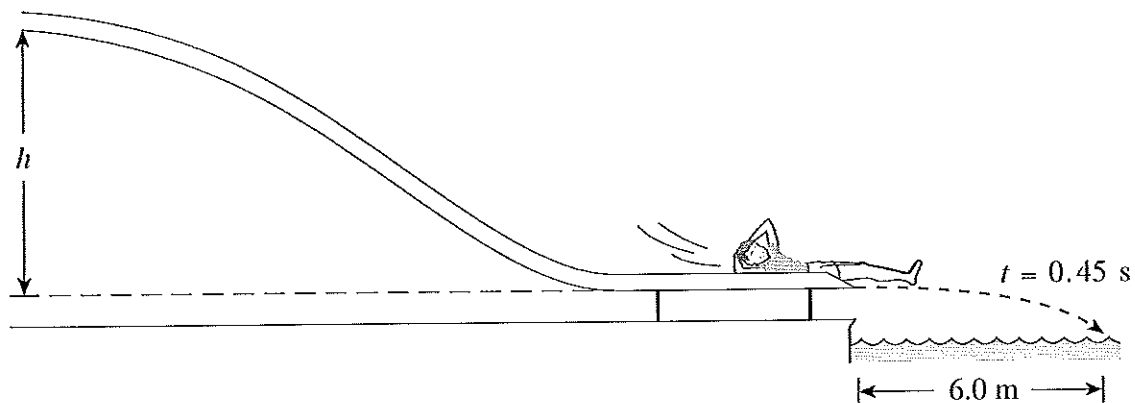
The coefficient of friction between the object and the horizontal surface is 0.25.

- a) Draw and label a free body diagram showing the forces acting on the object. (2 marks)

- b) *What is the acceleration of the object?*
(5 marks)

JAN . 2002

2. A water slide is made so that swimmers, starting from rest at the top, leave the end of the slide travelling horizontally as shown.



One person is observed to hit the water at a horizontal distance of 6.0 m from the end of the slide 0.45 s after leaving the slide. The effects of friction and air resistance are negligible.

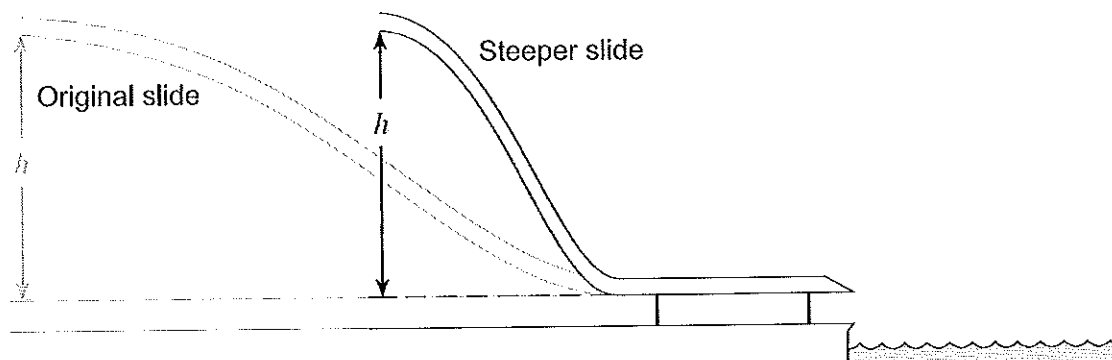
- a) From what vertical height, h , did the person start? (5 marks)

JAN , 2002

ANSWER:

a) height: _____

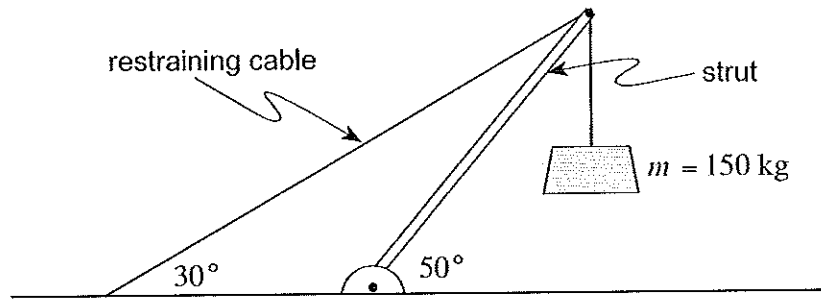
- b) Another slide has the same vertical height, h , as the original slide, but has a much steeper slide angle.



The same person is observed to go down this steep slide. Using principles of physics, explain how the new horizontal distance from the edge of the slide compares with the first situation. The effects of friction and air resistance are negligible. (4 marks)

JAN , 2002

3. The crane shown in the diagram below is made up of a strut and a restraining cable. The strut is uniform in cross section with a length of 6.0 m and a mass of 85 kg.



What is the tension in the restraining cable while the crane is supporting a 150 kg load?
(7 marks)

JAN , 2002

4. What minimum energy is required to take a stationary 3.5×10^3 kg satellite from the surface of the Earth and put it into a circular orbit with a radius of 6.88×10^6 m and an orbital speed of 7.61×10^3 m/s? (Ignore Earth's rotation.) (7 marks)

JAN , 2002

5. A 12 V battery from a car is used to operate a 65 W headlight.

a) How much energy does the headlight use in 1.5 hours?

(2 marks)

ANSWER:

a) energy: _____

b) What total charge passes through the headlight during this time?

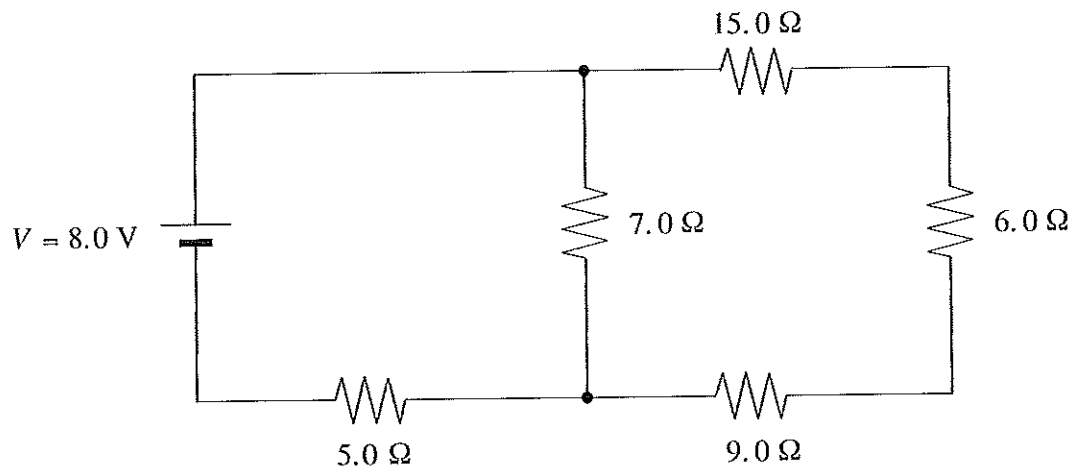
(3 marks)

c) What is the total number of electrons that pass through the headlight during this time period? (2 marks)

ANSWER:

b) total charge: _____

6. What is the potential difference across the $6.0\ \Omega$ resistor in the circuit shown? (7 marks)



JAN . 2002

7. A proton travelling at 2200 m/s enters a 0.15 T magnetic field perpendicularly.

- a) What is the magnitude of the proton's acceleration while travelling through the magnetic field? (4 marks)

b) What is the radius of the proton's circular path while travelling through the magnetic field? (3 marks)

JAN , 2002

ANSWER:

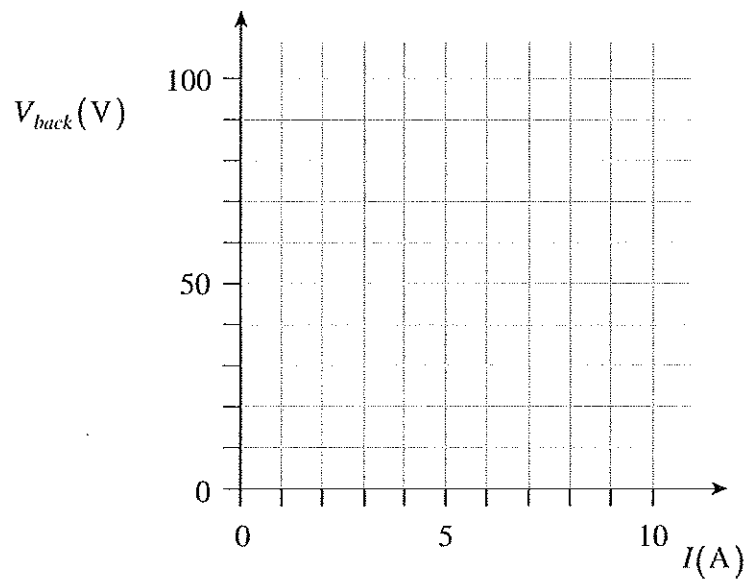
a) magnitude of acceleration: _____

8. A constant voltage is applied to an electric motor being used to lift a series of masses onto a truck. The current through the motor and its back emf are recorded for each different load. This data is shown below.

$I(\text{A})$	$V_{\text{back}}(\text{V})$
1.5	98
3.5	84
5.0	76
6.0	70
8.0	54

- a) Plot the data on the graph below and draw the best fit straight line.

(2 marks)



JAN . 2002

b) Determine the magnitude of the slope of the line.

(1 mark)

ANSWER:

b) magnitude of the slope: _____

c) What does the magnitude of the slope of this line represent?

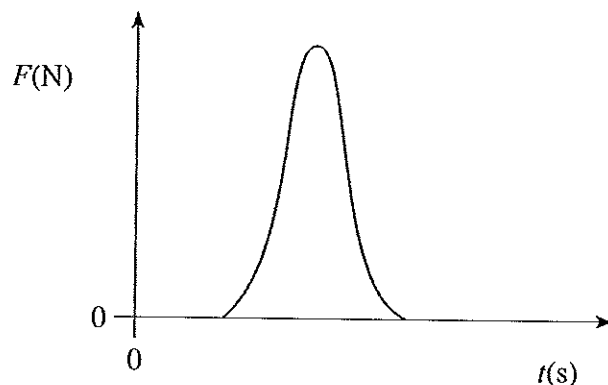
(2 marks)

ANSWER:

c) magnitude of the slope represents:

JAN . 2002

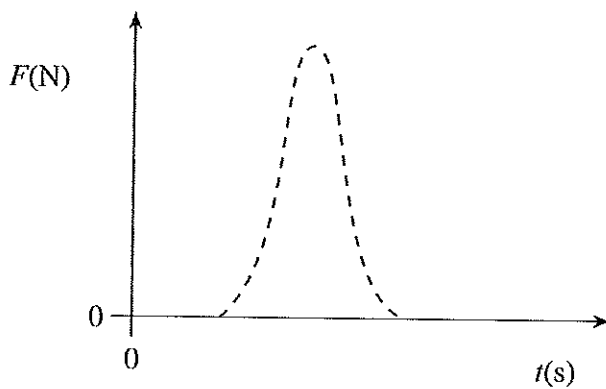
9. In sports such as golf, tennis and baseball, a player exerts a force over a time interval on a ball, as shown on the graph, in order to give it a high speed.



Players are instructed to “follow through” on their swing. A weaker player may not exert as large a force but may give the ball a higher speed than a stronger player.

- a) Sketch on the graph below how a weaker player can overcome the force handicap.

(1 mark)

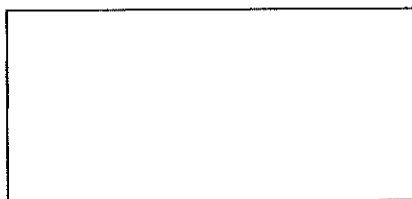


- b) Explain how the player can impart a greater impulse on a ball.

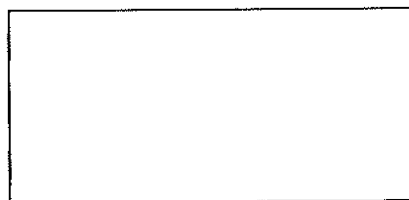
(3 marks)

END OF EXAMINATION

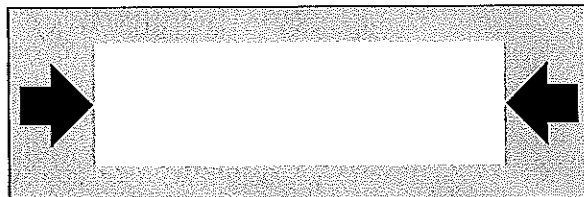
MINISTRY USE ONLY



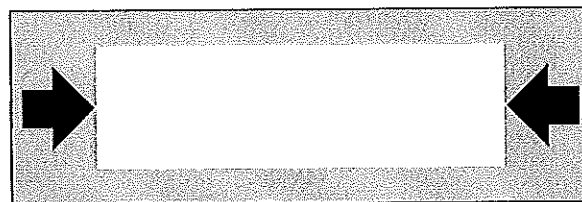
MINISTRY USE ONLY



Place Personal Education Number (PEN) here.



Place Personal Education Number (PEN) here.



**BRITISH
COLUMBIA**
© 2002 Ministry of Education

MINISTRY USE ONLY



Physics 12

JUNE 2002

Course Code = PH

Student Instructions

1. Place the stickers with your Personal Education Number (PEN) in the allotted spaces above. **Under no circumstance is your name or identification, other than your Personal Education Number, to appear on this booklet.**
2. Ensure that in addition to this examination booklet, you have an **Examination Response Form**. Follow the directions on the front of the Response Form.
3. **Disqualification** from the examination will result if you bring books, paper, notes or unauthorized electronic devices into the examination room.
4. When instructed to open this booklet, **check the numbering of the pages** to ensure that they are numbered in sequence from page one to the last page, which is identified by **END OF EXAMINATION**.
5. At the end of the examination, place your Response Form inside the front cover of this booklet and return the booklet and your Response Form to the supervisor.

530

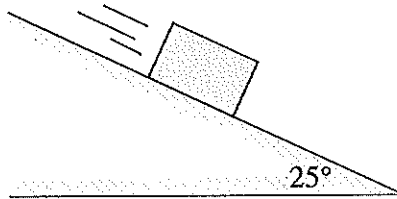
PART A: MULTIPLE CHOICE

Value: 60 marks (2 marks per question)

Suggested Time: 60 minutes

INSTRUCTIONS: For each question, select the **best** answer and record your choice on the Response Form provided. Using an HB pencil, completely fill in the circle that has the letter corresponding to your answer.

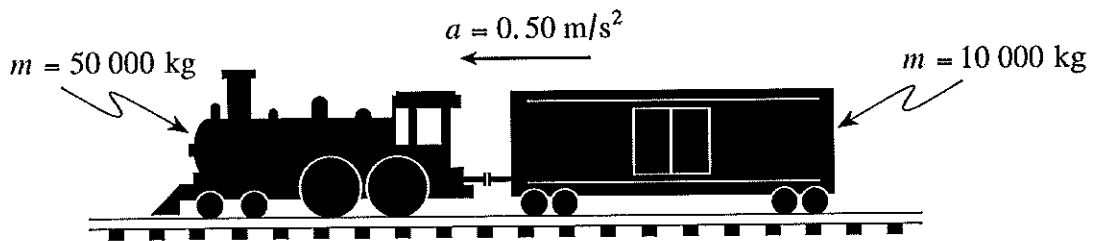
1. A 1.5 kg block slides down the incline at a constant speed.



What is the net force on this block?

- A. 0 N
- B. 6.2 N
- C. 13 N
- D. 15 N

2. A locomotive pulling a freight car accelerates at 0.50 m/s^2 as shown in the diagram.

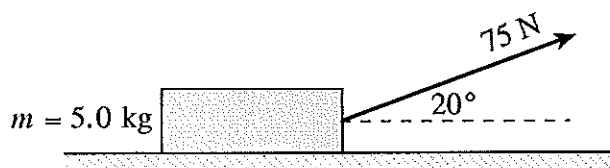


What is the tension in the coupling linking the locomotive and car? (Ignore friction.)

- A. 5 000 N
- B. 25 000 N
- C. 30 000 N
- D. 390 000 N

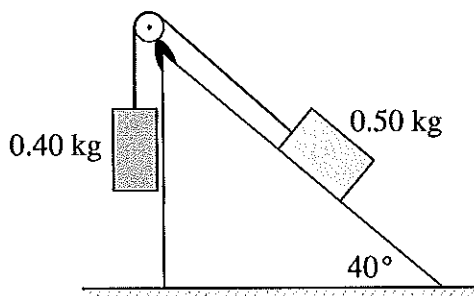
JUN -- 2002

3. A 5.0 kg block is being pulled to the right by a 75 N force.



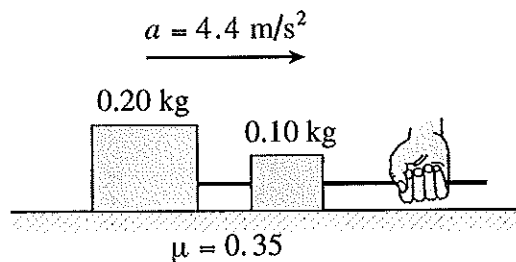
What is the normal force on this block?

- A. 23 N
 - B. 26 N
 - C. 49 N
 - D. 75 N
4. Two masses are connected by a string as shown in the diagram.



What is the magnitude of the acceleration of these masses? (Ignore friction.)

- A. 0.11 m/s^2
 - B. 0.19 m/s^2
 - C. 0.86 m/s^2
 - D. 1.1 m/s^2
5. The system of blocks shown in the diagram below is being accelerated to the right at 4.4 m/s^2 .

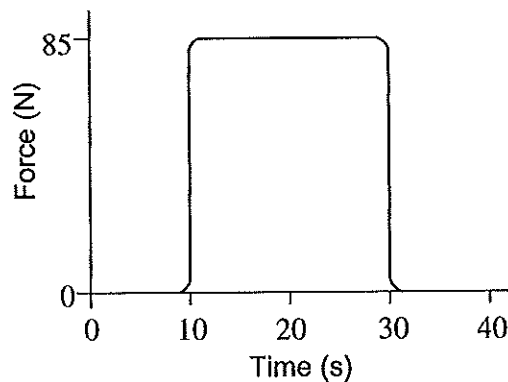


What pulling force is applied by the hand?

- A. 0.3 N
- B. 1.0 N
- C. 1.3 N
- D. 2.3 N

JUN -- 2002

6. A 15 kg cement-filled bucket is raised to a vertical height of 5.0 m in 4.2 s by a motor drawing 373 W of power. What is the efficiency of this lifting system?
- A. 4.8%
B. 47%
C. 51%
D. 84%
7. An object moving due east at 15 m/s collides with a wall. As a result, the object moves due west at 15 m/s. Which of the following best describes the collision?
- A. elastic collision
B. inelastic collision
C. total momentum is increased
D. total momentum is decreased
8. A 5.0 kg model vehicle travelling at 14 m/s experiences a rocket boost of 85 N (in the direction of motion) for 20 s as shown on the graph.



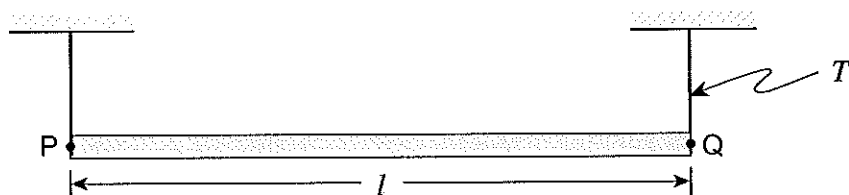
What is the resulting speed?

- A. 23 m/s
B. 30 m/s
C. 340 m/s
D. 350 m/s

JUN -- 2002

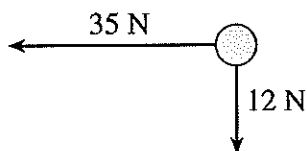
9. A 4.0 kg object moving due east at 15 m/s collides with and sticks onto a 12 kg object moving due south at 5.0 m/s. What is the resulting speed of the combined objects?
- A. 5.3 m/s
B. 10 m/s
C. 16 m/s
D. 20 m/s

10. A beam is suspended by cords from its ends as shown.



If the tension in the right hand cord is T , what is the sum of the torques about point P?

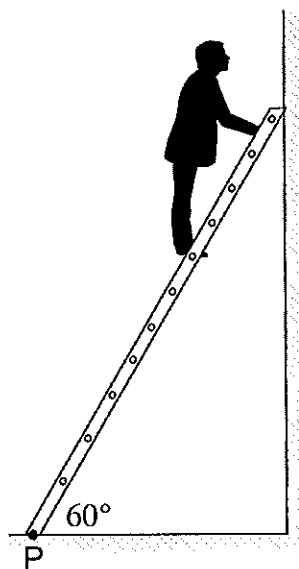
- A. $0 \text{ N} \cdot \text{m}$
B. $T \cdot l$
C. $T \cdot l/2$
D. $\frac{T}{l}$
11. Two forces act on an object as shown in the diagram below.



What are the magnitude and direction of a third force needed to keep the object in equilibrium?

	MAGNITUDE OF FORCE	DIRECTION OF FORCE
A.	37 N	19° below the horizontal
B.	37 N	19° above the horizontal
C.	47 N	19° below the horizontal
D.	47 N	19° above the horizontal

12. A 65 kg person is $\frac{3}{4}$ of the way up the 4.0 m ladder as shown in the diagram below.

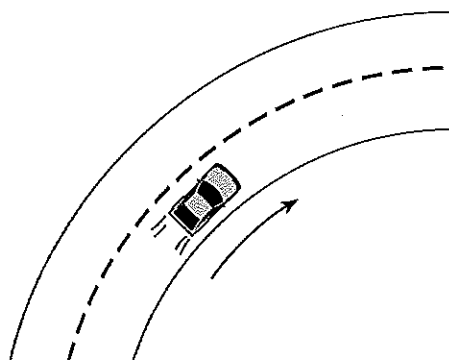


What are the magnitude and direction of the torque about the base of the ladder at P produced by the person?

	MAGNITUDE OF TORQUE	DIRECTION OF TORQUE
A.	$9.6 \times 10^2 \text{ N} \cdot \text{m}$	clockwise
B.	$9.6 \times 10^2 \text{ N} \cdot \text{m}$	counter-clockwise
C.	$1.9 \times 10^3 \text{ N} \cdot \text{m}$	clockwise
D.	$1.9 \times 10^3 \text{ N} \cdot \text{m}$	counter-clockwise

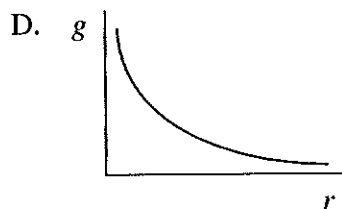
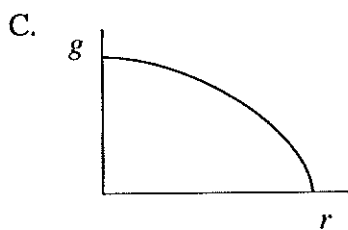
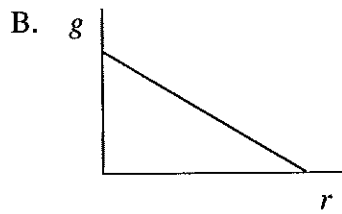
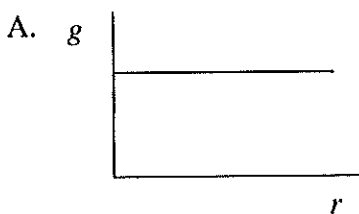
JUN -- 2002

13. A car is moving at a constant speed around a circular curve. Which of the following best describes this situation?

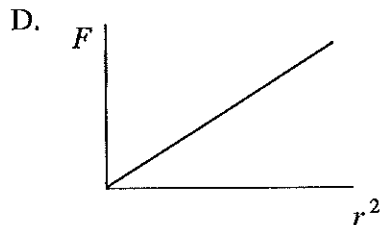
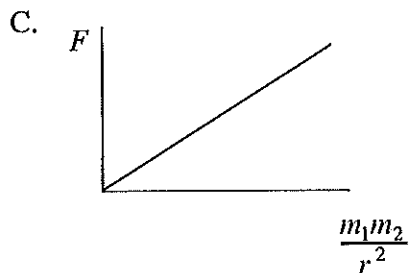
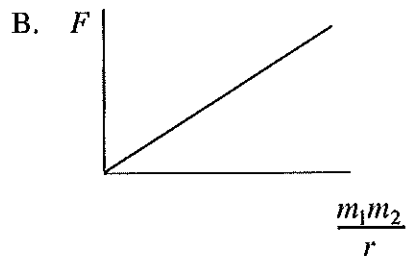
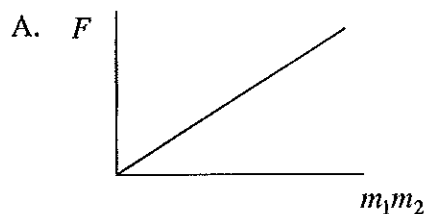


	VELOCITY OF CAR	ACCELERATION OF CAR	NET FORCE ON CAR
A.			
B.			
C.			
D.			

14. Which of the following best illustrates how the gravitational field strength of a body varies with distance r from the body's centre?



15. Which of the following graphs has a slope equal to the gravitational constant, G ?



16. What is the gravitational force exerted on a 63 kg student by her 1400 kg car when their centres are 7.0 m apart?

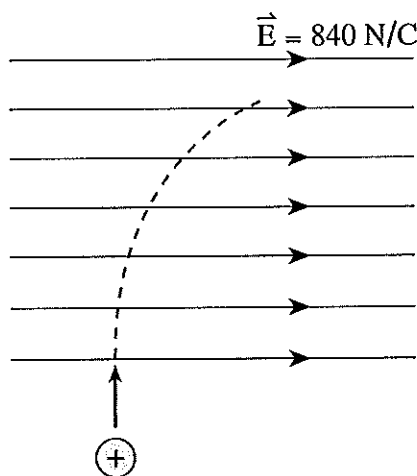
- A. 8.6×10^{-11} N
- B. 1.9×10^{-9} N
- C. 1.2×10^{-7} N
- D. 1.8×10^3 N

17. A satellite orbits the earth with a speed of 7.3×10^3 m/s. What is the distance from the centre of the earth to this satellite?

- A. 2.3×10^5 m
- B. 3.8×10^6 m
- C. 7.5×10^6 m
- D. 1.3×10^7 m

JUN -- 2009

18. At an altitude of 1.3×10^7 m above the surface of the earth an incoming meteor of mass 1.0×10^6 kg has a speed of 6.5×10^3 m/s. What would be the speed just before impact with the surface of the earth? Ignore air resistance.
- A. 9.1×10^3 m/s
B. 1.0×10^4 m/s
C. 1.1×10^4 m/s
D. 1.7×10^4 m/s
19. Which of the following are correct units for electric potential?
- A. J/s
B. J/C
C. N/m
D. N/C
20. A proton beam is fired into a uniform electric field. The protons follow a parabolic path as shown.

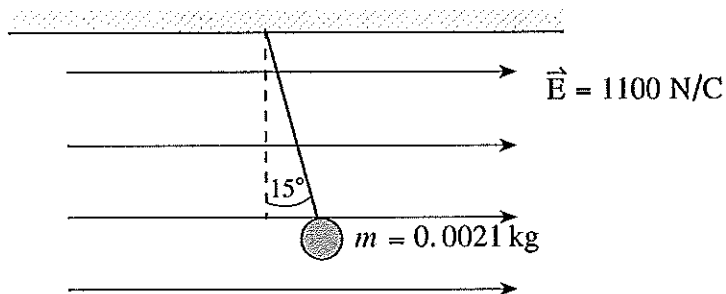


What is the acceleration of these protons?

- A. $1.3 \times 10^{-16} \text{ m/s}^2$
B. $8.0 \times 10^{10} \text{ m/s}^2$
C. $1.5 \times 10^{14} \text{ m/s}^2$
D. $5.0 \times 10^{29} \text{ m/s}^2$

JUN -- 2002

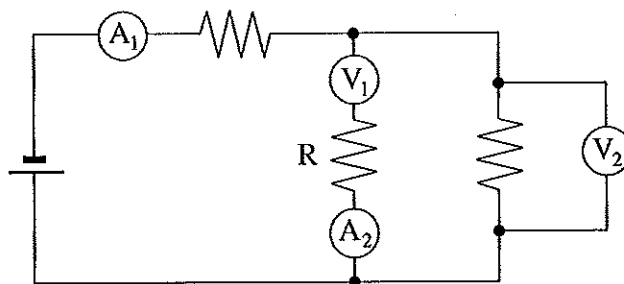
21. A small 0.0021 kg plastic ball is suspended by a string in a uniform electric field as shown.



If the string makes an angle of 15° with the vertical, as indicated, what is the charge on the ball?

- A. $4.8 \times 10^{-6} \text{ C}$
- B. $5.0 \times 10^{-6} \text{ C}$
- C. $1.9 \times 10^{-5} \text{ C}$
- D. $5.5 \times 10^{-3} \text{ C}$

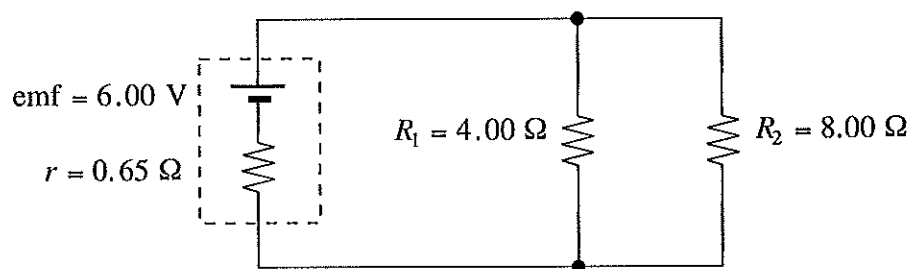
22. Which of the following meter placements would allow you to measure the current through and electric potential difference across resistor, R ?



	AMMETER	VOLTMETER
A.	A_1	V_1
B.	A_2	V_1
C.	A_1	V_2
D.	A_2	V_2

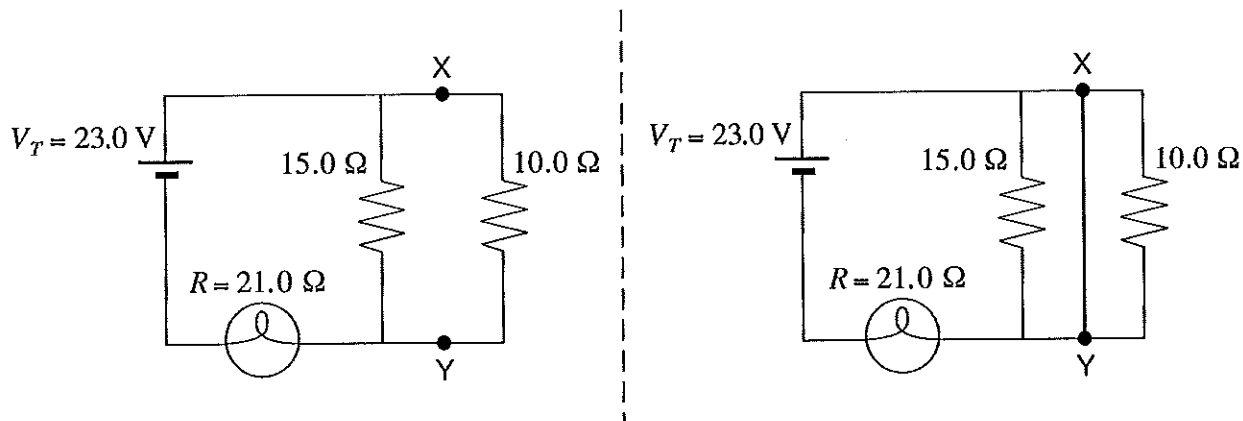
JUN -- 2002

23. What current flows through the $4.00\ \Omega$ resistor in the following circuit?



- A. $0.47\ \text{A}$
- B. $1.2\ \text{A}$
- C. $1.3\ \text{A}$
- D. $1.5\ \text{A}$

24. A circuit is made from two resistors and a light bulb as shown on the left. A short time later a copper wire is connected across points X and Y as shown on the right diagram.

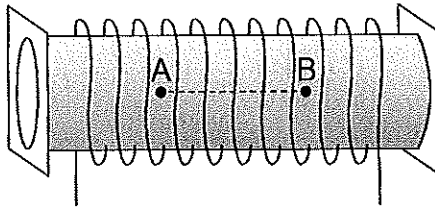


What is the current through the light bulb and what happens to the brightness of the bulb when the wire is connected?

	CURRENT	BRIGHTNESS OF BULB
A.	$0.64\ \text{A}$	dimmer
B.	$0.64\ \text{A}$	brighter
C.	$1.10\ \text{A}$	dimmer
D.	$1.10\ \text{A}$	brighter

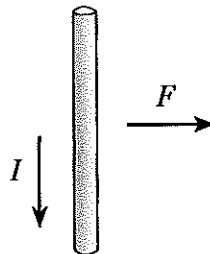
JUN -- 2002

25. Which of the following best describes the magnetic field inside a current-carrying solenoid as you move from A to B.



	DIRECTION	MAGNITUDE
A.	constant	constant
B.	constant	changing
C.	changing	constant
D.	changing	changing

26. A section of conductor is carrying a current due south, as shown below.



Due to the presence of a magnetic field, the conductor experiences a magnetic force to the right. What is the direction of the magnetic field?

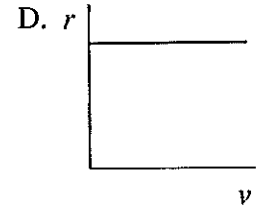
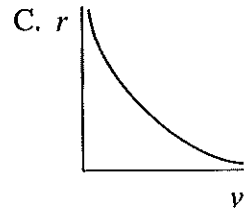
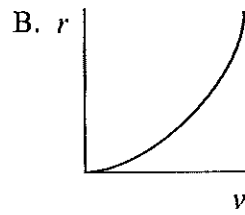
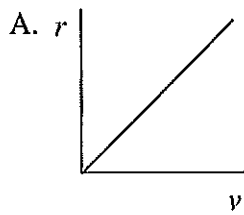
- A. left
- B. right
- C. into the page
- D. out of the page

JUN -- 2002

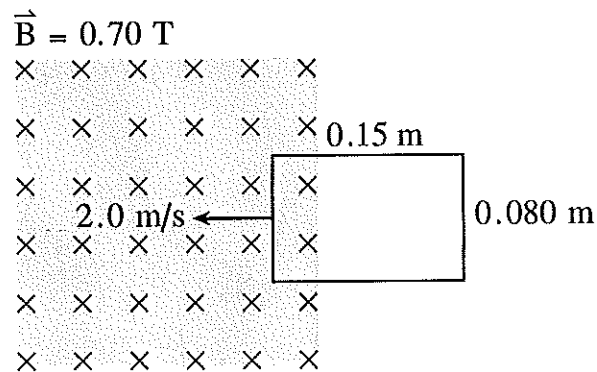
OVER

541

27. A charged mass is accelerated to various speeds and then passed through a perpendicular magnetic field. Which of the graphs below is the best representation of how the radius of its circular path through the magnetic field varies with speed?



28. The single rectangular loop shown below is being pulled into the magnetic field at 2.0 m/s. Determine the emf developed in the loop.



- A. 0.017 V
B. 0.11 V
C. 0.21 V
D. 0.64 V

JUN -- 2002

29. You are using an electric drill to put a hole in a piece of wood when it hits a tough spot. The drill slows down and its motor heats up. Which of the choices below describes what has happened to the back emf and current?

	BACK EMF	CURRENT
A.	increased	increased
B.	decreased	decreased
C.	increased	decreased
D.	decreased	increased

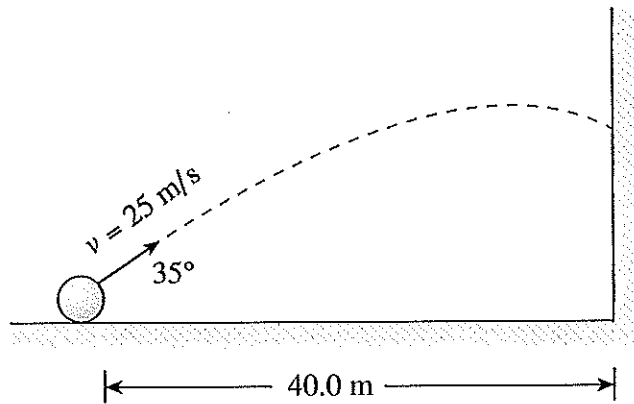
30. Which of the following combinations in the primary coil of an ideal transformer causes an emf to be developed in the secondary coil?

	CURRENT	MAGNETIC FIELD
A.	constant	constant
B.	constant	changing
C.	changing	constant
D.	changing	changing

JUN -- 2002

**This is the end of the multiple-choice section.
Answer the remaining questions directly in this examination booklet.**

1. A projectile is launched towards a wall as shown in the diagram below.

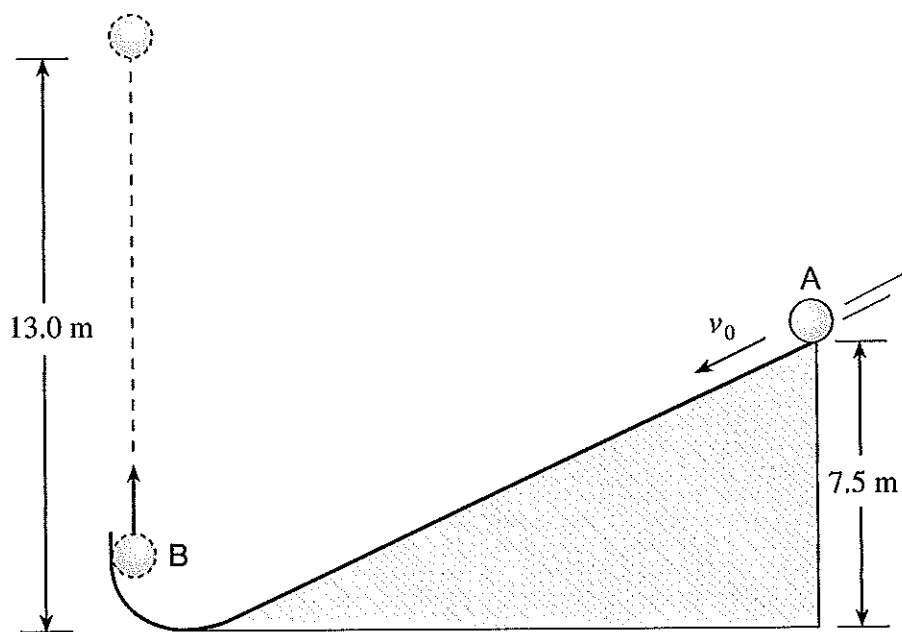


With what velocity (magnitude and direction) does the projectile hit the wall?

(7 marks)

2. A 0.50 kg ball starting from position A which is 7.5 m above the ground, is projected down an incline as shown. Friction produces 10.7 J of heat energy.

The ball leaves the incline at position B travelling straight upward and reaches a height of 13.0 m above the floor before falling back down.



What was the initial speed, v_0 , at position A? Ignore air resistance.

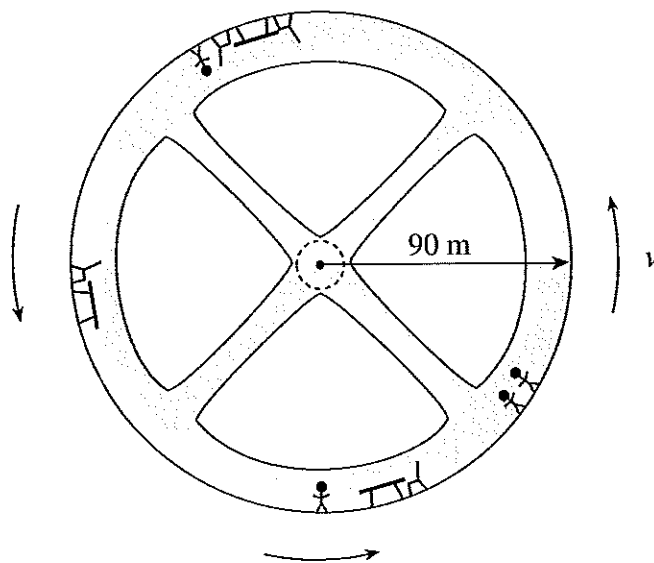
(7 marks)

-
- Diagram of a beam AB of length 10 m, hinged at A and supported by a cable at B. The cable is attached to a wall at C, forming a 30° angle with the horizontal and a 40° angle with the beam. A weight W is suspended from B.

546

JUN 11 2002

4. A space station of radius 90 m is rotating to simulate a gravitational field.



- a) What is the period of the space station's rotation so that a 70 kg astronaut will experience a normal force by the outer wall equal to 60% of his weight on the surface of the earth?
(5 marks)

ANSWER:

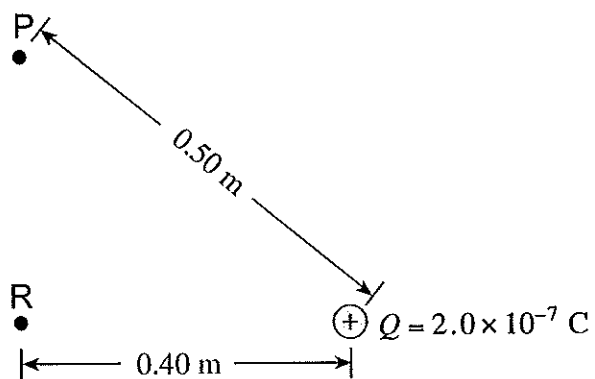
a) period of rotation: _____

547

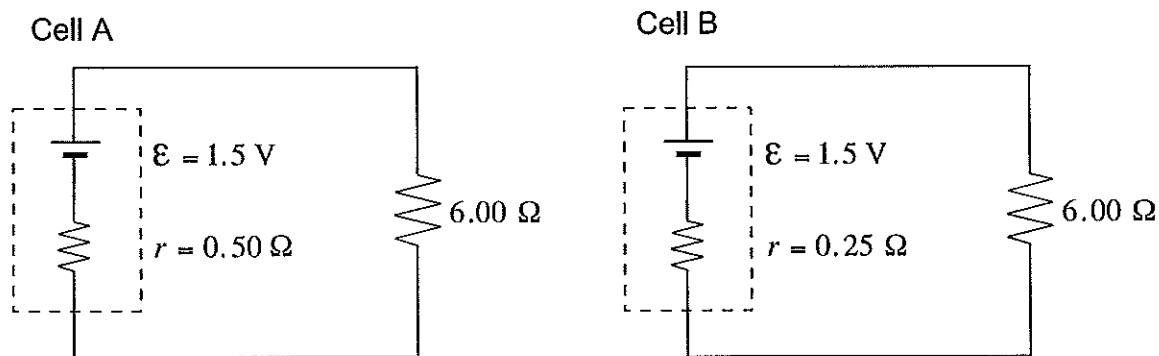
JUN -- 2002

- b) What would be the effect experienced by the astronaut if the space station rotated faster so that the period of rotation was decreased? Explain your predicted effect. **(4 marks)**

5. What is the electric potential difference between points P and R due to the fixed point charge Q ? (7 marks)

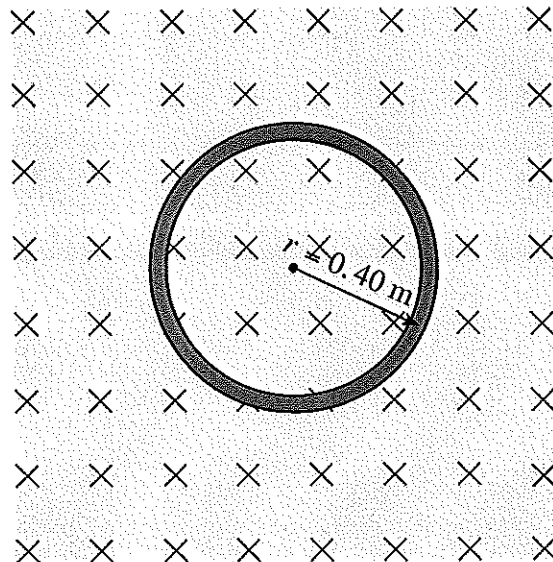


6. Each of the two cells shown is connected to an external $6.00\ \Omega$ resistor.



With supporting calculations, state which cell delivers the greater power to the $6.00\ \Omega$ resistor.
(7 marks)

7. A coil of wire containing 50 loops is lying on a flat surface in a 0.60 T magnetic field pointing directly into the surface.



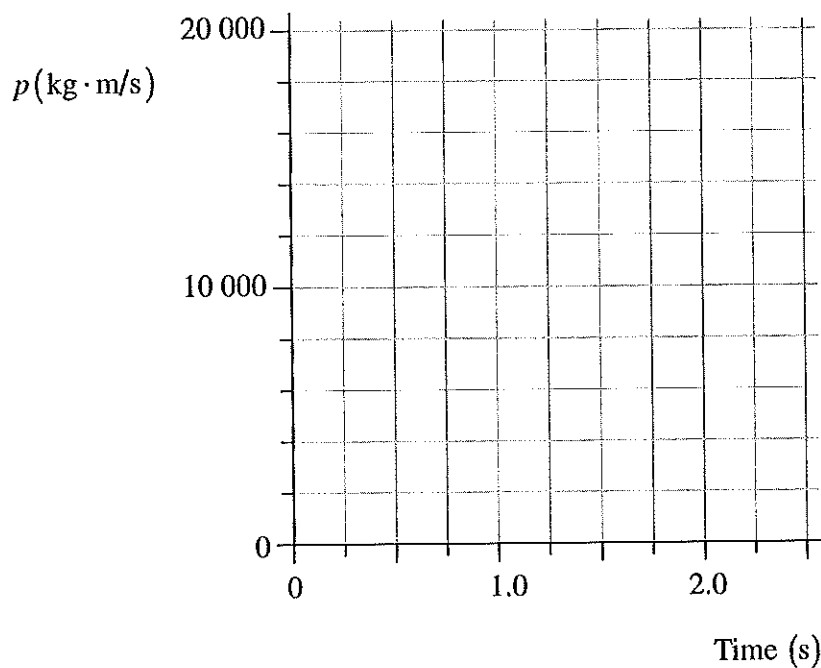
The magnetic field then changes to a value of 0.10 T in the opposite direction in 2.10 s . What is the average emf induced in the coil during the time that the magnetic field was changing? (7 marks)

8. As a formula one race car accelerates uniformly from rest, its momentum is recorded at regular time intervals. This data is shown below.

Time (s)	$p(\text{kg} \cdot \text{m/s})$
0.50	3 800
1.0	8 300
1.5	11 500
2.0	16 800
2.5	19 000

- a) Plot the data on the graph below and draw the best fit straight line.

(2 marks)



b) Determine the slope of the line (include units).

(1 mark)

ANSWER:

b) slope: _____

c) What does the slope of this line represent?

(2 marks)

ANSWER:

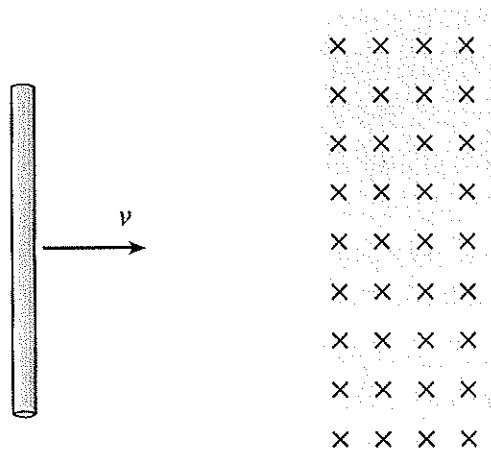
c) slope represents: _____

JUN -- 2002

553

OVER

9. A steel rod passes through a region where a magnetic field exists.



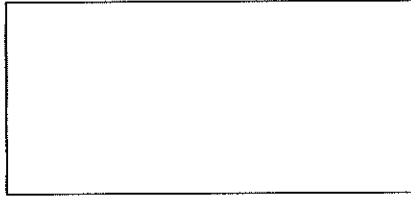
The rod slows as it passes through the magnetic field. Using principles of physics, explain why this happens. (4 marks)

END OF EXAMINATION

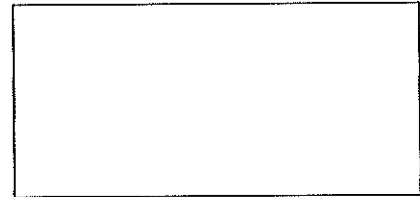
554

JUN -- 2002

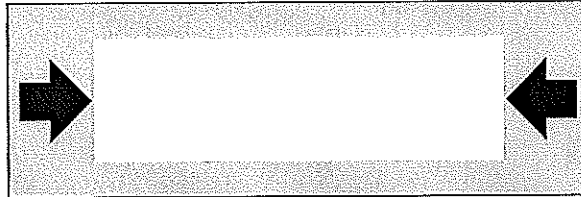
MINISTRY USE ONLY



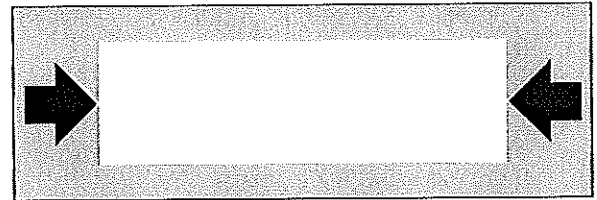
MINISTRY USE ONLY



Place Personal Education Number (PEN) here.



Place Personal Education Number (PEN) here.



MINISTRY USE ONLY



**BRITISH
COLUMBIA**
© 2002 Ministry of Education

Physics 12

AUGUST 2002

Course Code = PH

Student Instructions

1. Place the stickers with your Personal Education Number (PEN) in the allotted spaces above. **Under no circumstance is your name or identification, other than your Personal Education Number, to appear on this booklet.**
2. Ensure that in addition to this examination booklet, you have an **Examination Response Form**. Follow the directions on the front of the Response Form.
3. **Disqualification** from the examination will result if you bring books, paper, notes or unauthorized electronic devices into the examination room.
4. When instructed to open this booklet, **check the numbering of the pages** to ensure that they are numbered in sequence from page one to the last page, which is identified by
END OF EXAMINATION.
5. At the end of the examination, place your Response Form inside the front cover of this booklet and return the booklet and your Response Form to the supervisor.

555

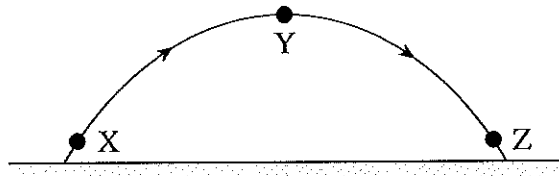
PART A: MULTIPLE CHOICE

Value: 60 marks (2 marks per question)

Suggested Time: 60 minutes

INSTRUCTIONS: For each question, select the best answer and record your choice on the Response Form provided. Using an HB pencil, completely fill in the circle that has the letter corresponding to your answer.

1. Consider three points in the path of a certain projectile as shown in the diagram below.



What is the acceleration of the projectile at each of these points?

ACCELERATION (m/s^2)			
	At X	At Y	At Z
A.	+9.8	0	-9.8
B.	+9.8	0	+9.8
C.	-9.8	0	-9.8
D.	-9.8	-9.8	-9.8

2. A projectile is launched over level ground with an initial velocity of 65 m/s at 30° above the horizontal. What is the projectile's time of flight?

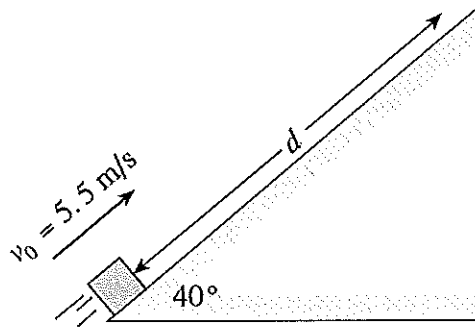
- A. 3.6 s
- B. 6.6 s
- C. 11 s
- D. 13 s

AUG -- 2002

556

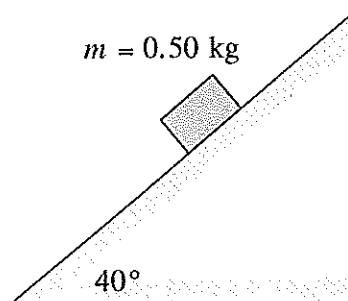
OVER

3. A block is launched up the frictionless incline in the diagram below with an initial speed of 5.5 m/s.



What is the maximum displacement, d , of the block up the incline?

- A. 0.44 m
 - B. 0.87 m
 - C. 1.5 m
 - D. 2.4 m
4. Which of the following are units for gravitational field strength?
- A. kg/m
 - B. $\text{kg} \cdot \text{m/s}^2$
 - C. N/kg
 - D. N/kg^2
5. The block shown in the diagram below remains at rest.



What is the friction force acting on the block?

- A. 0 N
- B. 3.1 N
- C. 3.8 N
- D. The friction force cannot be calculated.

6. Which of the following best represents the work-energy theorem?

- A. $W = \Delta E$
- B. $E_k = E_p$
- C. $W = F_f \times d$
- D. $E_p = P \times t$

7. A 1500 kg car moving at 8.0 m/s comes to a stop in 16 m when its brakes are applied. The speed of the car is now doubled to 16 m/s. Assuming the same braking force as before, how far will the car travel before coming to a stop?

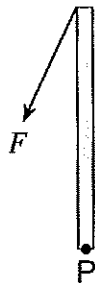
- A. 16 m
- B. 32 m
- C. 64 m
- D. 130 m

8. The momentum of a male Olympic sprinter is about

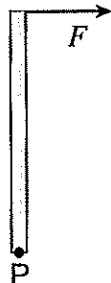
- A. 10 kg · m/s
- B. 100 kg · m/s
- C. 1000 kg · m/s
- D. 10 000 kg · m/s

9. In which of the following situations does force F produce a counter-clockwise torque about point P ?

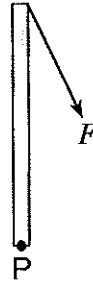
A.



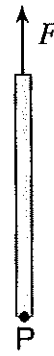
B.



C.

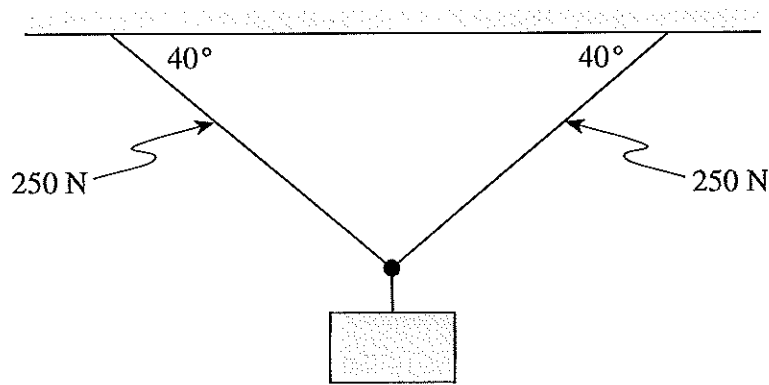


D.



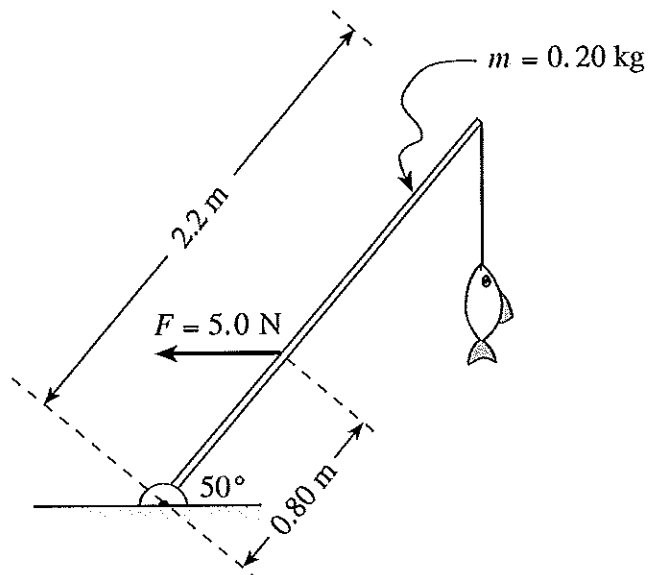
AUG -- 2002

10. An object is suspended by cords as shown in the diagram below.



If the tension in two of the cords is 250 N, what is the weight of the object?

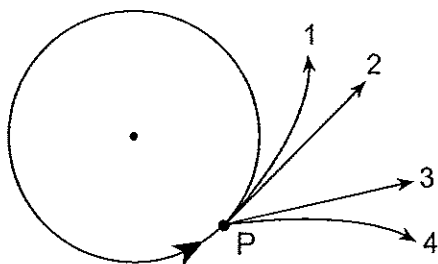
- A. 160 N
 - B. 320 N
 - C. 380 N
 - D. 500 N
11. As shown in the diagram below, a horizontally applied force of 5.0 N is required to hold a fish at the end of a uniform 0.20 kg fishing rod.



What is the weight of the fish?

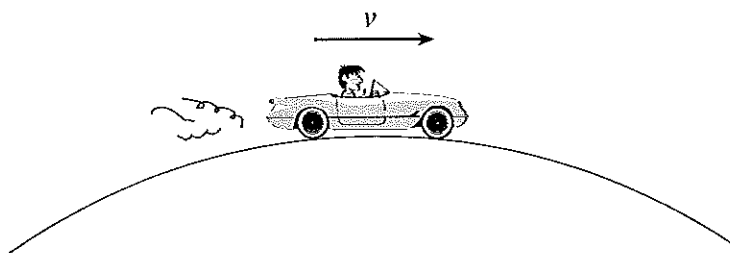
- A. 0.84 N
- B. 1.2 N
- C. 2.2 N
- D. 3.2 N

12. When an object moving in a horizontal circle breaks free at point P, it will follow which path?


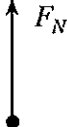




Viewed from above

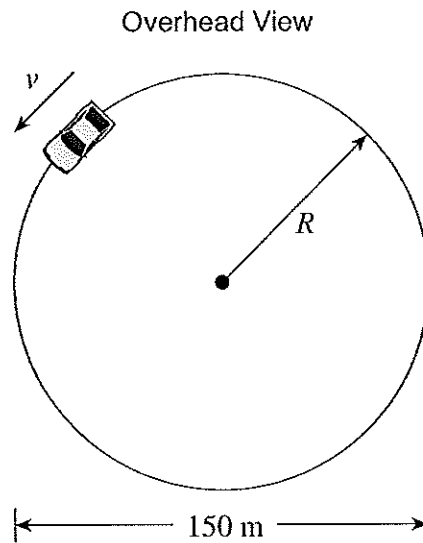
- A. 1
B. 2
C. 3
D. 4
13. A vehicle and driver travel at constant speed over the hill as shown.



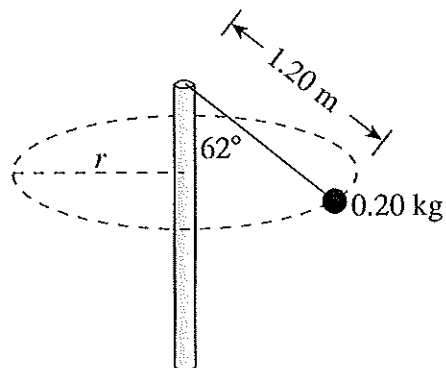
Which of the following free body diagrams best describes the vehicle at this position?

- A. 
- B. 
- C. 
- D. 

14. What is the maximum speed a car can travel along a level circular path (as shown below) if the coefficient of friction is 0.86?



- A. 4.1 m/s
 - B. 8.0 m/s
 - C. 25 m/s
 - D. Depends on the mass of the car
15. A 0.20 kg object moves at a constant speed in a horizontal circular path as shown.



What is the speed of this object?

- A. 2.3 m/s
- B. 3.2 m/s
- C. 3.4 m/s
- D. 4.4 m/s

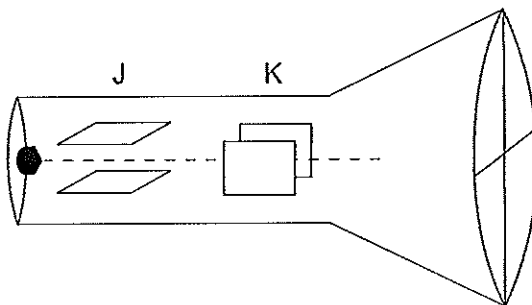
16. A 2.0×10^3 kg satellite is in a circular orbit around the earth. The satellite has a speed of 3.6×10^3 m/s at an orbital radius of 3.1×10^7 m. What is the total energy of this orbiting satellite?

A. -2.6×10^{10} J
 B. -1.3×10^{10} J
 C. 1.3×10^{10} J
 D. 3.9×10^{10} J

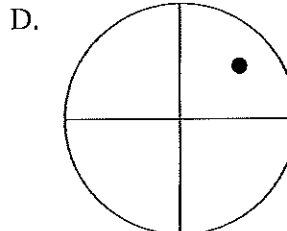
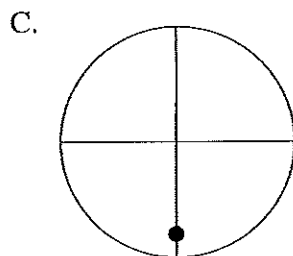
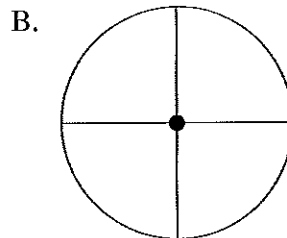
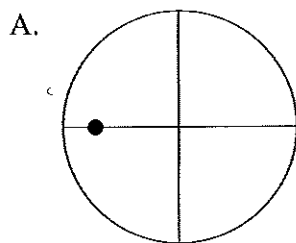
17. What is the change in gravitational potential energy as a 3500 kg object is raised vertically from the surface of the earth to a height of 8.2×10^5 m?

A. 5.5×10^7 J
 B. 2.5×10^{10} J
 C. 2.8×10^{10} J
 D. 1.9×10^{11} J

18. In the CRT shown below, a potential difference is only applied to the set of plates at J.



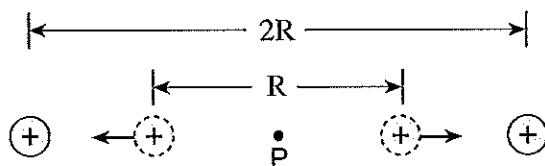
Which of the following could show the position of the electron beam on the screen?



562

Aug
2002
OVER

19. In one model of the hydrogen atom, the electron orbits the proton at a distance of 5.1×10^{-11} m. What is the electrostatic force between these two particles?
- A. 3.9×10^{-47} N
 B. 5.3×10^{-27} N
 C. 4.5×10^{-18} N
 D. 8.9×10^{-8} N
20. Two equal positive point charges are placed at distance R from each other. They are then moved to a distance of $2R$ away from each other. The electric potential and electric field at point P midway between the charges are measured before and after the move.



Which of the following is correct?

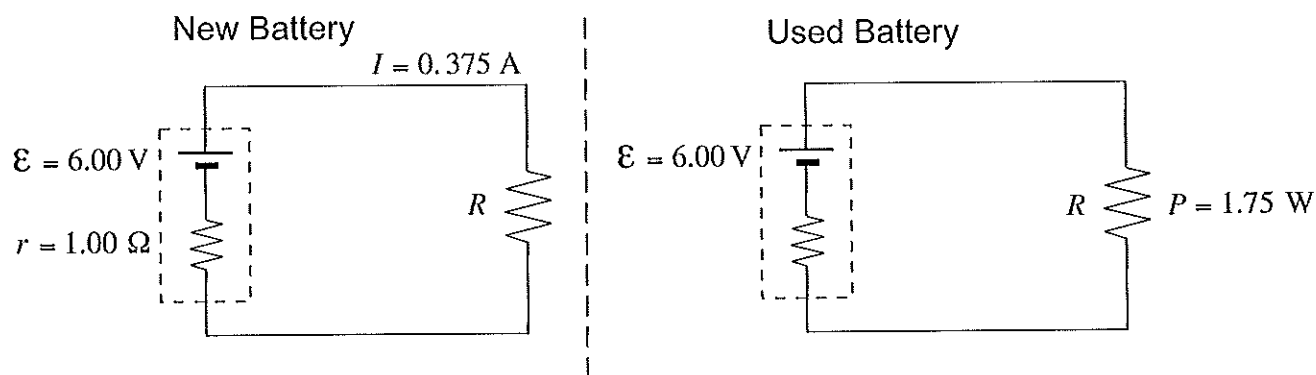
	NEW ELECTRIC POTENTIAL	NEW ELECTRIC FIELD
A.	half the original electric potential	half the original electric field
B.	same as the original electric potential	half the original electric field
C.	half the original electric potential	same as the original electric field
D.	same as the original electric potential	same as the original electric field

21. What happens to the total resistance of a circuit as one more resistor is added in parallel?
- A. The total resistance decreases.
 B. The total resistance increases.
 C. The total resistance becomes zero.
 D. The total resistance does not change.

22. The headlights in a car use 95 W of power. A driver parks her car but leaves the lights on. The 12 V battery has 3.4×10^5 C of stored charge. How long does it take for the battery to lose its charge?

A. 1.1×10^3 s
B. 3.6×10^3 s
C. 4.3×10^4 s
D. 2.7×10^6 s

23. A circuit using a new battery which has an emf of 6.00 V and an internal resistance of 1.00Ω is shown on the left. The battery is then replaced with a used one that has the same emf of 6.00 V but a different internal resistance.



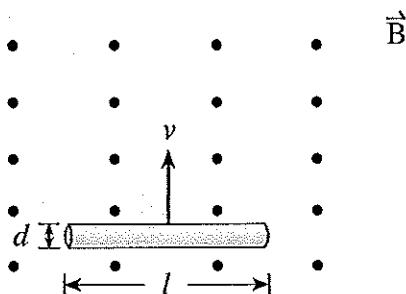
If resistor R now dissipates 1.75 W, what is the internal resistance of the used battery?

A. 1.00Ω
B. 2.57Ω
C. 3.55Ω
D. 5.60Ω

564

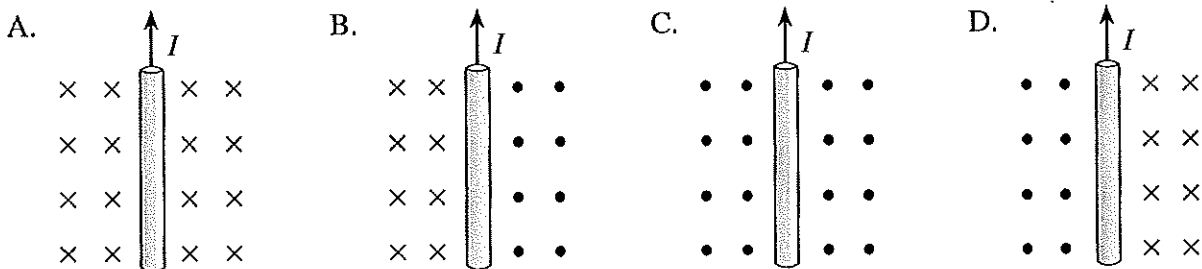
AUG
2002
OVER

24. A length of conducting wire is moving perpendicular to a magnetic field as shown below.



Which of the following does not affect the size of the emf produced between the ends of the wire?

- A. speed of wire
 - B. length of wire
 - C. thickness of wire
 - D. magnetic field strength
25. Which of the four diagrams below correctly depicts the magnetic field found on either side of a current carrying wire?

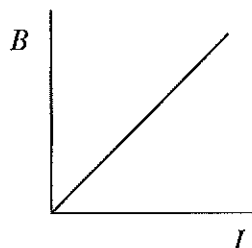


26. Charged particles having momentum p_1 , pass perpendicularly through a magnetic field and their circular path has a radius of r . What would the radius be for particles with the same charge having momentum $p_2 = 2p_1$?

- A. $2r$
- B. $\frac{1}{2}r$
- C. $\sqrt{2}r$
- D. $\frac{r}{\sqrt{2}}$

AUG -- 2002

27. The current through a solenoid is varied and the resulting magnetic field at its centre is recorded in each case. A graph of the magnetic field versus the current is produced.



Which of the following represents the slope of this graph?

- A. $\frac{\mu_0 N}{l}$
- B. $\frac{Nl}{\mu_0}$
- C. $\frac{\mu_0 B}{N}$
- D. $\frac{I}{N}$
28. A refrigerator condenser motor draws a 10 A current at startup (armature not rotating) when attached to a 110 V source. When the motor is operating at normal speed the current is 0.20 A. What back emf is the motor producing at this normal speed?
- A. 100 V
- B. 108 V
- C. 110 V
- D. 112 V
29. The secondary coil in an ideal transformer has 5 times as many windings as the primary. If the current in the primary is 0.40 A, determine the current in the secondary, and the type of the transformer.

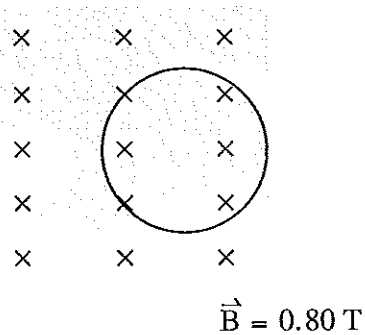
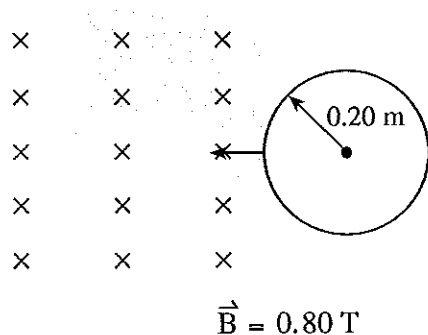
	CURRENT IN SECONDARY	TYPE OF TRANSFORMER
A.	0.080 A	step-up
B.	0.080 A	step-down
C.	2.0 A	step-up
D.	2.0 A	step-down

567

AUG -- 2002

OVER

30. A circular loop of resistance $1.2\ \Omega$ is pulled a distance of 0.40 m into a perpendicular magnetic field as shown below.



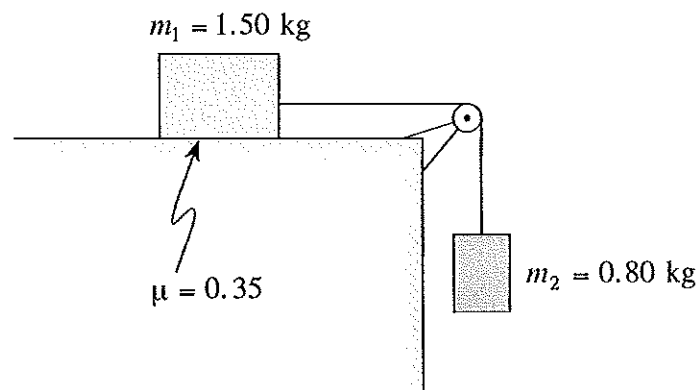
An average current of 0.50 A is produced in the coil during this event. Calculate the constant speed with which the coil was pulled.

- A. 0.10 m/s
- B. 0.75 m/s
- C. 1.9 m/s
- D. 2.4 m/s

AUG -- 2002

This is the end of the multiple-choice section.
Answer the remaining questions directly in this examination booklet.

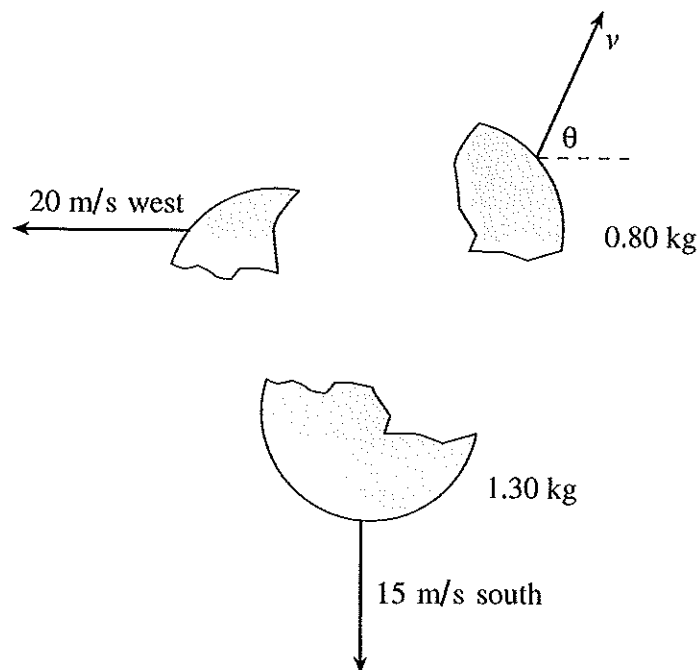
1. Two masses are connected by a light string passing across a frictionless pulley as shown in the diagram below. The coefficient of friction between mass m_1 and the horizontal surface is 0.35.



- a) Draw and label a free body diagram showing the forces acting on mass m_1 . (2 marks)

- b) What is the tension in the connecting string? (5 marks)

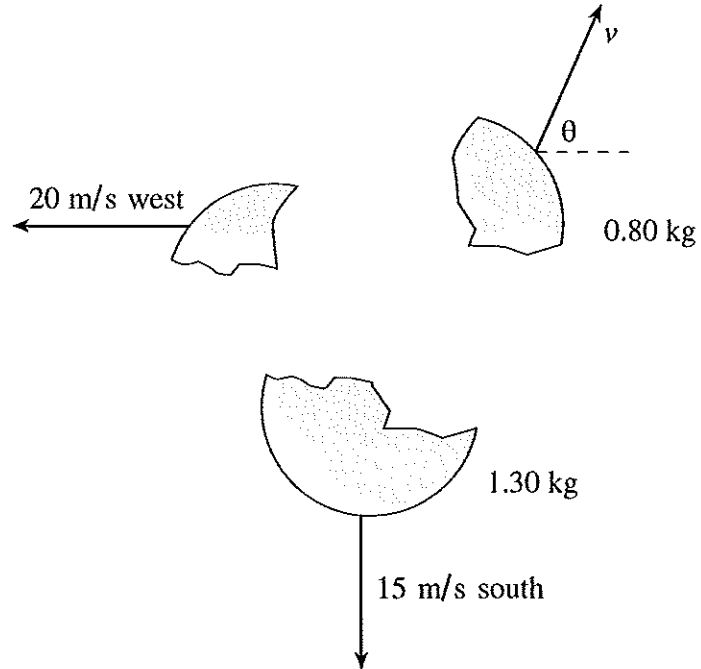
2. A 3.00 kg object initially at rest explodes into three fragments as shown in the diagram below.



What are the speed and direction of the 0.80 kg fragment?

(7 marks)

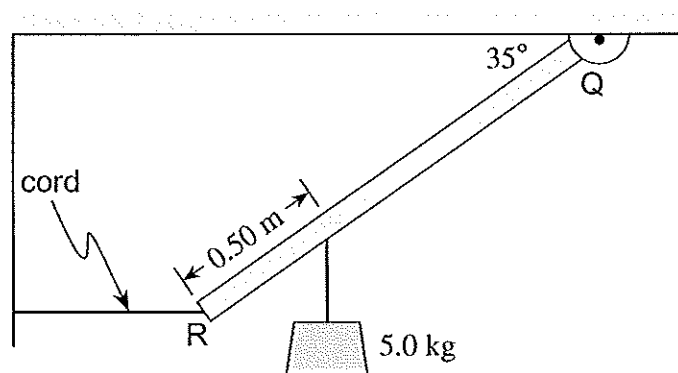
2. A 3.00 kg object initially at rest explodes into three fragments as shown in the diagram below.



What are the speed and direction of the 0.80 kg fragment?

(7 marks)

3. A uniform 2.4 m beam RQ has a mass of 3.0 kg. The beam is hinged at Q and held in place by a horizontal cord attached at R. A 5.0 kg mass is suspended 0.50 m from R.



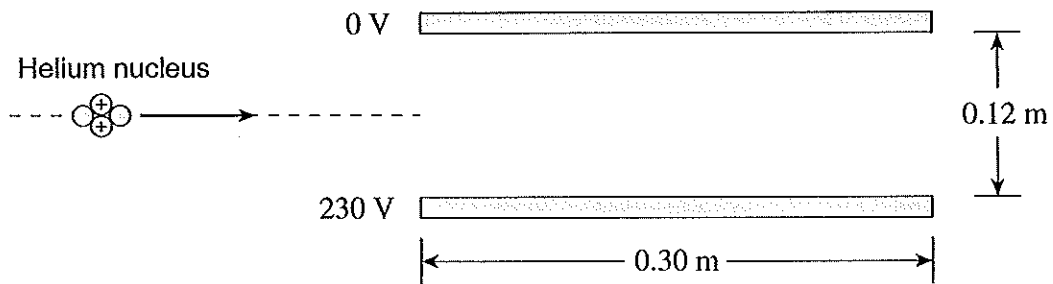
What is the tension in the horizontal cord?

(7 marks)

4. A 720 kg communication satellite is in synchronous orbit around the planet Mars. This synchronous orbit matches the period of rotation so that the satellite appears to be stationary over a position on the equator of Mars. What is the orbital radius of this satellite? (7 marks)

Planetary Data for Mars	
Mass:	$6.42 \times 10^{23} \text{ kg}$
Period of rotation:	$8.86 \times 10^4 \text{ s}$

5. A helium nucleus having twice the charge and four times the mass of a proton is travelling with high velocity when it enters a set of charged plates as shown.



- a) Find the magnitude of the acceleration of the helium nucleus due to these plates. (5 marks)

AUG 2002

ANSWER:

a) acceleration: _____

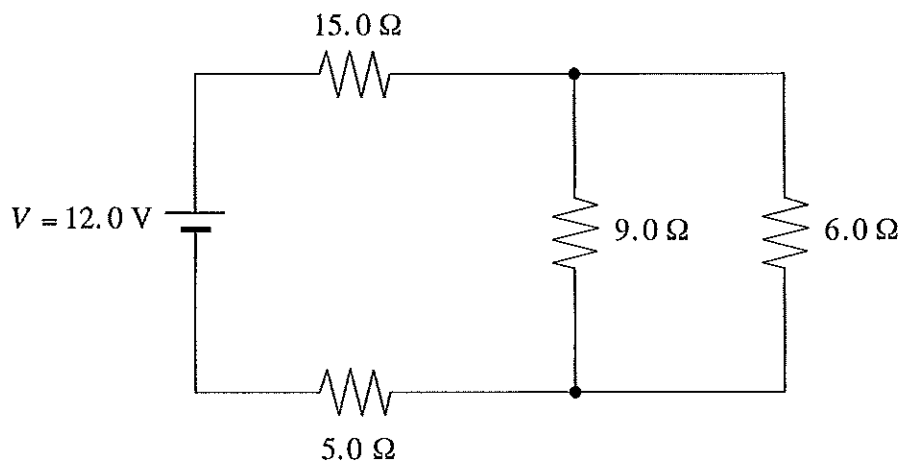
- b) A proton travelling at the same velocity as the helium nucleus is then sent through these same plates. Explain, using principles of physics, why the acceleration of the proton is larger than that of the helium nucleus. (4 marks)

AUG -- 2002

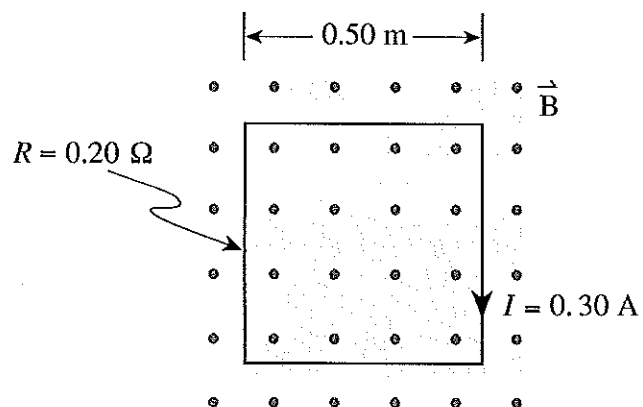
574

OVER

6. How much energy does the $6.0\ \Omega$ resistor dissipate in 15 seconds in the circuit shown? (7 marks)



7. The single square loop of copper wire with a resistance of $0.20\ \Omega$ has a current of 0.30 A due to a continuously increasing magnetic field.



At what rate, in T/s , is the magnetic field increasing?

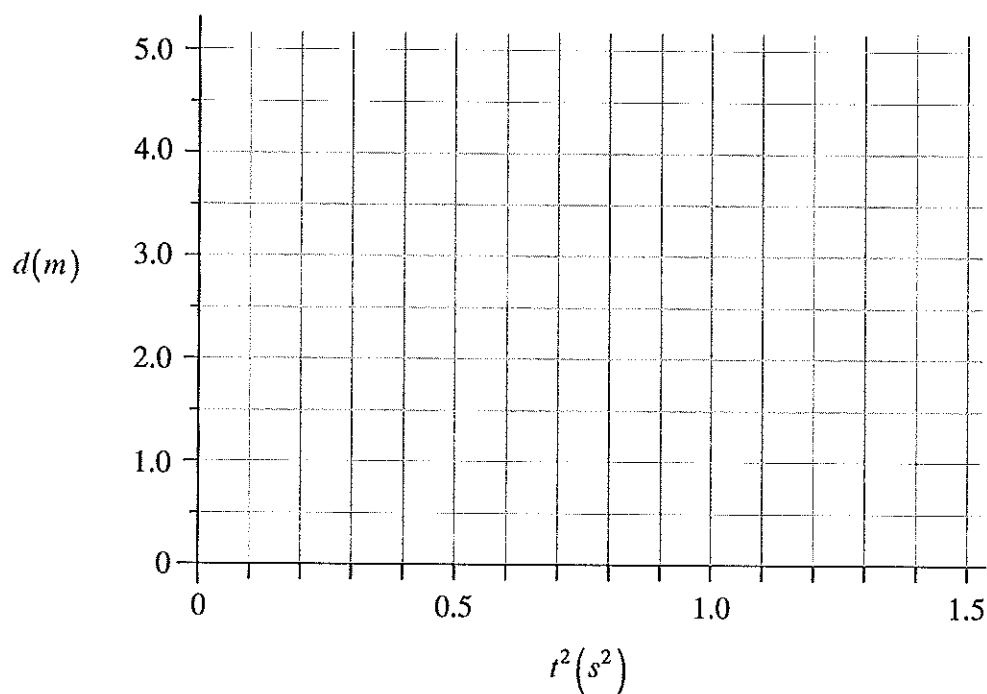
(7 marks)

8. The first colonists on Mars conduct a physics experiment by dropping a small mass (from rest) and recording its displacement at regular time intervals. This data is shown below.

$d(m)$	$t(s)$	
0.30	0.40	
0.60	0.60	
1.20	0.80	
1.80	1.00	
2.70	1.20	

- a) Plot a graph of displacement versus time squared and draw the best fit straight line.

(2 marks)



b) Determine the slope of the line.

(2 marks)

ANSWER:

b) slope: _____

c) Based on this experiment, what is the acceleration due to gravity on Mars?

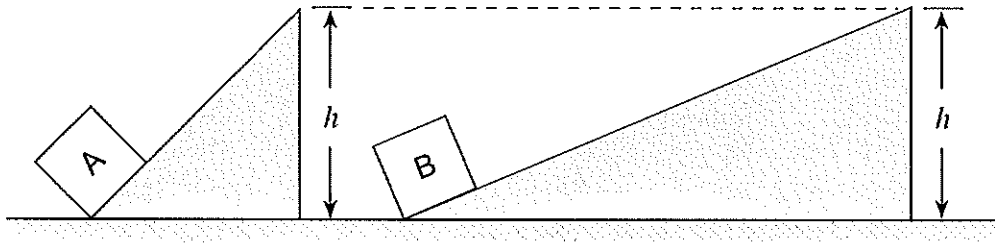
(1 mark)

ANSWER:

c) acceleration: _____

AUG -- 2002

9. Identical blocks are placed on inclines as shown. The coefficients of friction between the blocks and the inclined surfaces are identical.



Both blocks are then pushed to the top of each incline at the same constant speed. Using principles of physics, explain which block required more work to reach the top of the incline.

(4 marks)

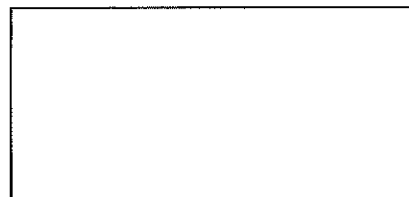
END OF EXAMINATION

AUG -- 2002

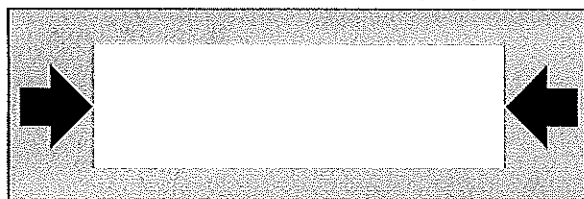
MINISTRY USE ONLY



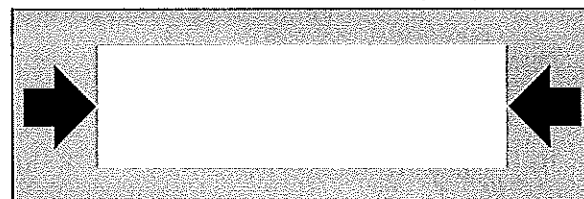
MINISTRY USE ONLY



Place Personal Education Number (PEN) here.



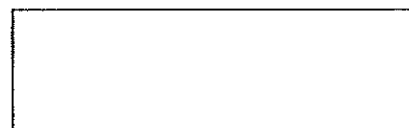
Place Personal Education Number (PEN) here.



BRITISH
COLUMBIA

© 2003 Ministry of Education

MINISTRY USE ONLY



Physics 12

JANUARY 2003

Course Code = PH

Student Instructions

1. Place the stickers with your Personal Education Number (PEN) in the allotted spaces above. **Under no circumstance is your name or identification, other than your Personal Education Number, to appear on this booklet.**
2. Ensure that in addition to this examination booklet, you have an **Examination Response Form**. Follow the directions on the front of the Response Form.
3. **Disqualification** from the examination will result if you bring books, paper, notes or unauthorized electronic devices into the examination room.
4. When instructed to open this booklet, **check the numbering of the pages** to ensure that they are numbered in sequence from page one to the last page, which is identified by

END OF EXAMINATION

5. At the end of the examination, place your Response Form inside the front cover of this booklet and return the booklet and your Response Form to the supervisor.

580

PART A: MULTIPLE CHOICE

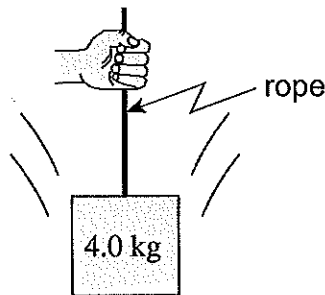
Value: 60 marks (2 marks per question)

Suggested Time: 60 minutes

INSTRUCTIONS: For each question, select the **best** answer and record your choice on the Response Form provided. Using an HB pencil, completely fill in the circle that has the letter corresponding to your answer.

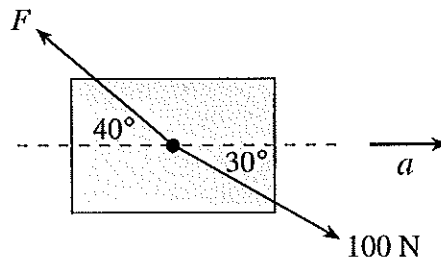
1. Inertia is directly related to which of the following quantities?
 - A. mass
 - B. charge
 - C. velocity
 - D. position

2. The 4.0 kg block shown below is accelerating downwards at 3.0 m/s^2 near the earth's surface. What is the tension in the rope attached to it?



- A. 12 N
 - B. 27 N
 - C. 39 N
 - D. 51 N

3. The mass shown below is accelerating to the right due to the two forces acting on it. What is the size of the force F ?



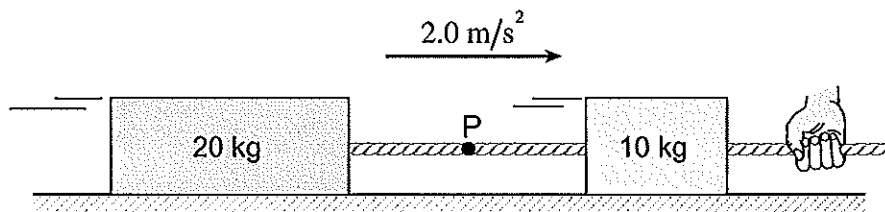
- A. 32 N
 - B. 50 N
 - C. 65 N
 - D. 78 N

JAN -- 2003

581

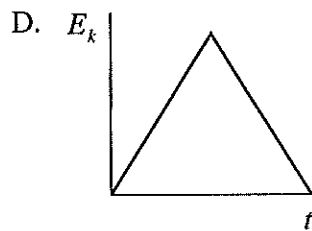
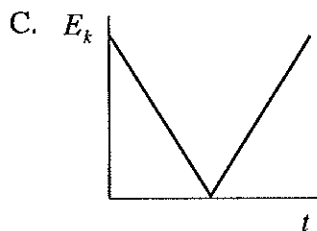
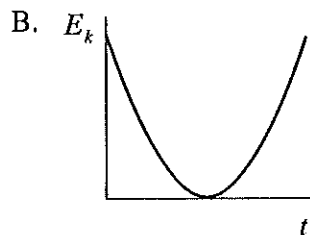
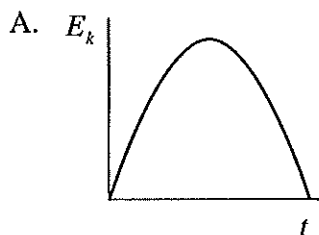
OVER

4. The system of masses shown below is accelerating to the right at 2.0 m/s^2 . If the tension in the rope at point P is 70 N, what is the coefficient of friction between the masses and the surface?



- A. 0.15
B. 0.20
C. 0.43
D. 0.57
5. A 6.0 kg penguin in a zoo exhibit starts from rest and slides 5.0 m along a very slippery rock slope (ignore friction) into the water in 1.4 s. What angle does the rock slope make with the horizontal?
- A. 21°
B. 28°
C. 31°
D. 59°
6. In which of the following would a person do the **least** amount of work?
- A. Lifting a 10 kg box a vertical height of 1.2 m.
B. Lifting a 10 kg box a vertical height of 1.2 m using a ramp.
C. Pushing a 10 kg box along a smooth floor a distance of 1.2 m.
D. Dragging a 10 kg box along a rough floor a distance of 1.2 m.

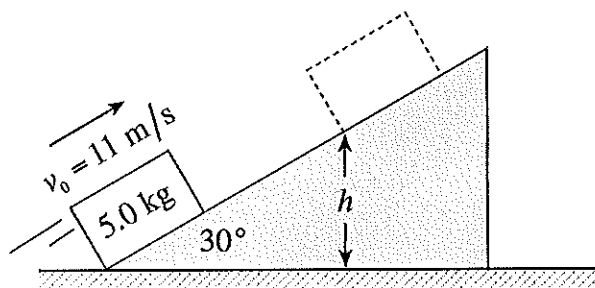
7. A rock is thrown straight up. Which of the following represents the kinetic energy versus time graph of the rock while it is in the air?



8. What minimum force applied over a distance of 35.0 m would be needed to accelerate a 925 kg car from rest to 13.9 m/s?

- A. 367 N
B. 2550 N
C. 12 900 N
D. 89 400 N

9. A 5.0 kg block initially travelling at 11 m/s moves up a 30° incline as shown.



A frictional force of 9.4 N acts on the block as it moves up the incline. What maximum vertical height, h , will the block reach?

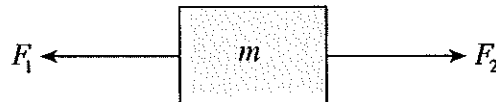
- A. 4.5 m
B. 5.2 m
C. 6.2 m
D. 6.7 m

JAN -- 2003

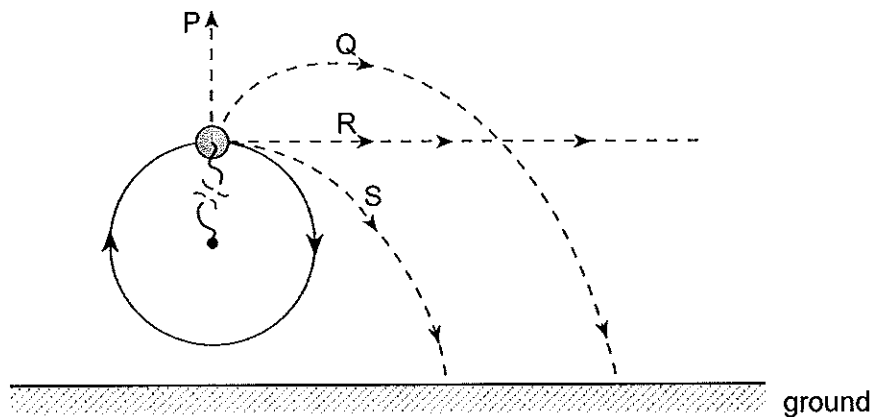
10. Which of the following are correct units for torque?

- A. N/m
- B. N/kg
- C. $\text{N} \cdot \text{s}$
- D. $\text{N} \cdot \text{m}$

11. If the only forces acting on the object shown below are equal in magnitude, which of the following is **not possible**?



- A. The object is at rest.
 - B. The object is accelerating to the left.
 - C. The object is moving with constant velocity to the right.
 - D. The object is moving with constant velocity towards the top of the page.
12. A ball moves at a constant speed in a **vertical** circle when the string breaks at the position shown.



The ball would then move along which of the indicated paths?

- A. P
- B. Q
- C. R
- D. S

13. A 0.090 m **diameter** computer floppy disk spins at a constant speed of 1.40 m/s measured at its rim. What is the centripetal acceleration at the rim of this floppy disk?
- A. 16 m/s^2
 - B. 22 m/s^2
 - C. 31 m/s^2
 - D. 44 m/s^2
14. A 960 kg car is travelling on a 65 m radius horizontal circular track. The coefficient of friction between the tires and the track surface is 0.57. What is the minimum time for the car to complete one lap of the track?
- A. 0.69 s
 - B. 12 s
 - C. 21 s
 - D. 67 s
15. A satellite is brought from a higher circular orbit to a lower circular orbit around the earth. Which of the following describes what has happened to the satellite's period?
- A. The satellite's period decreased.
 - B. The satellite's period increased.
 - C. The satellite's period did not change.
 - D. You cannot determine this without more information.
16. A 2500 kg satellite is placed into a circular orbit at an altitude of $1.2 \times 10^5 \text{ m}$ above the earth's surface. What is the period of this satellite?
- A. 13 s
 - B. 700 s
 - C. 5100 s
 - D. 5200 s

JAN - - 2003

585

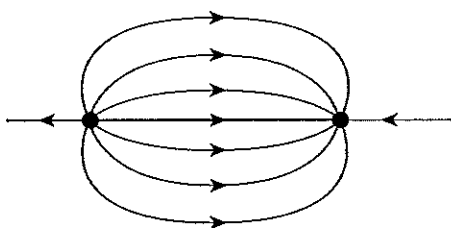
OVER

17. A 3500 kg piece of space debris is brought from an altitude of 2.1×10^5 m back to the earth's surface. What is the change in potential energy of this space debris?

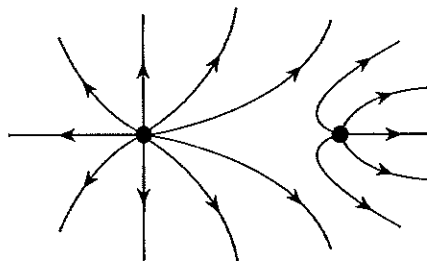
- A. -7.0×10^9 J
- B. -7.2×10^9 J
- C. -2.1×10^{11} J
- D. -2.2×10^{11} J

18. Which of the following represents the electric field between two opposite point charges of different magnitudes?

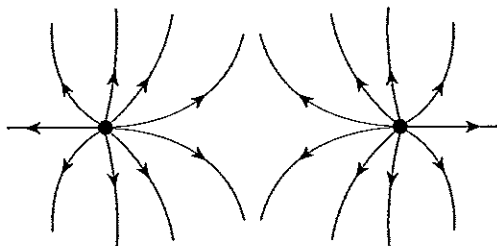
A.



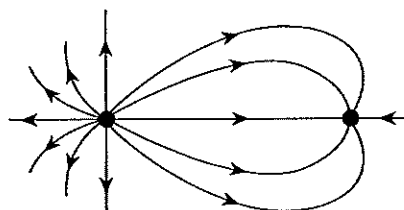
B.



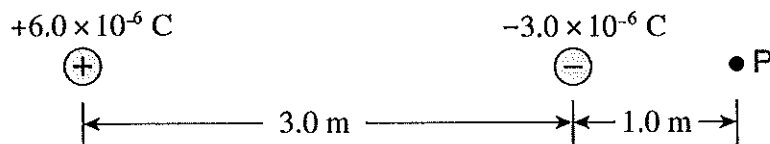
C.



D.

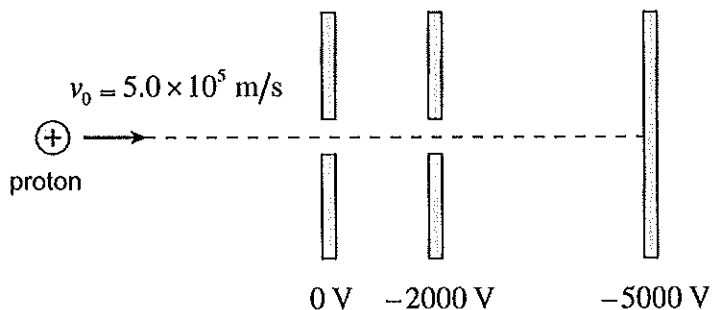


19. What are the magnitude and direction of the electric field at point P?

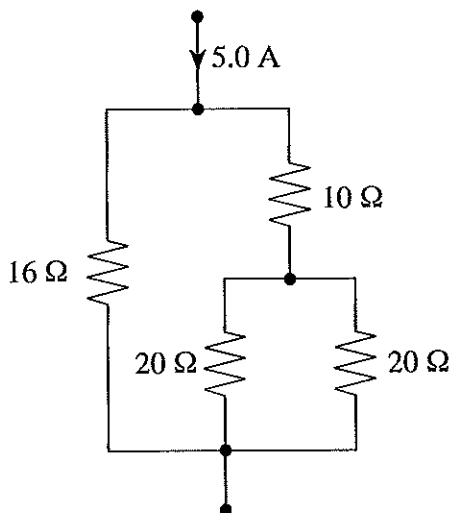


	MAGNITUDE OF ELECTRIC FIELD AT P	DIRECTION OF ELECTRIC FIELD AT P
A.	2.4×10^4 N/C	left
B.	2.4×10^4 N/C	right
C.	3.0×10^4 N/C	left
D.	3.0×10^4 N/C	right

20. A proton moving at 5.0×10^5 m/s enters a series of charged parallel plates. What is the impact speed on the last plate?



- A. 9.1×10^5 m/s
 B. 9.8×10^5 m/s
 C. 1.1×10^6 m/s
 D. 1.3×10^6 m/s
21. Which of the following is a correct statement?
- A. The current in a typical resistor is directly proportional to the applied voltage.
 B. The current in a typical resistor is inversely proportional to the applied voltage.
 C. The total current into a junction is less than the total current out of the junction.
 D. The total current into a junction is greater than the total current out of the junction.
22. The following diagram shows part of a complete circuit. What is the power dissipated in one of the 20Ω resistors?



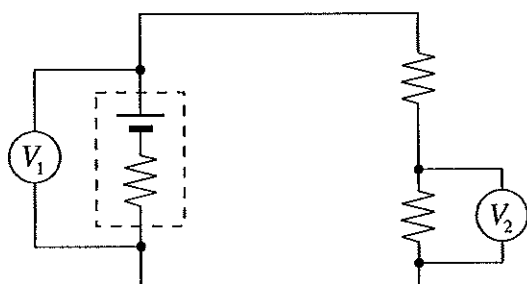
- A. 16 W
 B. 25 W
 C. 33 W
 D. 99 W

JAN -- 2003

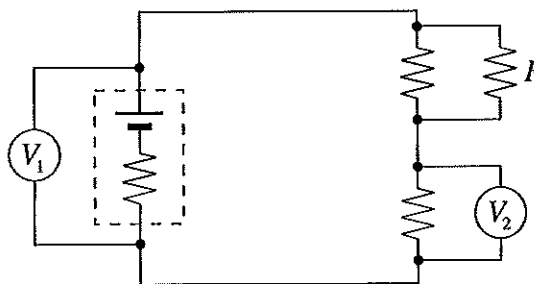
OVER

587

23. Circuit 1 is shown below. Resistor R is added to form circuit 2.



Circuit 1



Circuit 2

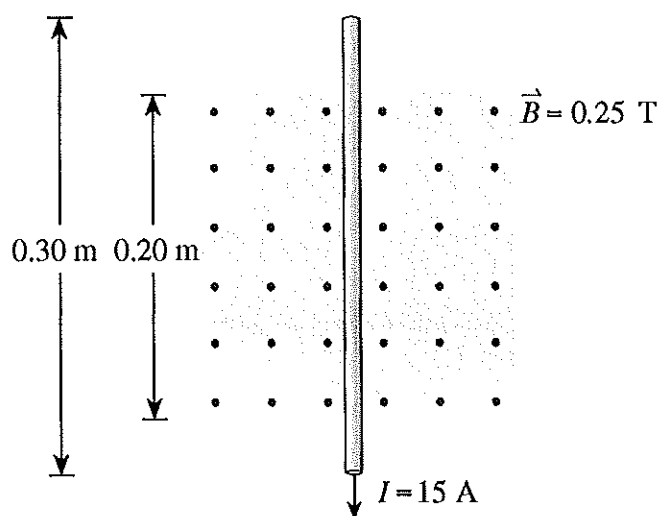
When resistor R is added, how do the voltmeter readings change?

	V_1	V_2
A.	decrease	decrease
B.	decrease	increase
C.	increase	decrease
D.	increase	increase

24. Which of the following are correct units for magnetic flux?

- A. T
- B. T/m
- C. Wb
- D. $\text{Wb} \cdot \text{m}^2$

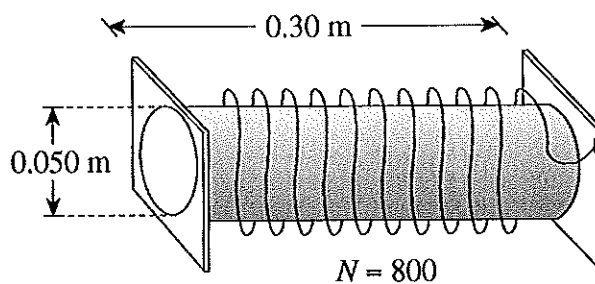
25. A conductor is placed in a magnetic field as shown.



What are the magnitude and direction of the magnetic force acting on this conductor when it carries a 15 A current?

	MAGNITUDE OF MAGNETIC FORCE	DIRECTION OF MAGNETIC FORCE
A.	0.75 N	To the left
B.	0.75 N	To the right
C.	1.1 N	To the left
D.	1.1 N	To the right

26. Consider the 800-turn solenoid shown in the diagram below.



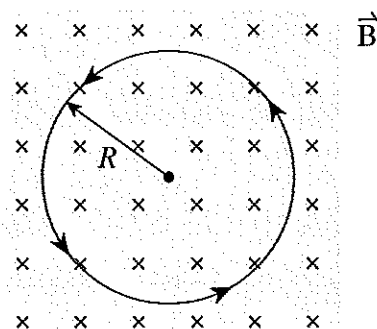
What is the current in the windings that would produce a magnetic field of 0.060 T at the centre of this solenoid?

- A. 3.0 A
- B. 8.0 A
- C. 18 A
- D. 290 A

JAN -- 2003

OVER

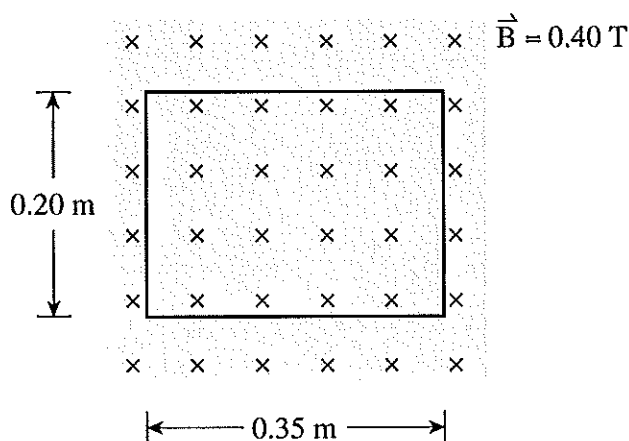
27. The path of a charged particle in a uniform magnetic field is circular when the initial velocity is perpendicular to the field.



Which of the following is a valid expression for the radius of this orbit in terms of the magnetic field strength, and the particle's momentum and charge?

- A. Bqp
- B. $\frac{Bp}{q}$
- C. $\frac{Bq}{p}$
- D. $\frac{p}{Bq}$

28. A rectangular loop of wire is placed in a magnetic field as shown in the diagram.



If the loop is removed from the field in a time of 0.050 s , what is the induced emf?

- A. 0.028 V
- B. 0.28 V
- C. 0.56 V
- D. 5.7 V

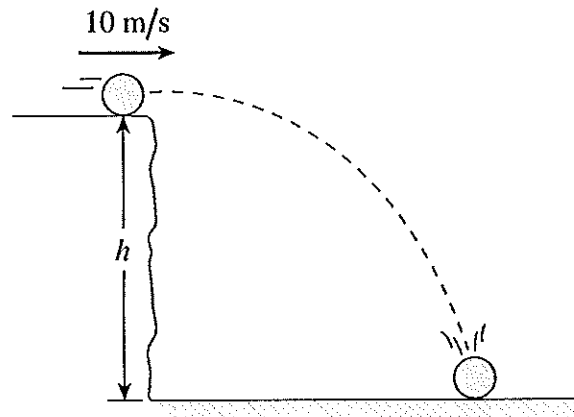
29. A direct current motor operates from a 24.0 V supply. When the motor is operating the current through it is 1.50 A and the back emf is 22.0 V. What is the resistance of the motor's armature?
- A. $0.75\ \Omega$
B. $1.3\ \Omega$
C. $15\ \Omega$
D. $16\ \Omega$
30. A certain step-down transformer has a 500-turn primary that operates at 120 V ac. Which one of the following sets of conditions could describe the secondary turns and voltage of this transformer?

	SECONDARY TURNS	SECONDARY VOLTAGE
A.	400	96 V
B.	400	150 V
C.	2000	30 V
D.	2000	480 V

JAN - - 2003

**This is the end of the multiple-choice section.
Answer the remaining questions directly in this examination booklet.**

1. A blue ball rolls off the cliff shown below at 10 m/s and hits the ground with a speed of 30 m/s.



- a) What is the vertical component of the ball's impact velocity?

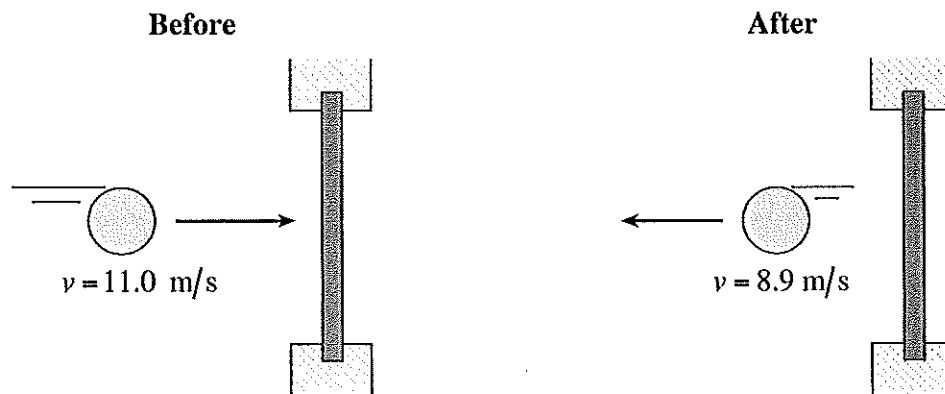
(4 marks)

- b) *How high (h) is the cliff? (3 marks)*

ANSWER:

- a) vertical component of velocity:

2. a) A 0.120 kg ball travelling at 11.0 m/s impacts a solid massive steel wall. The ball bounces straight back at 8.9 m/s.



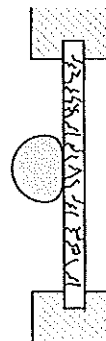
If the ball was in contact with the steel wall for 0.17 s, what is the magnitude of the force that the steel wall imparted on the ball? **(5 marks)**

JAN - - 2003

ANSWER:

a) force: _____

- b) An identical ball with the same initial speed as in part a) is then thrown towards a glass window. The glass window cracks and the ball stops in 0.17 s.



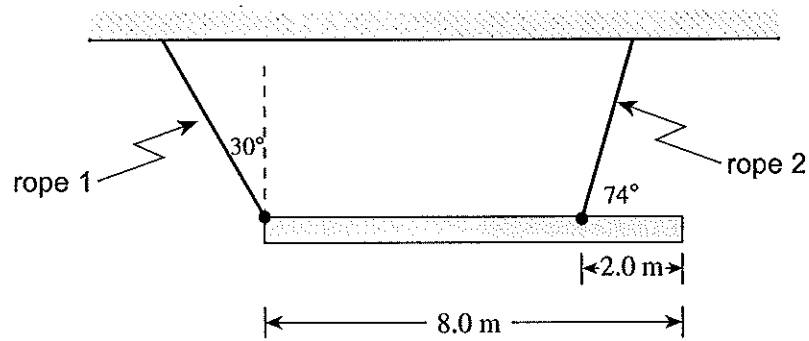
Using principles of physics, explain which ball, from part a) or part b), experiences the greater force. (4 marks)

JAN - 2003

594

OVER

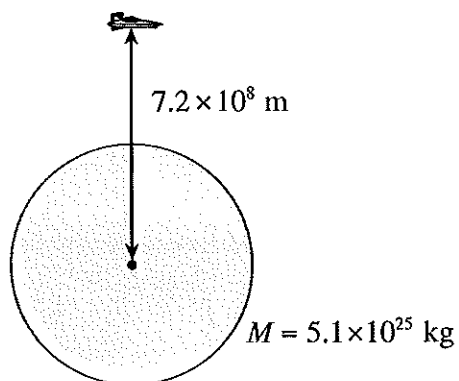
3. The 8.0 m uniform beam shown below, suspended horizontally by two ropes, has a mass of 75 kg.



Determine the tension in rope 1 and the tension in rope 2.

(7 marks)

4. A 12 000 kg spaceship is 7.2×10^8 m from the centre of a planet that has a mass of 5.1×10^{25} kg.

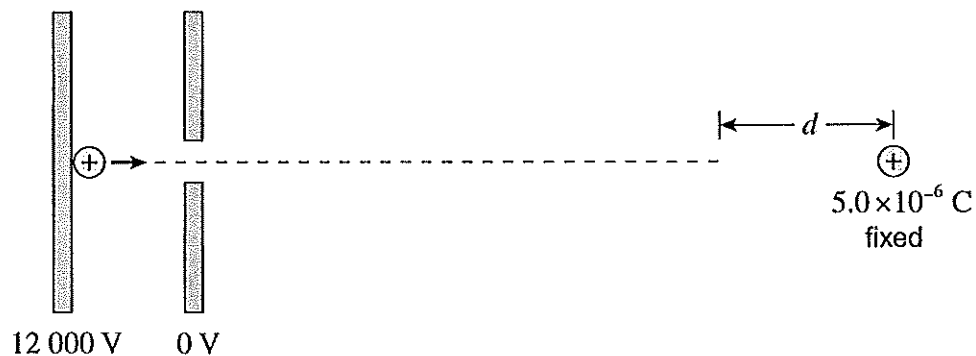


The spaceship gains 9.0×10^{11} J of kinetic energy as it falls to the planet's surface. What is the radius of this planet? (7 marks)

JAN -- 2003

596

5. A proton, accelerated from rest through a potential difference of 1.2×10^4 V, is directed at a fixed 5.0×10^{-6} C charge.



(Diagram not to scale.)

- a) What is the speed of the proton as it leaves the parallel plates?

(4 marks)

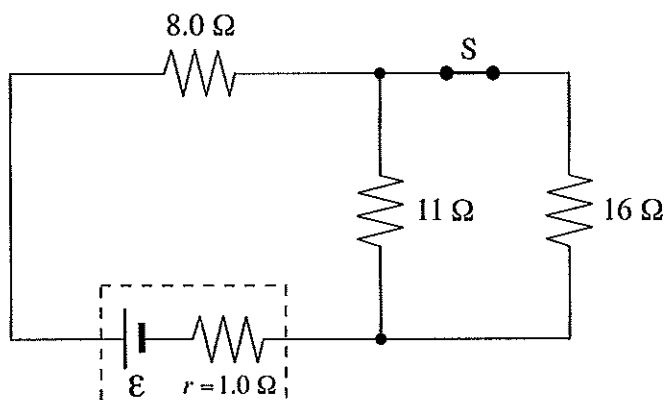
- b) What is the distance (d) from the fixed charge when the proton is stopped? (3 marks)

JAN -- 2003

ANSWER:

a) speed: _____

6. The terminal voltage of the battery is 5.8 V.



- a) What is the emf of this battery?

(6 marks)

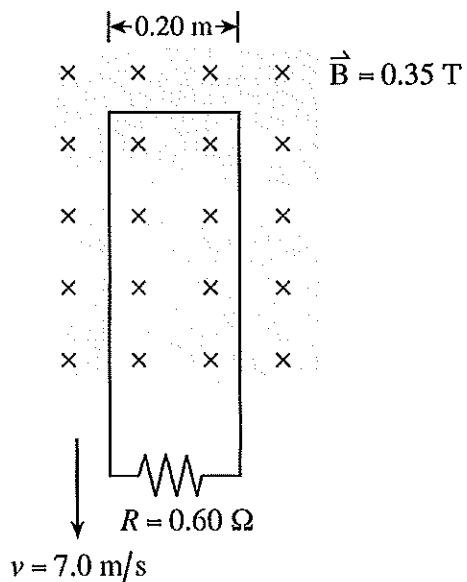
- b) What is the effect on the emf of the battery when switch S is opened? (1 mark)

JAN -- 2003

ANSWER:

a) emf of the battery: _____

7. A rectangular wire loop with a resistance of $0.60\ \Omega$ is pulled out of a magnetic field at $7.0\ \text{m/s}$ as shown in the diagram.



- a) What is the current in the loop?

(5 marks)

- b) *what is the direction of the current in the loop?* (2 marks)

ANSWER:

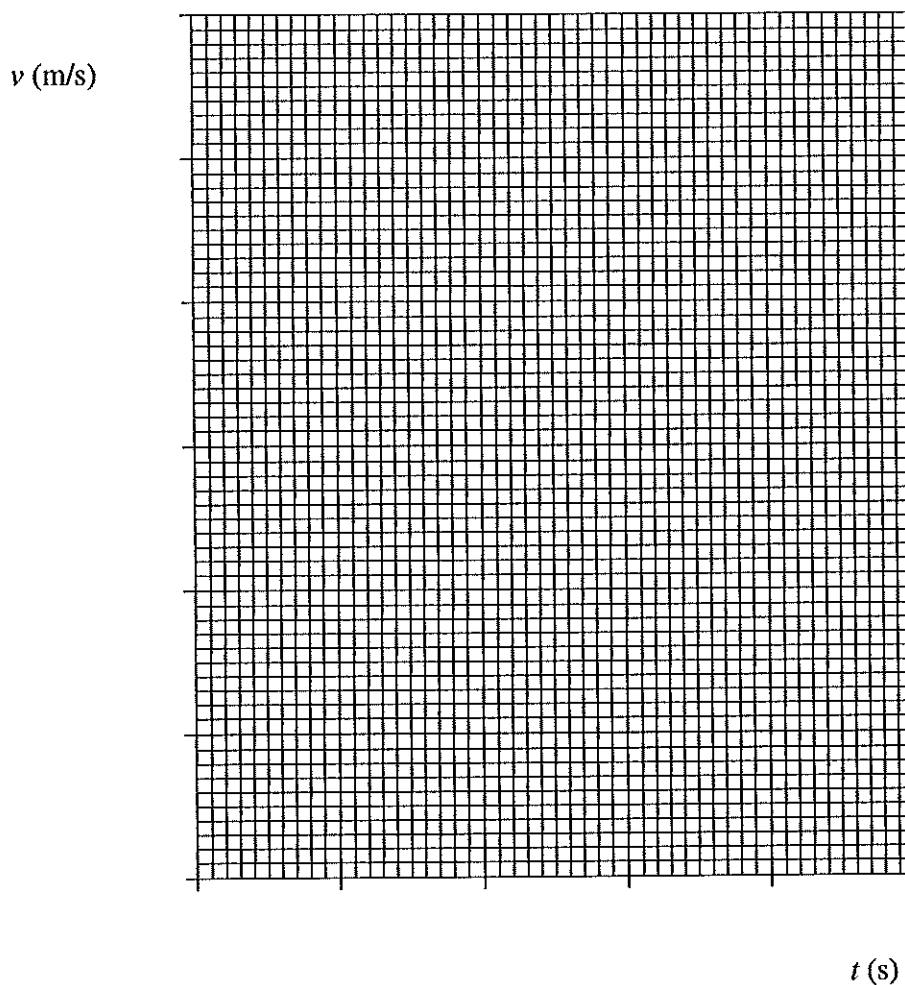
current: _____

8. The following data is collected in a kinematics experiment using a toy car.

t (s)	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90
v (m/s)	0.35	0.46	0.59	0.70	0.83	0.94	1.10	1.18

a) Plot the data on a v vs. t graph and extrapolate your line back to $t = 0$.

(2 marks)



b) What is the displacement of the toy car from $t = 0$ to $t = 0.90 \text{ s}$?

(2 marks)

ANSWER:

b) displacement of toy car: _____

c) What does the y -intercept of the graph represent?

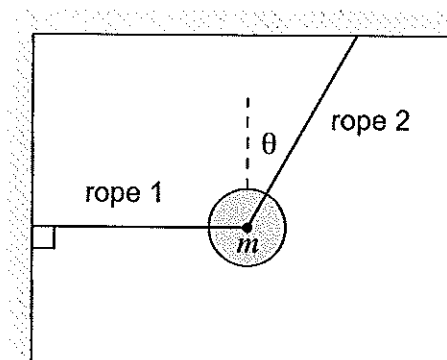
(1 mark)

JAN - 2002

601

OVER

9. A mass suspended by two ropes is shown below. It is noticed that for any angle θ used for rope 2, the tension in rope 2 is always greater than the tension in rope 1.



Using principles of physics, explain why this is the case.

(4 marks)

END OF EXAMINATION

JAN - - 2003

602

MINISTRY USE ONLY

MINISTRY USE ONLY

Place Personal Education Number (PEN) here.

Place Personal Education Number (PEN) here.



**BRITISH
COLUMBIA**

© 2003 Ministry of Education

MINISTRY USE ONLY

Physics 12

JUNE 2003

Course Code = PH

Student Instructions

1. Place the stickers with your Personal Education Number (PEN) in the allotted spaces above. **Under no circumstance is your name or identification, other than your Personal Education Number, to appear on this booklet.**
2. Ensure that in addition to this examination booklet, you have an **Examination Response Form**. Follow the directions on the front of the Response Form.
3. **Disqualification** from the examination will result if you bring books, paper, notes or unauthorized electronic devices into the examination room.
4. When instructed to open this booklet, **check the numbering of the pages** to ensure that they are numbered in sequence from page one to the last page, which is identified by
5. At the end of the examination, place your Response Form inside the front cover of this booklet and return the booklet and your Response Form to the supervisor.

END OF EXAMINATION

603

PART A: MULTIPLE CHOICE

Value: 60 marks (2 marks per question)

Suggested Time: 60 minutes

INSTRUCTIONS: For each question, select the **best** answer and record your choice on the Response Form provided. Using an HB pencil, completely fill in the circle that has the letter corresponding to your answer.

1. Which of the following is constant for all projectiles?
 - A. vertical velocity
 - B. horizontal velocity
 - C. vertical displacement
 - D. horizontal displacement

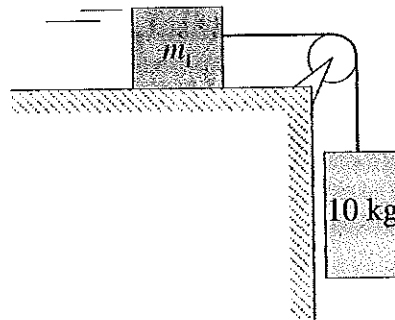
2. A projectile is launched at 30 m/s over level ground at an angle of 37° to the horizontal. What maximum height does this projectile reach?
 - A. 3.1 m
 - B. 17 m
 - C. 29 m
 - D. 46 m

3. A few minutes after takeoff a jet is heading due east with an air speed of 300 km/h. If the wind is blowing at 60 km/h, towards 40° S of E, what is the jet's ground speed?
 - A. 260 km/h
 - B. 340 km/h
 - C. 350 km/h
 - D. 360 km/h

4. Which of the following statements is always correct about an object in motion?
 - A. It has a tendency to accelerate.
 - B. A net force must be acting on it.
 - C. It has a tendency to keep moving.
 - D. The net force acting on it must be zero.

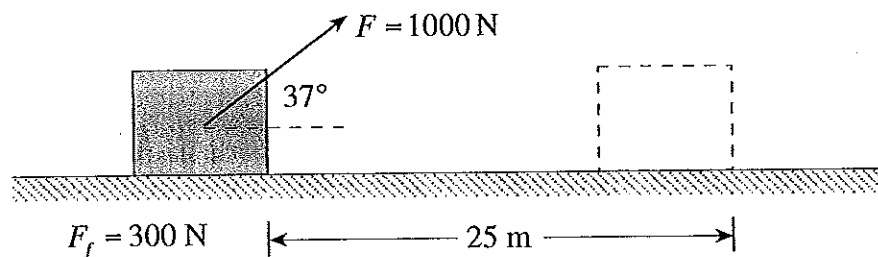
JUN -- 2003

5. If the tension in the line joining the two masses shown below is 12 N, what is the mass, m_1 ? (Ignore surface friction.)



- A. 1.1 kg
B. 1.4 kg
C. 2.0 kg
D. 10 kg
6. Power is
- A. work done.
B. the change in energy.
C. the change in kinetic energy.
D. the rate of change in energy.
7. A motor using 1500 W takes 52 s to raise a 250 kg load vertically 24 m. What is the efficiency of this motor?
- A. 7.7 %
B. 12 %
C. 25 %
D. 75 %

8. A 1000 N force is applied to a block as shown. There is 300 N of sliding friction as the block moves 25 m along the surface.

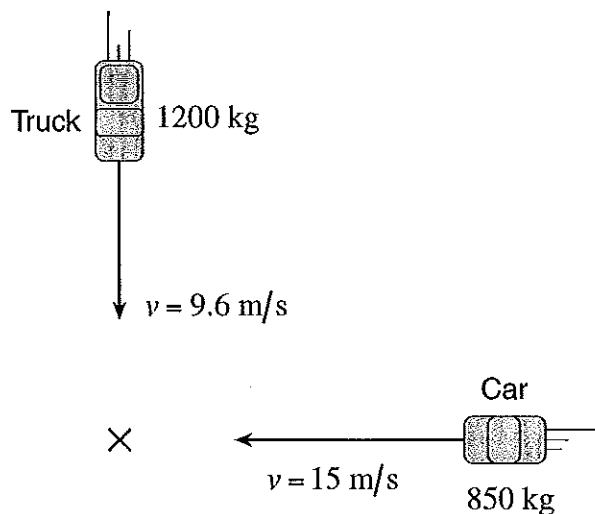


How much work was done by the applied force in moving this block?

- A. $1.5 \times 10^4\text{ J}$
 - B. $1.8 \times 10^4\text{ J}$
 - C. $2.0 \times 10^4\text{ J}$
 - D. $2.7 \times 10^4\text{ J}$
9. What is the work done by the brakes of a 1500 kg car as they slow the car from 25 m/s to 15 m/s over a distance of 80 m ?
- A. $-2.6 \times 10^4\text{ J}$
 - B. $-7.5 \times 10^4\text{ J}$
 - C. $-3.0 \times 10^5\text{ J}$
 - D. $-1.2 \times 10^6\text{ J}$

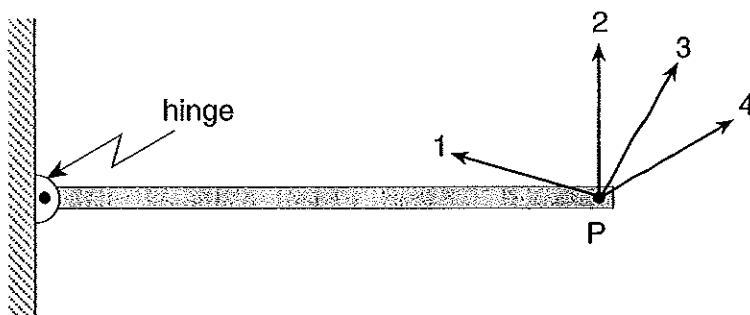
JUN -- 2003

10. A 1200 kg truck travelling at 9.6 m/s due south runs into a 850 kg car travelling at 15 m/s due west. The two vehicles stick together after they collide.



With what speed does the combined mass move immediately after the collision?

- A. 0.60 m/s
B. 2.7 m/s
C. 8.4 m/s
D. 12 m/s
11. The diagram below shows a force F applied in several different directions at the point P on a hinged beam. In which direction will the force produce the **smallest** torque about the hinge?

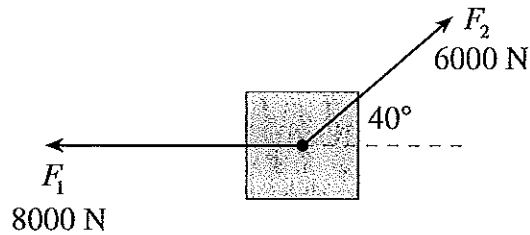


- A. 1
B. 2
C. 3
D. 4

607

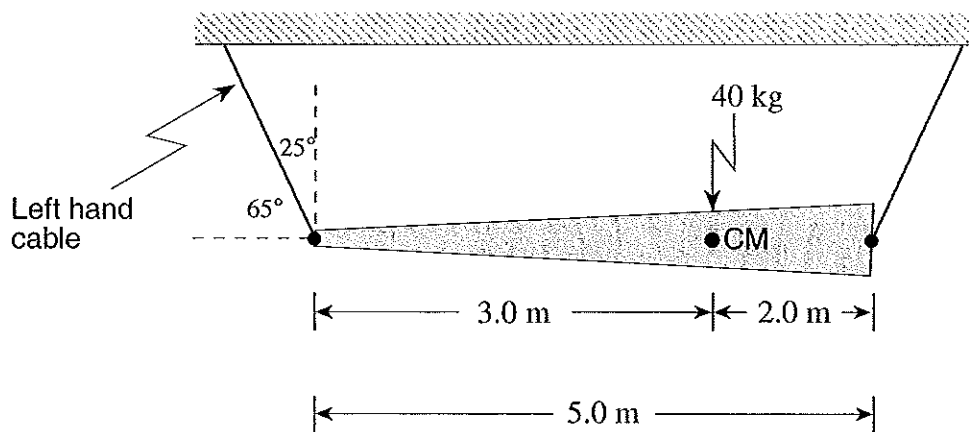
JUN --- 2012

12. Two forces are acting at a single point on an object. Force 1 has a magnitude of 8000 N and is directed due W. Force 2 has a magnitude of 6000 N and is directed at 40° N of E.



Determine the magnitude of the third force which must act at the same point so that the object will be in translational equilibrium.

- A. 2000 N
 - B. 3400 N
 - C. 5100 N
 - D. 6200 N
13. A 40 kg non-uniform beam (centre of mass CM) is supported by two cables.



(Diagram not to scale.)

What is the tension in the left hand cable?

- A. 170 N
- B. 260 N
- C. 370 N
- D. 560 N

JUN -- 2013

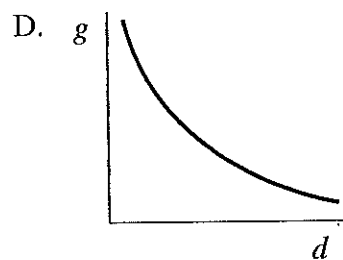
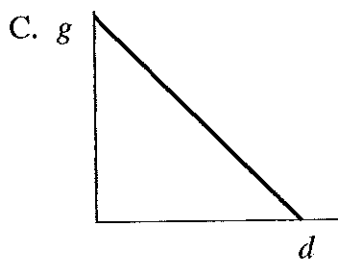
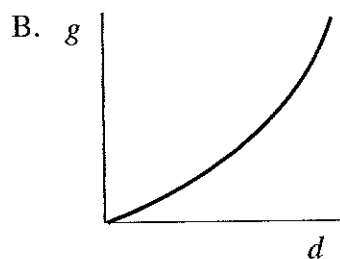
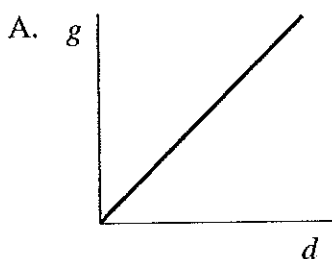
14. A car is travelling in uniform circular motion. Which of the following correctly describes the speed, velocity and acceleration of the car?

	SPEED	VELOCITY	ACCELERATION
A.	Constant	Constant	Constant
B.	Constant	Changing	Changing
C.	Changing	Constant	Constant
D.	Changing	Changing	Changing

15. A 45 kg child stands on the rim of a merry-go-round of radius 2.3 m. The child completes 5 rotations in 72 s. What is the centripetal force acting on the child?

- A. 0.44 N
- B. 0.79 N
- C. 20 N
- D. 280 N

16. Which of the following represents the graph of gravitational field strength g as a function of the distance d from the centre of a planet?

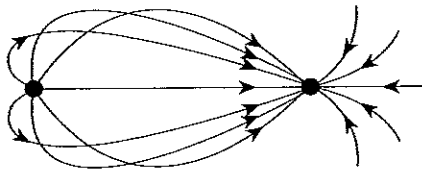


17. Which of the following best represents the gravitational force of attraction between two people one metre apart?

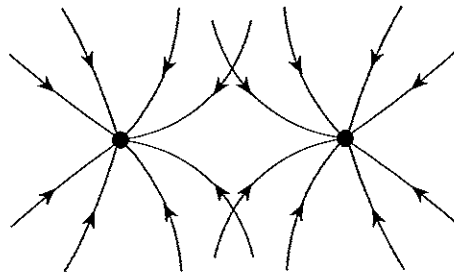
- A. 10^{-17} N
- B. 10^{-12} N
- C. 10^{-7} N
- D. 10^{-2} N

18. Which of the following is a possible electric field configuration?

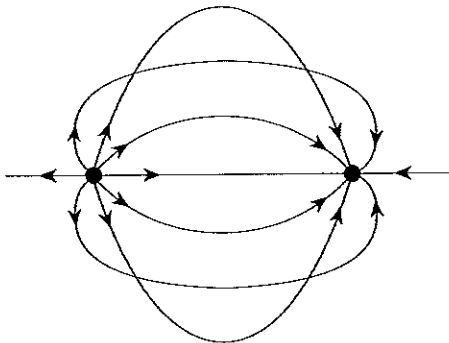
A.



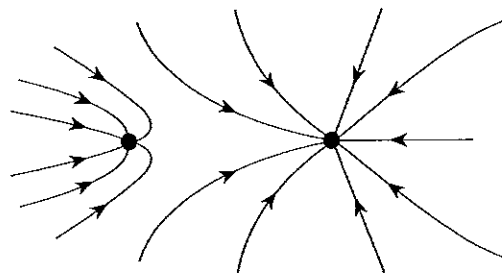
B.



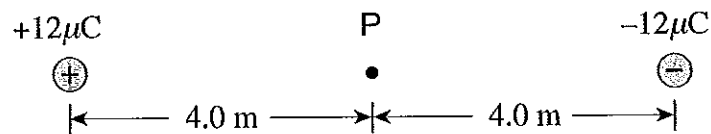
C.



D.



19. What is the electric potential at point P midway between the two point charges shown below?
 ($1\mu\text{C} = 1.0 \times 10^{-6}\text{ C}$)



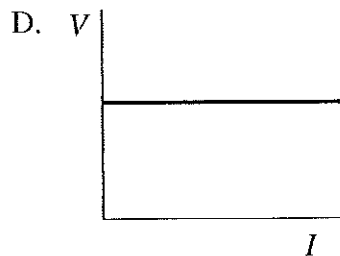
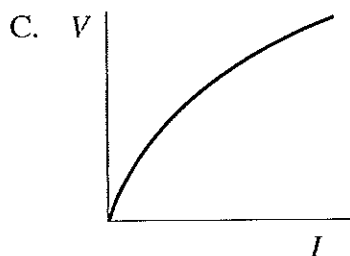
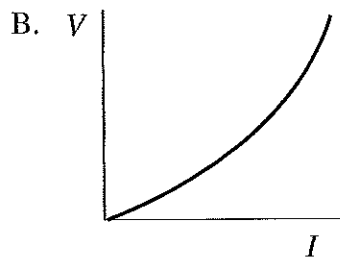
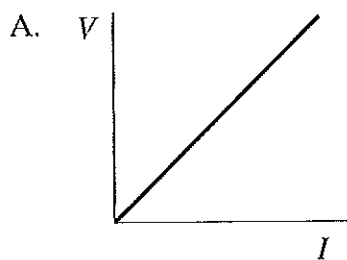
- A. 0 V
- B. 6.8×10^3 V
- C. 1.4×10^4 V
- D. 5.4×10^4 V

JUN -- 2003

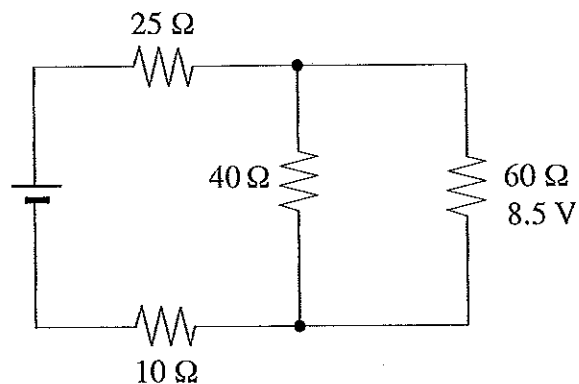
20. A proton is moving at 5.0×10^6 m/s when it is 8.0 m from a fixed 1.5×10^{-5} C charge Q. What is the speed of the proton when it is 2.0 m from the fixed charge Q?

- A. 2.5×10^6 m/s
- B. 3.6×10^6 m/s
- C. 3.9×10^6 m/s
- D. 4.5×10^6 m/s

21. Which of the following illustrates Ohm's Law?

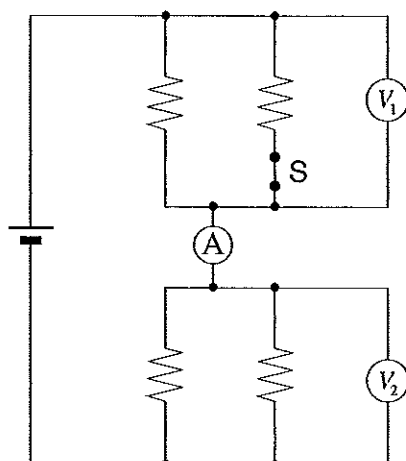


22. What is the total power dissipated by the four resistors in the diagram below?



- A. 1.7 W
- B. 2.7 W
- C. 4.7 W
- D. 7.4 W

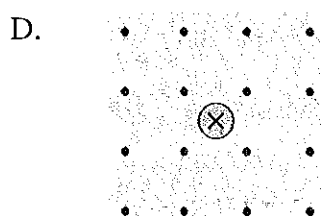
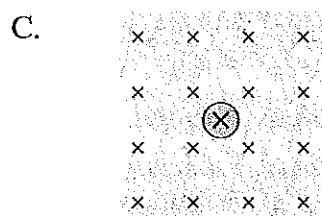
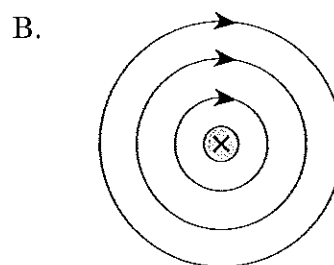
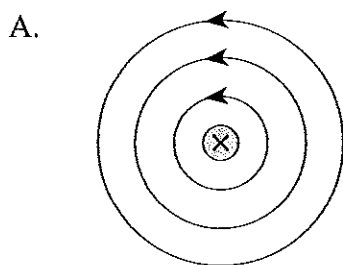
23. The circuit and meters are connected as shown with the switch S closed.



If the switch is then opened, what effects will be observed in the readings of the three meters? (All resistors have the same value.)

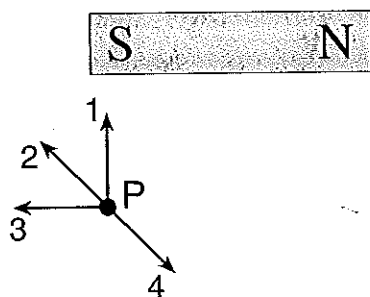
	V_1	V_2	A
A.	decreased	no change	decreased
B.	decreased	increased	decreased
C.	increased	decreased	increased
D.	increased	decreased	decreased

24. Which one of the following diagrams best illustrates the magnetic field produced by a current-carrying wire?



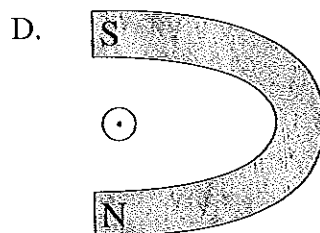
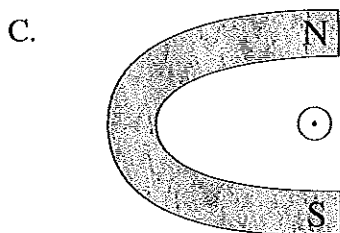
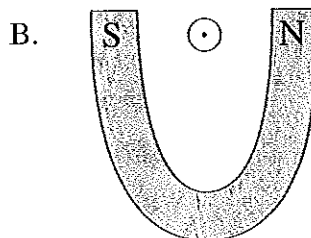
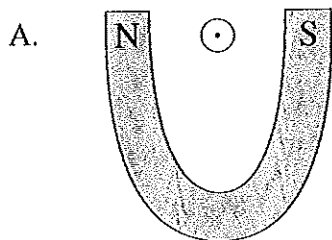
JUN -- 2003

25. What is the direction of the magnetic field at point P due to the bar magnet?



- A. 1
- B. 2
- C. 3
- D. 4

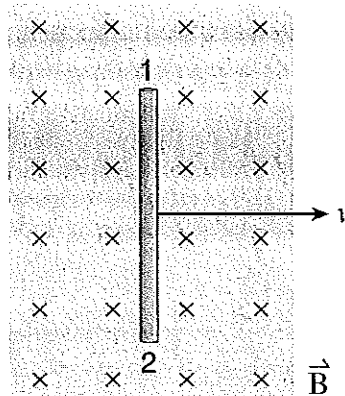
26. The diagrams below each illustrate a magnet and a conductor. In each case, the current in the conductor is out of the page. In which of these situations will there be a force on the conductor that points toward the top of the page?



27. A positively charged object ($q = 1.6 \times 10^{-19} \text{ C}$) is travelling at $1.9 \times 10^4 \text{ m/s}$ perpendicular to a $1.0 \times 10^{-3} \text{ T}$ magnetic field. If the radius of the resulting path is 0.40 m , what is the object's mass?

- A. $3.4 \times 10^{-27} \text{ kg}$
- B. $3.1 \times 10^{-19} \text{ kg}$
- C. $2.1 \times 10^{-9} \text{ kg}$
- D. 0.77 kg

28. A conducting rod of length 0.25 m is moved to the right at 6.0 m/s as shown in the diagram. The induced emf is 3.0 V.



What is the magnitude of the magnetic field and which end of the conducting rod, 1 or 2, becomes positively charged?

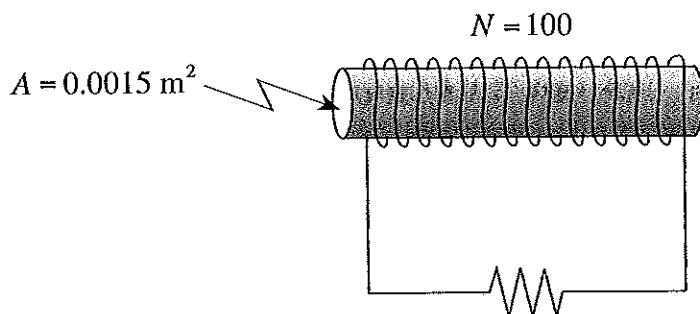
	MAGNETIC FIELD	POSITIVELY CHARGED END
A.	1.50 T	1
B.	1.50 T	2
C.	2.0 T	1
D.	2.0 T	2

29. A coil consisting of 50 loops of radius 4.0×10^{-2} m is placed with its plane perpendicular to a magnetic field that is increasing at a rate of 0.20 T/s. What is the magnitude of the emf induced in the coil?

- A. 0.0010 V
 B. 0.050 V
 C. 0.40 V
 D. 1.3 V

JUN -- 2003

30. One hundred turns of wire are wrapped around an iron core with a cross-sectional area of 0.0015 m^2 . The ends of the wire are connected to a resistor producing a circuit with a total resistance of 10.0Ω .



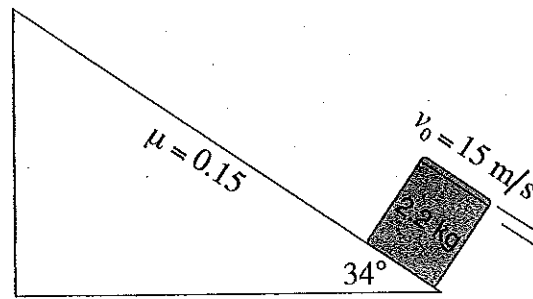
If the magnetic field in the iron core changes from 3.0 T towards the left to 1.0 T towards the right, how much charge flows in the circuit?

- A. 0.030 C
- B. 0.060 C
- C. 0.30 C
- D. 0.60 C

JUN -- 2003

This is the end of the multiple-choice section.
Answer the remaining questions directly in this examination booklet.

1. A 2.2 kg can of paint is projected up an inclined plane with an initial velocity of 15 m/s as shown below.

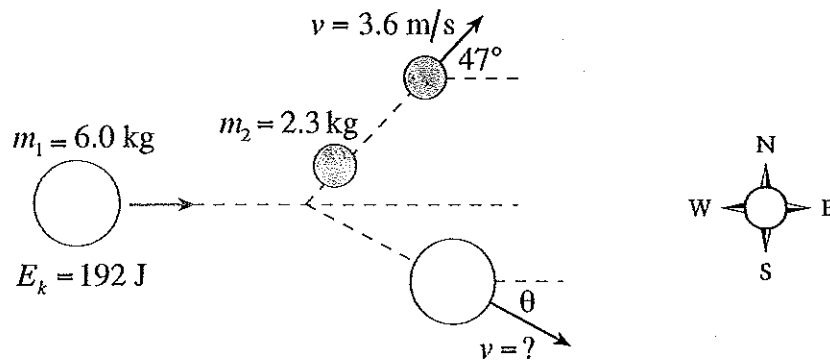


- a) Determine the magnitude of the force due to friction which acts on the paint can as it slides up the incline. (2 marks)

- b) Determine the magnitude of the net force on the paint can as it slides up the incline. (3 marks)

- c) Determine how far the paint can slides up the incline before stopping. (2 marks)

2. A 6.0 kg ball having a kinetic energy of 192 J was travelling due east when it underwent an oblique collision with a stationary 2.3 kg ball. The 2.3 kg ball travelled at 3.6 m/s at an angle of 47° north of east after the collision.

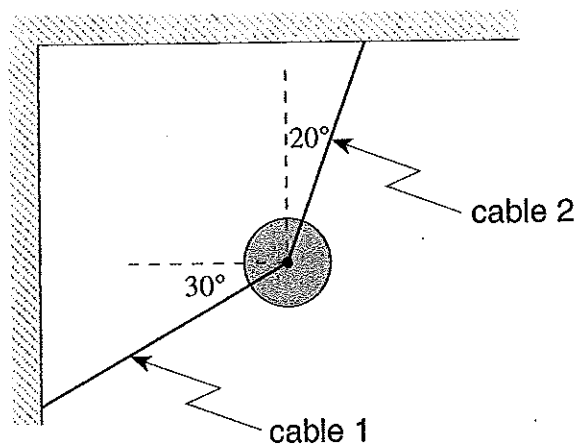


(Diagram not to scale.)

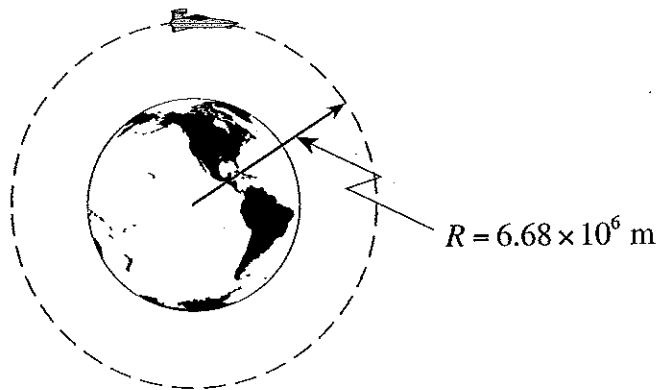
What was the velocity (magnitude and direction) of the 6.0 kg ball after the collision?

(7 marks)

3. A wrecking ball is suspended by two cables as shown below. If the tension in cable 2 is 12 000 N, what is the weight of the wrecking ball? (7 marks)



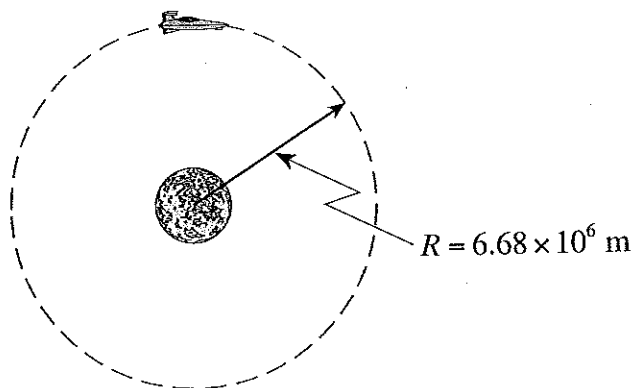
4. A 3.2×10^4 kg spacecraft is in a circular orbit of radius 6.68×10^6 m around the earth.



- a) Calculate the period of this spacecraft.

(5 marks)

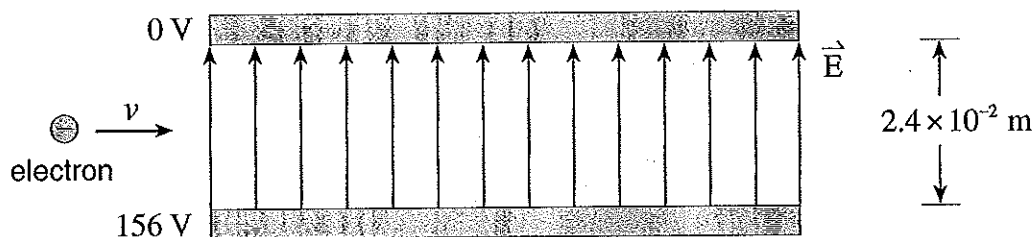
- b) If this spacecraft is then placed into an orbit of the same radius around the moon,



explain how and why the period of this spacecraft would be different than when it was orbiting the earth.

(4 marks)

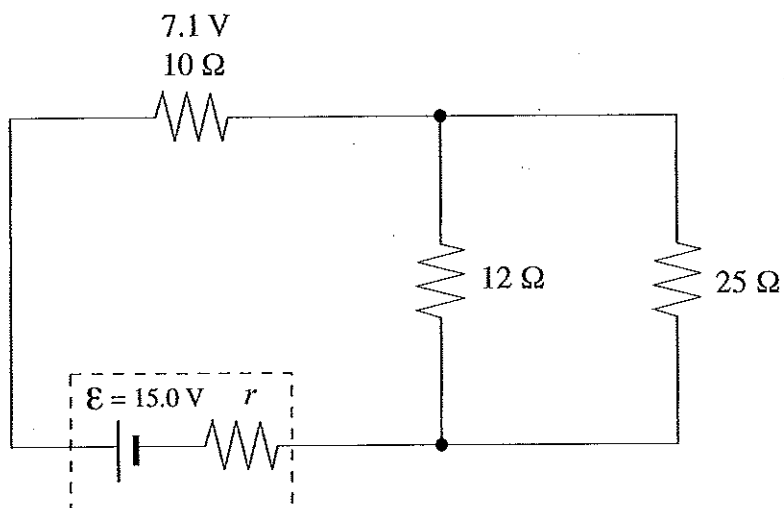
5. An electron with a speed of 3.3×10^7 m/s is directed between charged parallel plates as shown.



- a) What are the magnitude and direction of the electrostatic force on the electron while it is between the plates? (5 marks)
- b) What is the magnitude of the acceleration of the electron while it is between the plates? (2 marks)

JUN -- 2003

6. The potential difference across the $10\ \Omega$ resistor is $7.1\ \text{V}$.



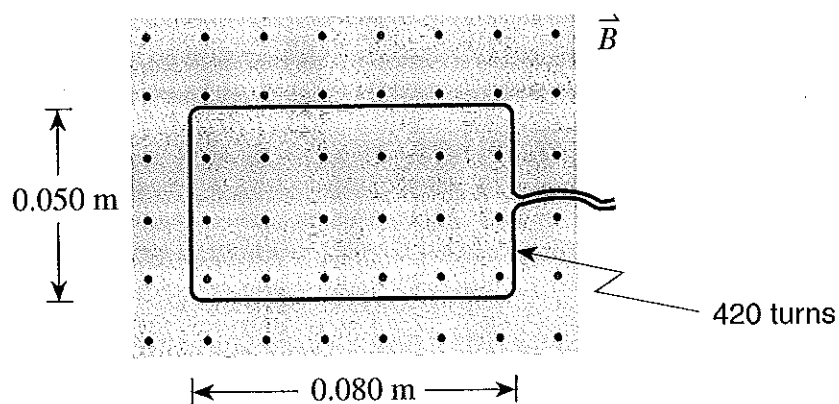
- a) What is the power dissipated by the $25\ \Omega$ resistor?

(4 marks)

- b) What is the internal resistance of the battery?

(3 marks)

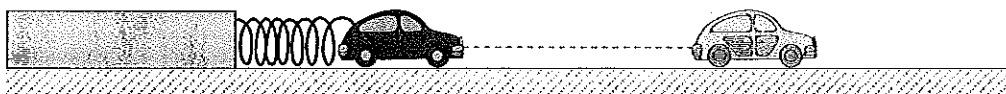
7. A 420-turn rectangular coil is positioned as shown in a 0.14 T magnetic field.



The magnetic field strength is increased over a 0.20 s interval, inducing an average emf of 1.8 V in the coil. What is the final magnetic field strength? (7 marks)

JUN -- 2003

8. A small toy car is placed in a spring-loaded launcher.

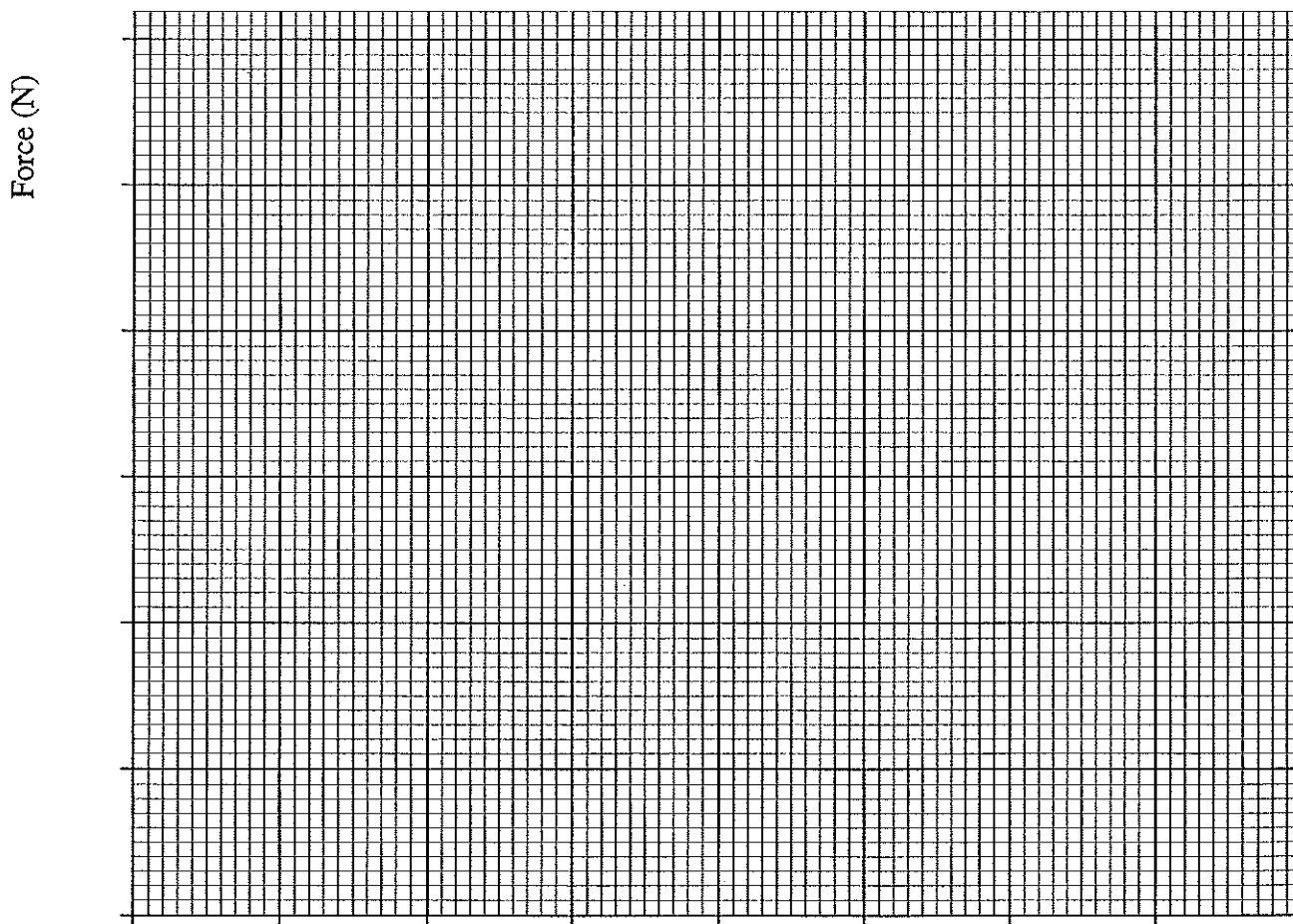


The force needed to compress the spring is recorded as a function of distance.

- a) Plot a graph of force vs. distance using the data table shown.

(2 marks)

Force (N)	Distance (m)
7.5	0.020
13.2	0.035
14.8	0.040
19.1	0.050
23.0	0.060
29.5	0.080



Distance (m)

622

JUN -- 2003

- b) Calculate the area under this graph from distance = 0.0 m to distance = 0.080 m. (2 marks)

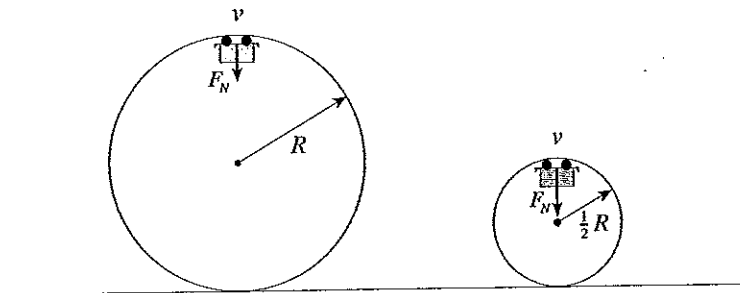
ANSWER:

area: _____

- c) What does this area represent?

(1 mark)

9. During a roller coaster ride, the riders move through two loops, the second being one-half the radius of the first. The riders, however, travel at the same speed at the top of each of these two loops.

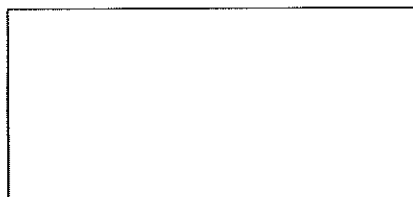


Using principles of physics, explain why the riders would experience a greater normal force at the top of the second smaller loop than at the top of the first, larger loop. (4 marks)

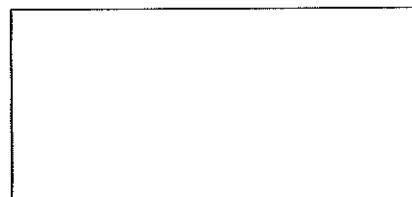
JUN -- 2003

623

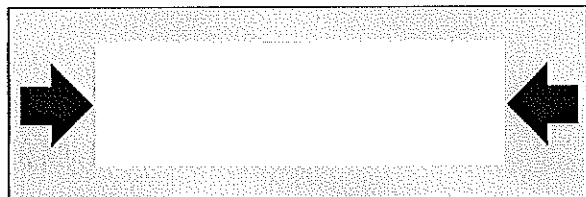
MINISTRY USE ONLY



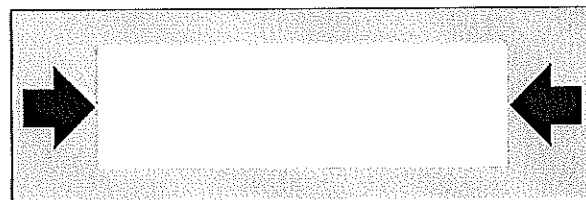
MINISTRY USE ONLY



Place Personal Education Number (PEN) here.



Place Personal Education Number (PEN) here.



**BRITISH
COLUMBIA**
© 2003 Ministry of Education

MINISTRY USE ONLY



Physics 12

AUGUST 2003

Course Code = PH

Student Instructions

1. Place the stickers with your Personal Education Number (PEN) in the allotted spaces above. **Under no circumstance is your name or identification, other than your Personal Education Number, to appear on this booklet.**
2. Ensure that in addition to this examination booklet, you have an **Examination Response Form**. Follow the directions on the front of the Response Form.
3. **Disqualification** from the examination will result if you bring books, paper, notes or unauthorized electronic devices into the examination room.
4. When instructed to open this booklet, **check the numbering of the pages** to ensure that they are numbered in sequence from page one to the last page, which is identified by

END OF EXAMINATION

5. At the end of the examination, place your Response Form inside the front cover of this booklet and return the booklet and your Response Form to the supervisor.

624

PART A: MULTIPLE CHOICE

Value: 60 marks (2 marks per question)

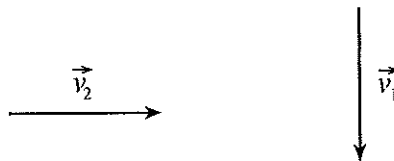
Suggested Time: 60 minutes

INSTRUCTIONS: For each question, select the **best** answer and record your choice on the Response Form provided. Using an HB pencil, completely fill in the circle that has the letter corresponding to your answer.


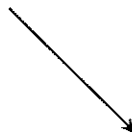
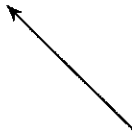

1. The velocity of a moving object as observed from another moving object is called its

- A. relative velocity.
- B. associated velocity.
- C. differential velocity.
- D. comparative velocity.

2. Consider the two vectors shown below.



Which of the choices given best represents $\vec{v}_2 - \vec{v}_1$?

- A.  B.  C.  D. 

3. A green ball rolls off the end of a table at 2.5 m/s. The table top is 1.5 m above the floor. How much time passes before the ball hits the floor?

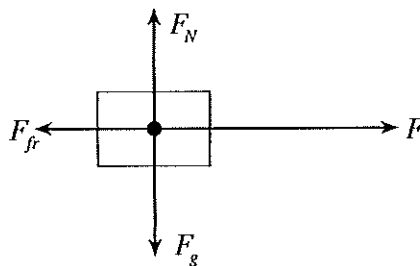
- A. 0.35 s
- B. 0.55 s
- C. 0.60 s
- D. 1.2 s

625

AUG 2003

OVER

4. The free body diagram shown below is for a block being accelerated across a floor to the right by the force F . Which of the following represents the coefficient of friction for this situation?



- A. $\frac{F}{F_g}$
- B. $\frac{F_{fr}}{F}$
- C. $\frac{F_N}{F_g}$
- D. $\frac{F_{fr}}{F_N}$
5. A 6.0 kg object is projected directly upward with an initial speed of 15 m/s. This object experiences an average air resistance force of 24 N. What is the maximum height reached by this object?
- A. 8.2 m
- B. 11 m
- C. 16 m
- D. 19 m
6. Which of the following correctly identifies momentum and impulse as scalar or vector quantities?

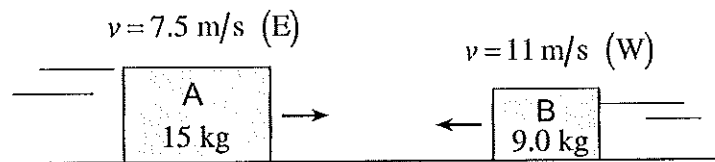
	MOMENTUM	IMPULSE
A.	scalar	scalar
B.	scalar	vector
C.	vector	scalar
D.	vector	vector

7. A 0.26 kg ball travelling due west at 22 m/s was hit by a bat and as a result the ball travelled due east at 18 m/s. If the bat remained in contact with the ball for 0.13 s, what average force did the bat exert on the ball?

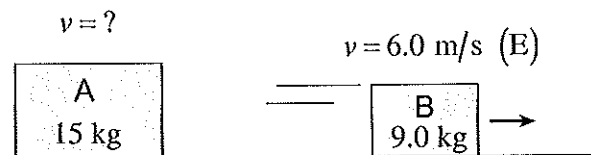
A. 8.0 N
 B. 80 N
 C. 116 N
 D. 310 N

8. Block A of mass 15 kg is travelling at 7.5 m/s due east when it collides with block B of mass 9.0 kg travelling at 11 m/s due west. Block B bounces back at 6.0 m/s.

Before



After

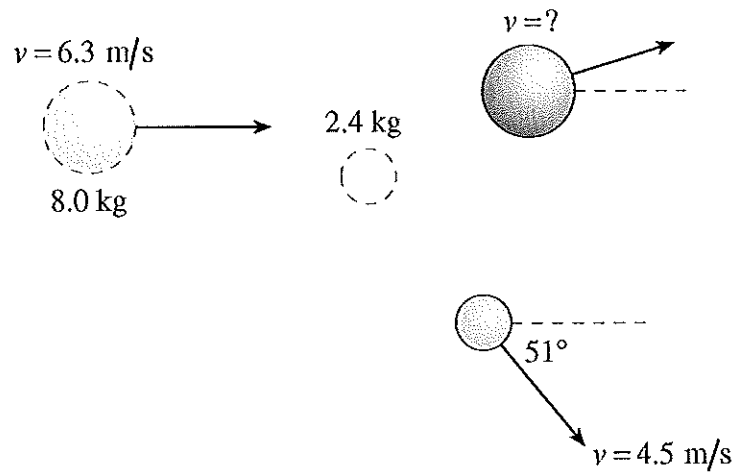


With what speed and in what direction will block A move?

	SPEED	DIRECTION
A.	2.7 m/s	East
B.	2.7 m/s	West
C.	4.5 m/s	East
D.	4.5 m/s	West

AUG 2003

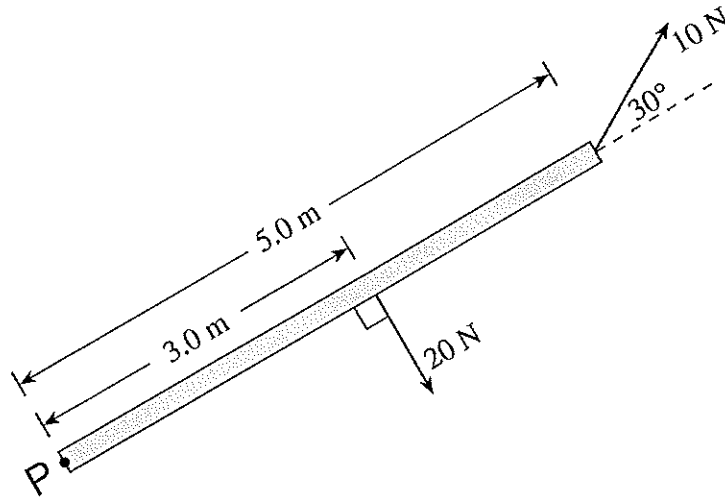
9. An 8.0 kg ball travelling at 6.3 m/s due east strikes a 2.4 kg ball initially at rest. The collision is oblique, causing the 2.4 kg ball to travel at 4.5 m/s at 51° south of east.



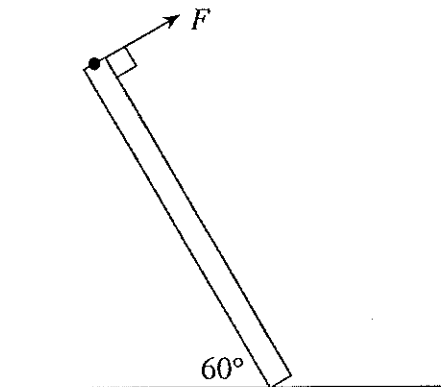
What speed will the 8.0 kg ball have after the collision?

- A. 5.0 m/s
 - B. 5.6 m/s
 - C. 5.8 m/s
 - D. 7.7 m/s
10. A physics exam booklet lying on a table in front of you is in translational equilibrium because
- A. there are no forces acting on it.
 - B. the forces acting on it are balanced.
 - C. the force due to gravity is holding it down.
 - D. surface friction is preventing it from sliding.

11. Determine the sum of the torques about the point P for the two forces shown below acting on a very light wooden beam. (Ignore its weight.)



- A. $10 \text{ N} \cdot \text{m}$
B. $17 \text{ N} \cdot \text{m}$
C. $35 \text{ N} \cdot \text{m}$
D. $85 \text{ N} \cdot \text{m}$
12. The 0.10 kg metre stick shown below is held up by the perpendicular force F . The bottom of the metre stick is on the verge of sliding to the right.



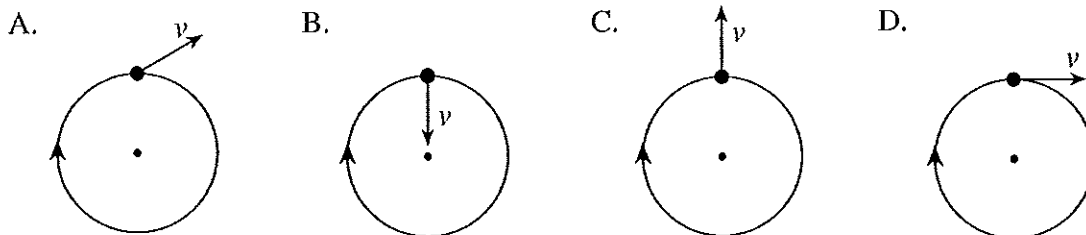
Determine the size of the friction force being provided by the floor.

- A. 0.12 N
B. 0.21 N
C. 0.25 N
D. 0.49 N

AUG 2003

OVER

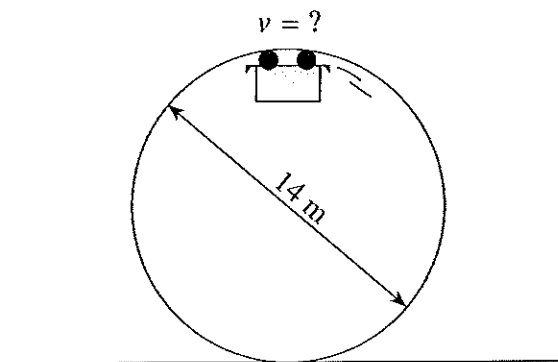
13. Which of the following correctly shows the velocity vector, v , for an object in uniform circular motion?



14. An airplane is flying in a horizontal circle at a speed of 86 m/s . The 72 kg pilot does not want his centripetal acceleration to exceed 68.6 m/s^2 . What is the minimum radius of the circular path?

- A. 90 m
 B. 110 m
 C. 750 m
 D. 7700 m

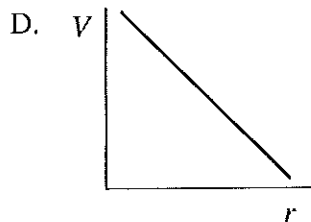
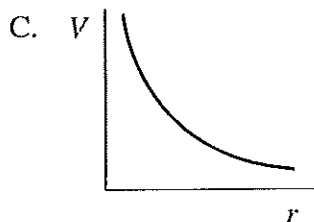
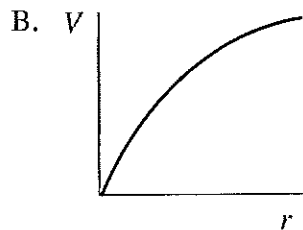
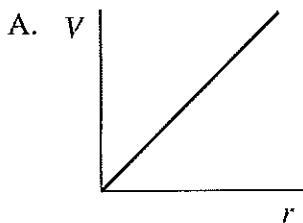
15. A roller coaster car is moving past the top of a loop of diameter 14 m as shown below. The normal force (directed downwards) provided by the track at the top of the loop is equal to one-half the weight of the car.



What is the speed of the coaster car at this point?

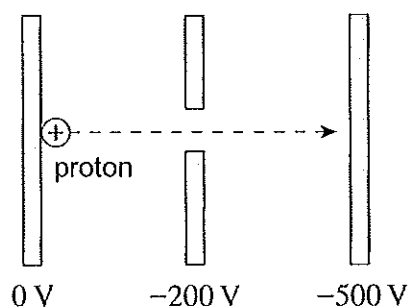
- A. 5.9 m/s
 B. 8.3 m/s
 C. 10 m/s
 D. 14 m/s

16. The earth pulls an apple towards its centre with a force of 4.9 N. Which of the following is correct?
- A. The apple attracts the earth with a force of 4.9 N.
 - B. The apple does not exert an attractive force on the earth.
 - C. The apple attracts the earth with a force that is less than 4.9 N.
 - D. The apple attracts the earth with a force that is more than 4.9 N.
17. A 2500 kg space probe is sitting on the surface of an asteroid of mass 4.8×10^{14} kg. The asteroid has a radius of 3.5×10^4 m. What is the force of attraction between the space probe and the asteroid?
- A. 2.6×10^{-5} N
 - B. 6.5×10^{-2} N
 - C. 9.1×10^{-1} N
 - D. 2.3×10^3 N
18. A satellite circling the earth completes each orbit in 5.10×10^3 s. What is the gravitational field strength at the location of the satellite's orbit?
- A. 3.08 m/s^2
 - B. 9.68 m/s^2
 - C. 9.72 m/s^2
 - D. 9.80 m/s^2
19. Which of the following shows how electric potential varies with distance from a positive point charge?



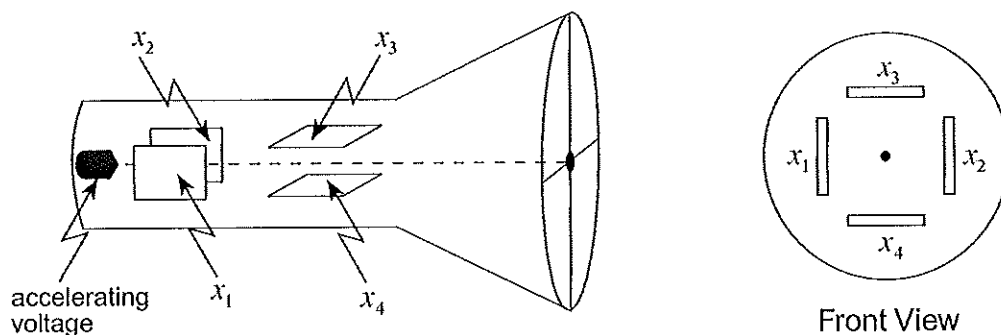
AUG 2003

20. At what speed will a proton, accelerated from rest, hit the plate at the right?

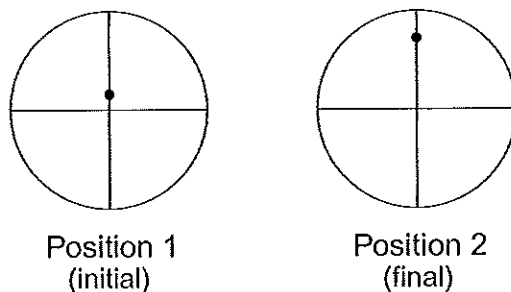


- A. 2.2×10^5 m/s
- B. 2.4×10^5 m/s
- C. 3.1×10^5 m/s
- D. 4.4×10^5 m/s

21. Two views of a cathode ray tube are shown below.



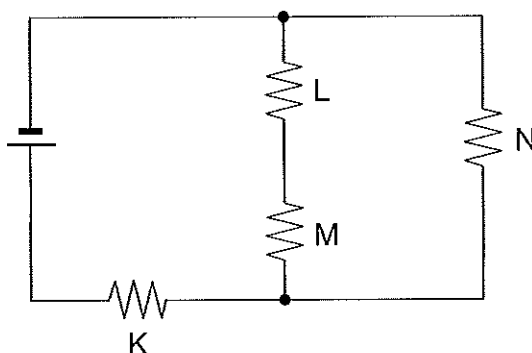
The beam is then adjusted to Position 1 as shown below.



In order to change the electron beam from Position 1 to Position 2, a student can

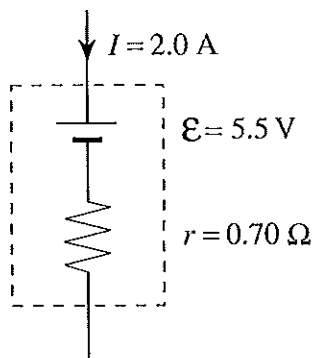
- A. make plate x_2 more positive.
- B. make plate x_4 more positive.
- C. increase the accelerating voltage.
- D. decrease the accelerating voltage.

22. All the resistors shown in the circuit have the same resistance value.



Which resistor dissipates the most heat?

- A. K
 - B. L
 - C. M
 - D. N
23. A battery is being charged by a 2.0 A current as shown in the diagram below.



What is the terminal voltage of this battery?

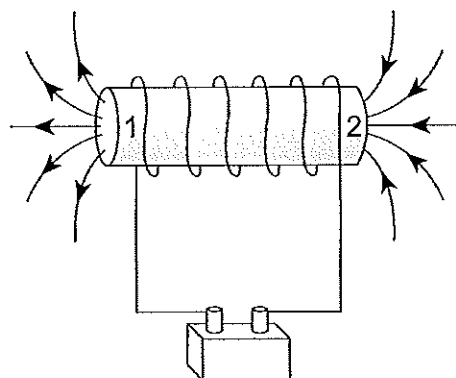
- A. 1.4 V
- B. 4.1 V
- C. 5.5 V
- D. 6.9 V

AUG 2003

633

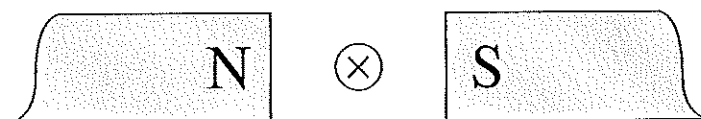
OVER

24. Identify the magnetic poles 1 and 2 of the current-carrying solenoid in the diagram below.



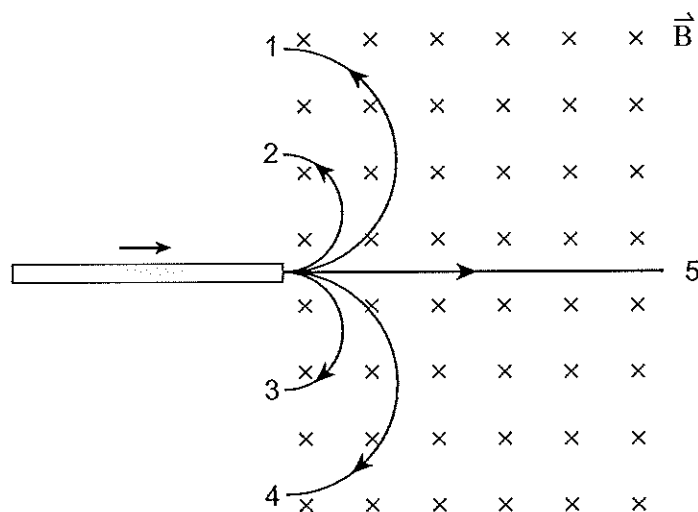
	POLE 1	POLE 2
A.	North	North
B.	North	South
C.	South	North
D.	South	South

25. Determine the direction of the magnetic force on the current-carrying conductor in the diagram below.



- A. Towards the left
- B. Towards the right
- C. Towards the top of the page
- D. Towards the bottom of the page

26. A beam made up of ions of various charges and masses enters a uniform magnetic field as shown.

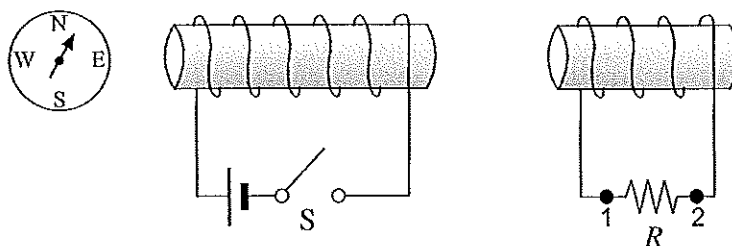


One type of ion is observed to follow path 2. Which path describes the one taken by an oppositely charged ion with twice the mass and twice the charge? (Assume all ions have the same speed.)

- A. Path 1
 - B. Path 3
 - C. Path 4
 - D. Path 5
27. A step-down transformer is required to operate a 12 V, 25 W halogen lamp. Which of the following sets of conditions could apply to this transformer?
- A. $N_p = 20$, $N_s = 200$
 - B. $V_p = 120$ V, $I_s = 0.21$ A
 - C. $I_p = 2.1$ A, $I_s = 2.1$ A
 - D. $V_p = 120$ V, $I_p = 0.21$ A

AUG 2003

28. A 0.25 m wire is perpendicular to a uniform 0.20 T magnetic field. What force is exerted on this wire when it carries a 15 A current?
- A. 0.12 N
B. 0.75 N
C. 3.0 N
D. 6.0 N
29. As switch S is closed, in what direction does the compass needle point and what is the direction of the current through resistor R?



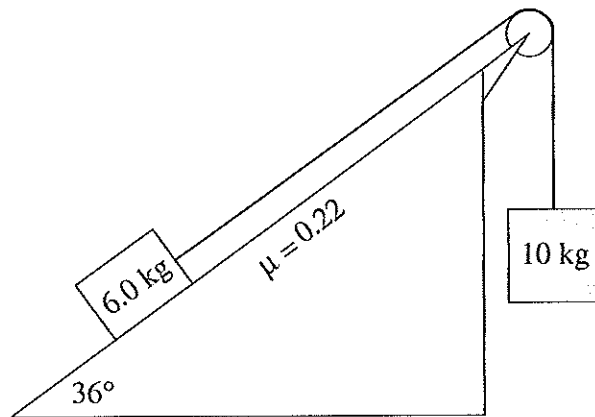
	COMPASS NEEDLE DIRECTION	CURRENT DIRECTION THROUGH R
A.	west	From 1 to 2
B.	west	From 2 to 1
C.	east	From 1 to 2
D.	east	From 2 to 1

30. One method for determining masses of heavy ions involves timing their orbital period in a known magnetic field. What is the mass of a singly charged ion that makes 7.0 revolutions in 1.3×10^{-3} s in a 4.5×10^{-2} T field?
- A. 2.1×10^{-25} kg
B. 1.3×10^{-24} kg
C. 6.5×10^{-23} kg
D. 5.0×10^{-20} kg

AUG 2003

This is the end of the multiple-choice section.
Answer the remaining questions directly in this examination booklet.

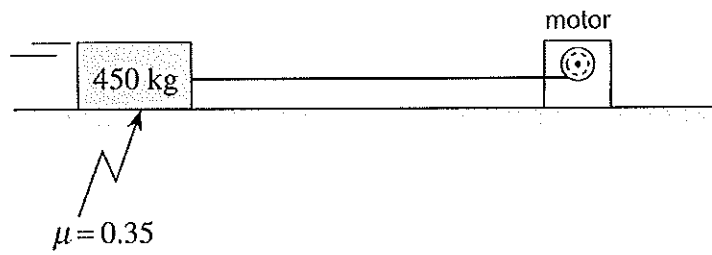
1. Determine the acceleration of the system of masses shown below when it is released. (7 marks)



AUG 2003

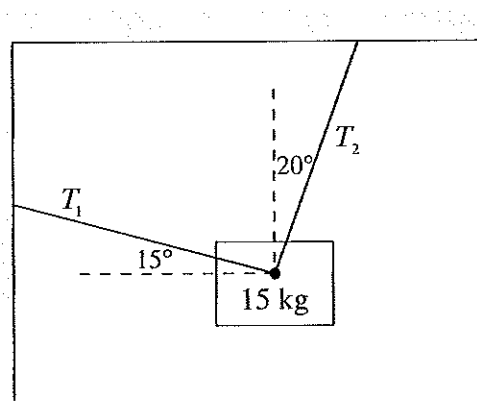
637

2. A motor using $3.7 \times 10^3 \text{ W}$ is 81% efficient. This motor is pulling a 450 kg block along a horizontal surface. If the coefficient of friction is 0.35, what is the speed of the block? (7 marks)



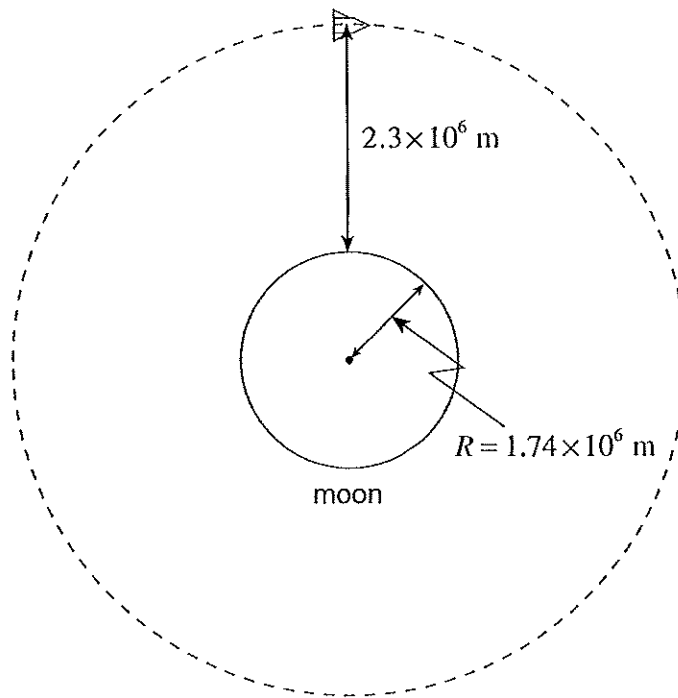
AUG 2003

3. A 15 kg store sign is hung using two ropes as shown below. Determine the tension in each rope. (7 marks)



AUG 2003

4. A 1500 kg satellite orbits the moon at an altitude of 2.3×10^6 m.



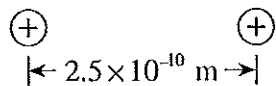
What is the period of the satellite?

(7 marks)

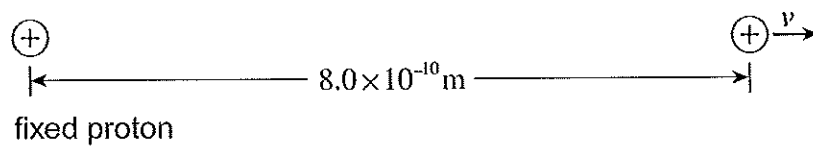
AUG 2003

640

5. Two protons are initially held at rest 2.5×10^{-10} m apart.



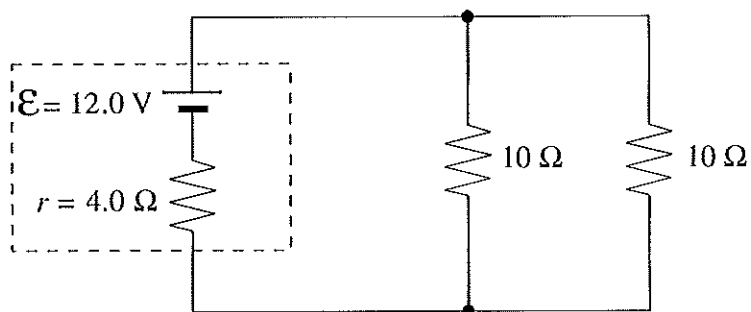
If one of the protons is released as shown below, what is its speed when it is 8.0×10^{-10} m from the fixed proton? (7 marks)



AUG 2003

6. a) For the circuit below, what is the terminal voltage of the battery?

(4 marks)



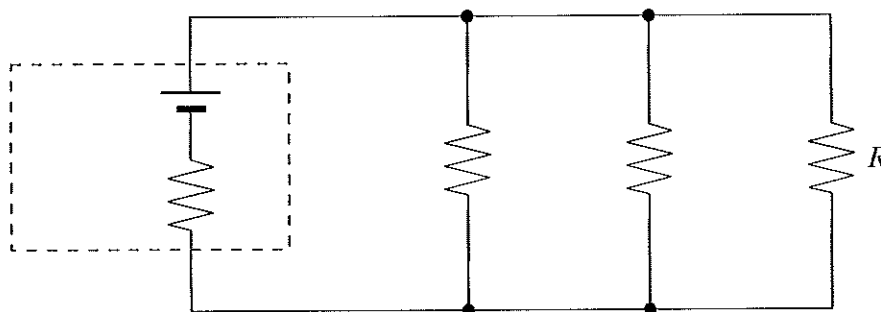
AUG 2003

ANSWER:

terminal voltage: _____

642

- b) If resistor R is added in parallel to the circuit as shown, what is the effect on the terminal voltage? (1 mark)

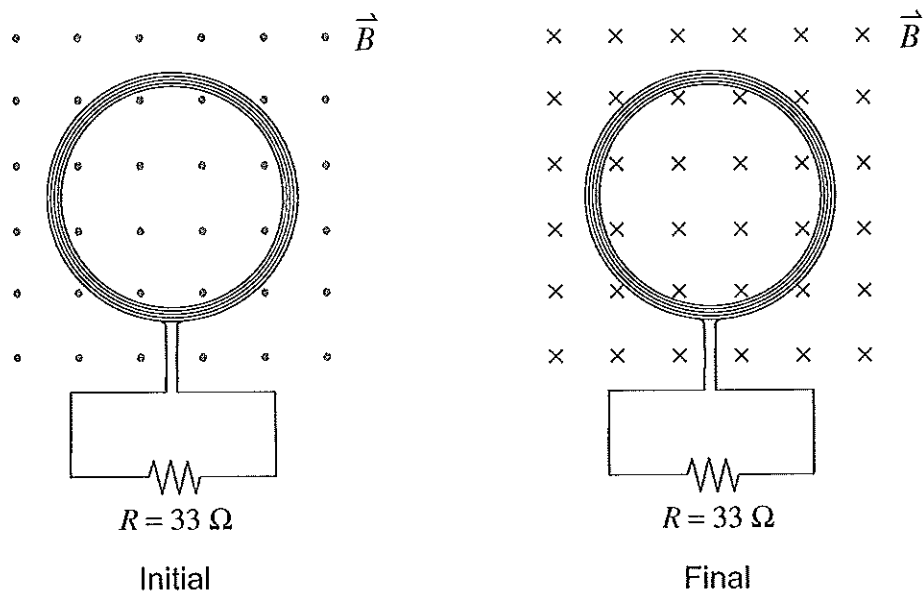


- ☐ increase
☐ no change
☐ decrease

- c) Using principles of physics, explain your choice for b). (4 marks)

AUG 2003

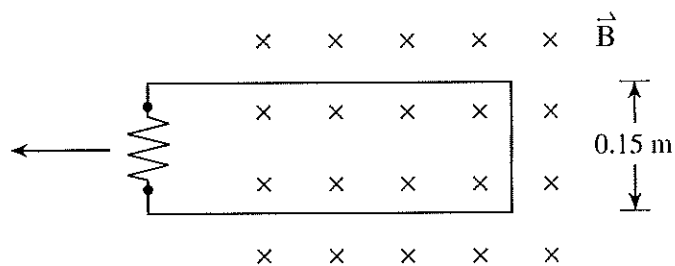
7. A 0.120 m diameter coil consisting of 200 loops is placed in a 0.35 T magnetic field. The magnetic field is changed to 0.25 T in the opposite direction in 0.80 s.



What is the magnitude of the current through the $33 \, \Omega$ resistor connected to the coil?
(Ignore the resistance of the coil.) (7 marks)

AUG 2003

8. A conducting loop is pulled at various speeds through a region of constant magnetic field strength.



A student measures the potential difference across the resistor in the loop for each trial and records the following data.

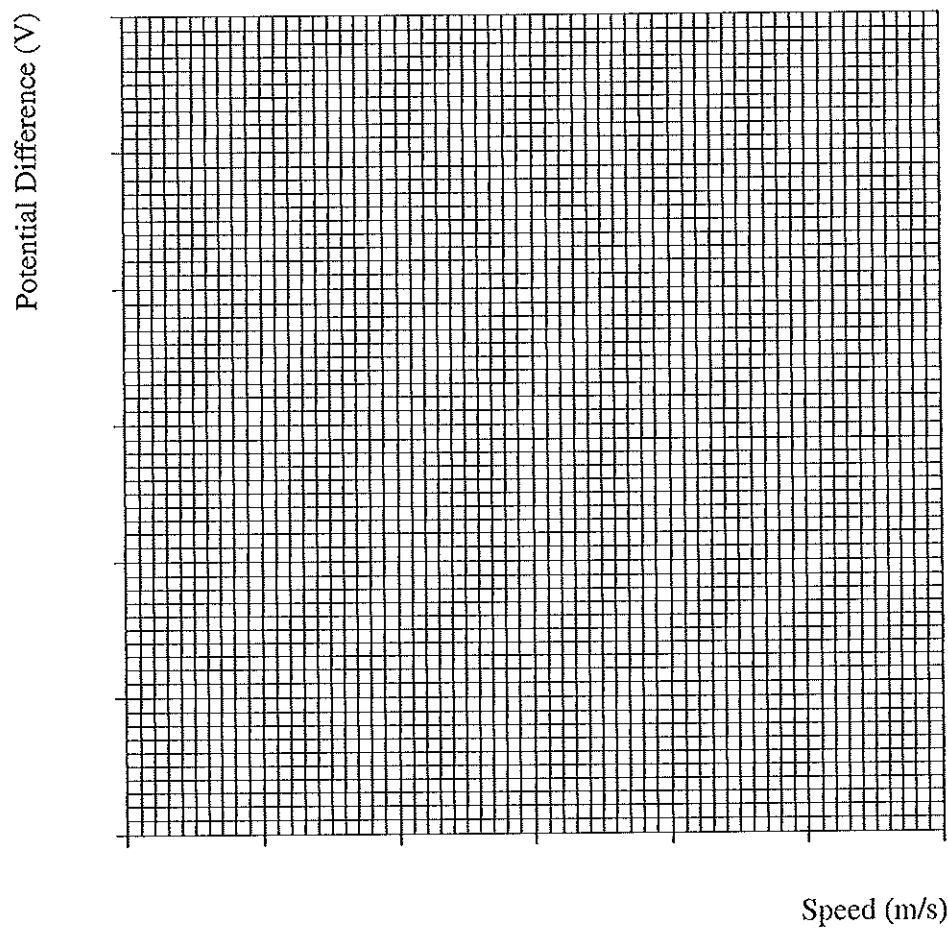
POTENTIAL DIFFERENCE (V)	SPEED (m/s)
0.10	1.5
0.17	2.5
0.20	3.0
0.24	4.0
0.34	5.5
0.41	6.0

AUG 2003

645

a) Plot a graph of the potential difference vs. speed.

(2 marks)



b) Calculate the slope of your graph. (Include units.)

(1 mark)

c) What is the strength of the magnetic field?

(2 marks)

AUG 2003

ANSWER:

b) slope: _____

c) strength of magnetic field:

646

OVER

9. A crate is being accelerated across a rough concrete floor by a rope as shown in position 1 below. It is noticed that when the rope is lifted to a small angle θ as shown in position 2 the acceleration of the crate increases (F remains the same).



Using principles of physics, explain why this is the case.

(4 marks)

END OF EXAMINATION

AUG 2003

647

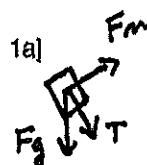
B. Problems ***always do the problems

June 99

1b) 5.34 e

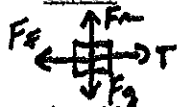
1a) vert 16.4 m/s hor 30.9 m/s 1b) 165 m 2) 17.9 m/s 3a) $F_a=349$ N, $F_b=484$ N 3b) Increases 3c) As he moves right the clockwise torque increases about A, so the counter-clockwise torque must increase, length is constant so greater force at B 4) 7.12×10^9 J 5a) 3.19×10^3 V/m 5b) 79.8 V 5c) positive (long side) to top plate, neg to bottom plate 6a) 11.7 volts 6b) 12.6 V 7) -0.089 T 8a) linear graph slope of 633 N/m 8b) 2.85×10^4 J 9a) T 9b) positive charge turns the other way, more mass larger R according to $F_c=F_b$

Aug 99



1a) 1b) 7.29 m/s^2 2) 0.115 m 3) 1.44×10^3 m/s 4b) less 4c) $v^2 r = \text{constant}$
5a) -4.5×10^4 V 5b) 1.8×10^4 V 5c) +2.0 uC 6a) 9.0Ω 6b) 33 V 7) 34.5 A
8a) straight line -- neg slope 8b) -1.5Ω 8c) resistance 9) $W = \Delta E$, E_k is proportional to V^2

Jan 00



1b) 5.65 m/s^2 2a) 1.16×10^4 J 2b) 193 N 3) 302 N, 224 N 4a) 3.75 m/s^2 4b) 6.42×10^{23} kg
5) 3.94 J 6a) $.889 \Omega$ 6b&c) omit 7) 10.8 V 8a) 50 kg 8b) half mass

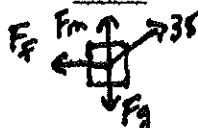
June 00

1) 0.15 2) 5.52 m/s, 31.8 deg N of E 3) 1.59×10^3 N 4a) 7.73×10^3 m/s 4b) less than 4c) v is proportional to $r^{1/2}$
5a) 2.4×10^{-15} J 5b) 1.5×10^4 V 6) 135 V 7a) 7.33 V 7b) 4.5 A 8a) straight line 8b) 85 m 8c) distance travelled
9) diagram #1 $T = F_g$ diagram #2 $T = F_c + F_g$

Aug 00

1a) 17 m/s 2b) 69° S of E 2a) 3.8×10^5 kg m/s 2b) 2.3×10^4 N/s 2c) p must be conserved 2d) explosion adds E_k
3) 1.49×10^4 , 3.31×10^4 N 4) 1.2×10^{10} J 5) 2.0×10^6 m/s 6) 26 W 7a) 320 7b) 1.0×10^5 W 8a) 7.6 W
8b) 38 W 9) you must have a vertical component to oppose weight of sign

Jan 01



1b) 3.47 m/s^2 2) 5.95 m 3) 3.76 kg 4a) 3.61 N/kg 4b) 421 N 5) 2.25×10^6 N/C 6) 70Ω
7a) 75 m 7b) circular $F_b=F_c$ 8a) 1.88×10^3 N-s 8b) impulse 8c) lower wider graph - same area
9) $F_c = F_g$ --- T is constant -- same R

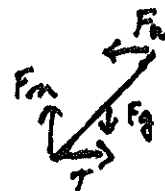
June 01

1a) 1b) 2.4 m/s^2 1c) straight down 1d) F_{net} is 0 so $f_g = T$ 2) 2.95 m/s, 29.6° W of S 3) 215 N
4a) 7.86×10^{24} kg 4b) 2.7×10^{10} J 4c) -2.74×10 J 5) 4.29×10^4 V 6a) 12 V 6b) .16 W
7a) 3.41×10^{-2} T 7b) 6.73×10^{-2} m 8a) 1.6 N 8b) .57 N/A 8c) 9.5 T 9) as you move to the right from Q_1 the field changes from strong right to strong left -- zero at some point nearer Q_1 than Q_2 .

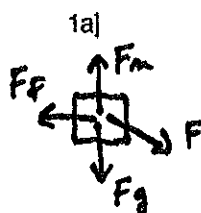
Aug 01

1) 55m 2a) 8.0 m/s 2b) 96 J 2c) same Imp - less v - less E_k because v is squared 3a)
3b) 82 N 4) 30 J 5a) 1.3×10^7 m/s 5b) 7.2×10^{-17} N 6a) 4.4 A 6b) 2.7Ω 6c) 53 W
6c) a bulb 7a) 1.3×10^{-3} T 7b) 1600 turns /m 8a)

8b) 63 J 9) higher terminal voltage



Jan 02

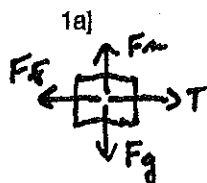


- 1b) 7.96 m/s^2 2a) 9.0 m 2b) same 2c) higher a for less distance ($E_k = E_p$)
3) $3.55 \times 10^3 \text{ N}$ 4) $1.17 \times 10^{11} \text{ J}$ 5a) $3.51 \times 10 \text{ J}$ 5b) $2.93 \times 10^4 \text{ C}$
5c) 1.83×10^{23} electrons 6) $.84 \text{ V}$ 7a) $3.16 \times 10^{10} \text{ m/s}^2$ 7b) $1.5 \times 10^{-4} \text{ m}$
8a) best fitting straight line 8b) 6.89 V/A 8c) resistance of motor
9a) curve is wider and flatter 9b) longer contact time - more impulse

June 02

- 1) 21 m/s 13.3° below horizontal 2) 12.3 m/s 3) $2.63 \times 10^3 \text{ N}$ 4a) 24.6 s 4b) faster - T less - more f_c -- astronaut would feel heavier 5) 900 V 6) cell A $.32 \text{ W}$, cell B $.35 \text{ W}$ 7) 8.37 V
8a) best fitting straight line 8b) $8.0 \times 10^3 \text{ N}$ 8c) force on car 9) Lenz's Law

Aug 02



- 1b) 6.9 N 2) 33 m/s , 47° N of E 3) 76 N 4) $2.0 \times 10^7 \text{ m}$ 5a) $9.2 \times 10^{10} \text{ m/s}^2$
5b) .25 the mass and .5 the charge so 2 x the acceleration 6) 8.4 J 7) $.24 \text{ T/s}$
8a) best fitting straight line 8b) 1.9 m/s^2 8c) 3.8 m/s^2 9) Block B experiences more friction (greater normal) plus more distance so way more work.

Jan 03

- 1a) 28.3 m/s 1b) 40.8 m 2a) 14 N 2b) part a - greater change in v -- greater change in p -- greater Imp -- greater F
3) $F_1 = 283 \text{ N}$ $F_2 = 510 \text{ N}$ 4) $4.3 \times 10^7 \text{ m}$ 5a) $1.52 \times 10^6 \text{ m/s}$ 5b) 3.8 m 6a) 6.2 V 6b) none 7a) 0.817 A
7b) clockwise 8a) straight line intersecting y intercept at 0.12 m/s 8b) area under line = $.53 \text{ m}$ 8c) initial velocity
9) Rope 2 must have two components and one of them = rope 1 for $F_{net} = 0$ so rope must be greater than rope

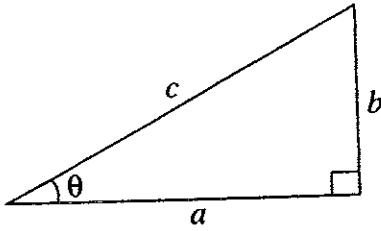
June 03

- 1a) 2.68 N 1b) 14.7 N 1c) 16.8 N 2) 7.13 m/s , 8.1 deg S of E 3) $8.9 \times 10^3 \text{ N}$ 4a) $5.4 \times 10^3 \text{ s}$
4b) M is proportional to $1/T^2$ -- constant r - smaller M = larger T 5a) $1.04 \times 10^{-15} \text{ N}$ towards bottom plate
5b) $1.1 \times 10^{15} \text{ m/s}^2$ 6a) 1.33 W 6b) 3.01 ohms 7) $-.074 \text{ T}$??? 8) straight line through $(.08, 30)$
8b) 1.2 J 8c) work done on the spring 9) since $F_c = F_n + F_g$ and F_g is constant then circle 2 has a smaller R therefore requires more F_c since F_c is proportional to R then more $F_c =$ more F_n

Aug 03

- 1) 3.31 m/s^2 2) 1.94 m/s 3a) 50 N 3b) 140 N 4) $2.3 \times 10^4 \text{ s}$ 5) $2.7 \times 10^4 \text{ m/s}$ 6a) 6.7 V 6b) decrease
6c) r in parallel - r_t down - I_r up - V_t down 7) $.057 \text{ A}$ 8a) straight line through origin 8b) approx 0.065 Vs/m
8c) approx 0.43 T 9) F_y reduces F_n which reduces F_f -- F_x stays much the same.

For Right-angled Triangles:

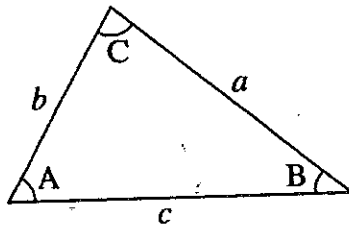


$$a^2 + b^2 = c^2$$

$$\sin \theta = \frac{b}{c} \quad \cos \theta = \frac{a}{c} \quad \tan \theta = \frac{b}{a}$$

$$\text{area} = \frac{1}{2} ab$$

For All Triangles:



$$\text{area} = \frac{1}{2} \text{base} \times \text{height}$$

$$\sin 2A = 2 \sin A \cos A$$

$$\text{Sine Law: } \frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$$

$$\text{Cosine Law: } c^2 = a^2 + b^2 - 2ab \cos C$$

Circle:

$$\text{Circumference} = 2\pi r$$

$$\text{Area} = \pi r^2$$

Sphere:

$$\text{Surface area} = 4\pi r^2$$

$$\text{Volume} = \frac{4}{3}\pi r^3$$

Quadratic Equation:

$$\text{If } ax^2 + bx + c = 0, \text{ then } x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Gravitational constant	$G = 6.67 \times 10^{-11} \text{ N} \cdot \text{m}^2/\text{kg}^2$
Acceleration due to gravity at the surface of Earth (for the purposes of this examination)	$g = 9.80 \text{ m/s}^2$
Earth	
radius	$= 6.38 \times 10^6 \text{ m}$
radius of orbit about Sun	$= 1.50 \times 10^{11} \text{ m}$
period of rotation	$= 8.61 \times 10^4 \text{ s}$
period of revolution about Sun	$= 3.16 \times 10^7 \text{ s}$
mass	$= 5.98 \times 10^{24} \text{ kg}$
Moon	
radius	$= 1.74 \times 10^6 \text{ m}$
radius of orbit about Earth	$= 3.84 \times 10^8 \text{ m}$
period of rotation	$= 2.36 \times 10^6 \text{ s}$
period of revolution about Earth	$= 2.36 \times 10^6 \text{ s}$
mass	$= 7.35 \times 10^{22} \text{ kg}$
Sun	
mass	$= 1.98 \times 10^{30} \text{ kg}$
Constant in Coulomb's Law	$k = 9.00 \times 10^9 \text{ N} \cdot \text{m}^2/\text{C}^2$
Elementary charge	$e = 1.60 \times 10^{-19} \text{ C}$
Mass of electron	$m_e = 9.11 \times 10^{-31} \text{ kg}$
Mass of proton	$m_p = 1.67 \times 10^{-27} \text{ kg}$
Mass of neutron	$m_n = 1.68 \times 10^{-27} \text{ kg}$
Permeability of free space	$\mu_o = 4\pi \times 10^{-7} \text{ T} \cdot \text{m/A}$
Planck's constant	$h = 6.63 \times 10^{-34} \text{ J} \cdot \text{s}$ $h = 4.14 \times 10^{-15} \text{ eV} \cdot \text{s}$
Speed of light	$c = 3.00 \times 10^8 \text{ m/s}$
Rydberg's constant	$R = 1.097 \times 10^7 \text{ m}^{-1}$
Unified atomic mass unit	$u = 1.66 \times 10^{-27} \text{ kg}$
Boltzmann's constant	$k = 1.38 \times 10^{-23} \text{ J/K}$
Gas constant	$R = 8.31 \text{ J/mol} \cdot \text{K}$
Density of water	$= 1.00 \times 10^3 \text{ kg/m}^3$
Density of air	$= 1.29 \text{ kg/m}^3$
Standard atmospheric pressure	$= 1.01 \times 10^5 \text{ Pa}$
Volume of one mole of gas at STP	$= 22.4 \text{ L} (2.24 \times 10^{-2} \text{ m}^3)$
Avogadro's number	$N = 6.02 \times 10^{23} \text{ particles/mol}$
Absolute zero	$= -273^\circ \text{C}$

**You may detach this page for convenient reference.
Exercise care when tearing along perforations.**