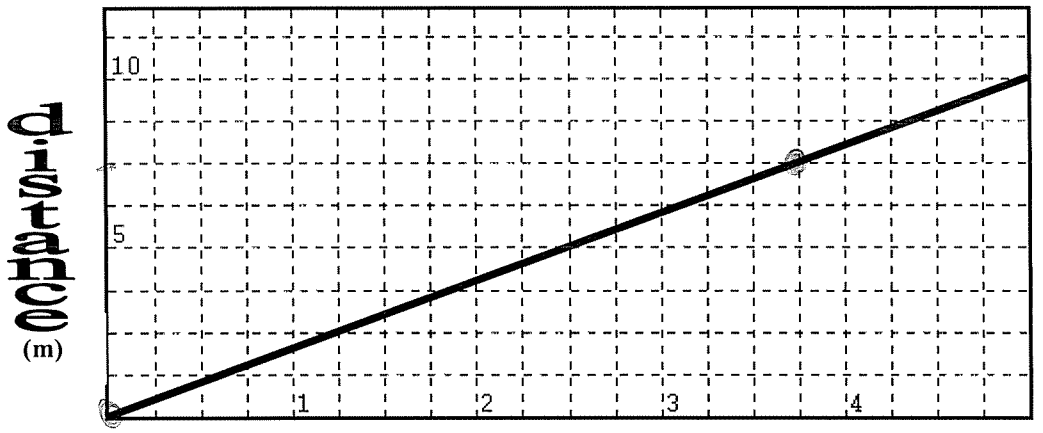
Graphical Analysis Review

1) On any question with a graph when not sure how to proceed you should:

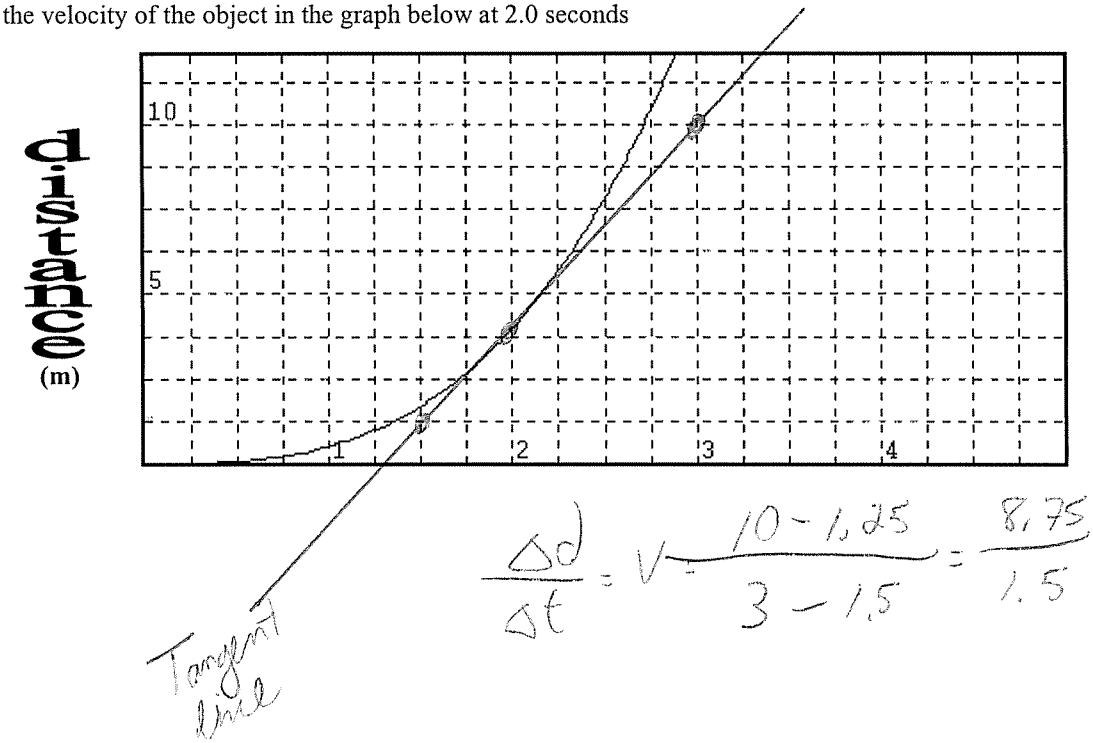
find the slope

2) Find the velocity on the graph



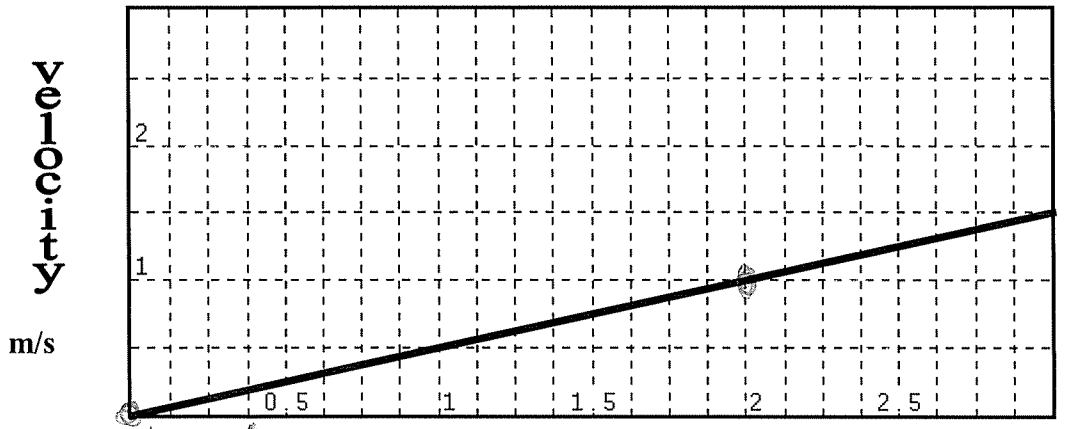
$\frac{\Delta d}{\Delta t} = v = \frac{7.5 - 0}{3.75 - 0} = \frac{7.5}{3.75} = 2.0 \frac{m}{s}$

3) Find the velocity of the object in the graph below at 2.0 seconds



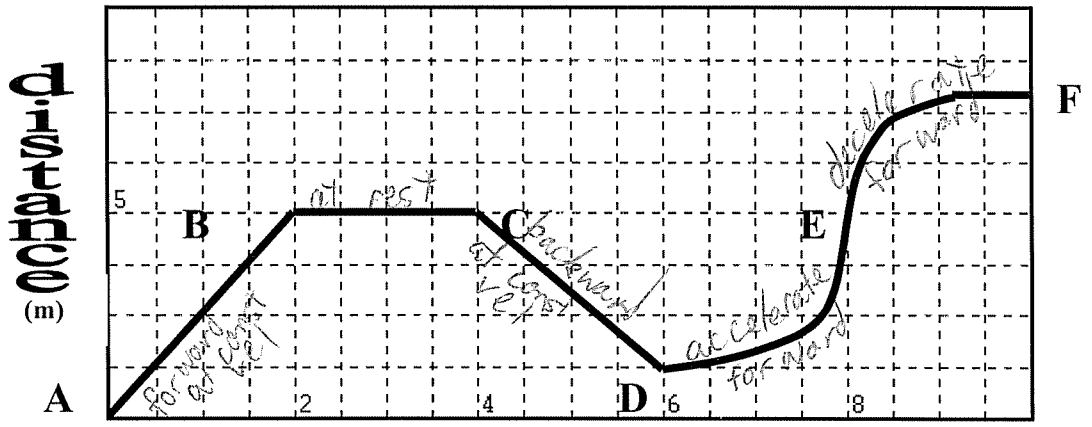
$\frac{\Delta d}{\Delta t} = v = \frac{10 - 1.25}{3 - 1.5} = \frac{8.75}{1.5} = 5.83 \frac{m}{s}$

4) Find the acceleration on the graph below and the distance travelled.



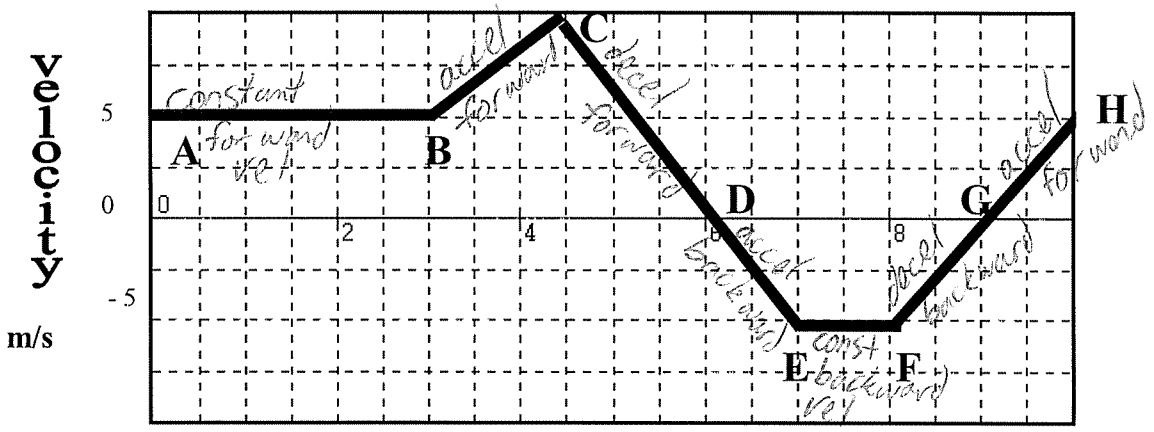
$a = \frac{\Delta v}{\Delta t} = \frac{2-0}{2-0} = 0.5\ m/s^2$

5) Describe what the object is doing between each point on the graph, include direction



Time (s)

6) State what the object is doing between each point on the graph



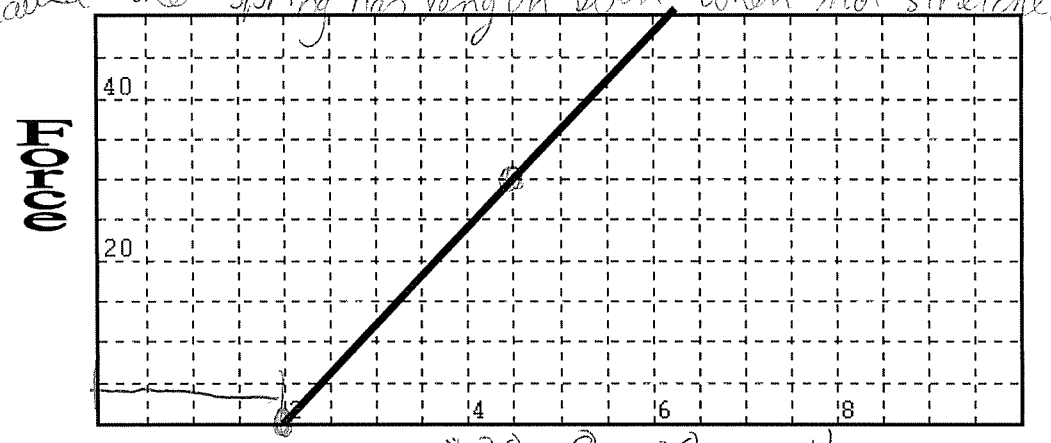
Time(s)

7) What is the initial velocity in the previous graph?

$5\ m/s$

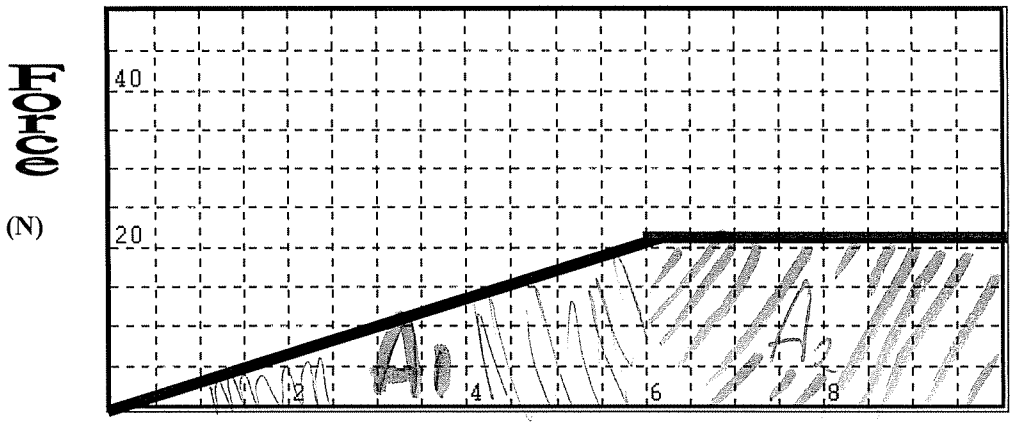
8) On the following graph determine the spring constant include a unit calculation. Why is the x intercept not zero?

Because the spring has length even when not stretched



$Fe = kx \quad \frac{Fe}{x} = slope = k = \frac{30-0}{4.5-2} = \frac{30}{2.5} = 12\ N/m$

9) What is the work done in the graph below?



$A_1 = \frac{1}{2}bh$

$= 60$

$A_2 = bh$

$= 80$

$Work = 60 + 80$

$140\ J$

10) On a graph of Ff vs. Fn what physical quantity does the slope represent? What are its units?

coefficient of friction has none

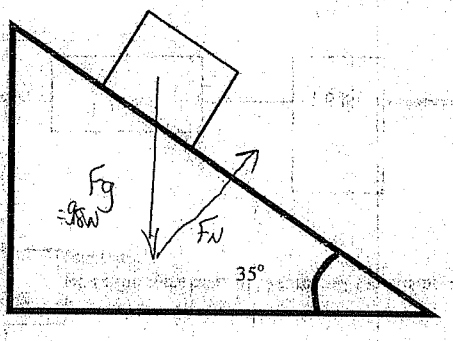
Kinematics Review

Solve the following problems using the principles and equations of kinematics.

1) The average velocity of a min-bike is 15.0km/h, how long will it take to go 35.0m? 8.4s
2) A sprinter starting from rest reaches a final velocity of 28.8 km/h. What is her average velocity? 4
3) A coin is dropped and strikes the earth with a velocity of 15.15 m/s. For how long was it falling, and what from what height did it fall? 1.55 s, 11.7 m
4) A rocket lifts off from Earth at 13.3 m/s^2 from the launch pad, how high into the atmosphere does it rise during the first five seconds of its path? 166.3 m
5) A truck accelerates from rest to a velocity of 22.4 m/s at a rate of 0.60 m/s^2. How long was it accelerating and how far did it travel while accelerating? 417.8m, 37.35
6) A car in a school zone accelerates from 85 km/h to 120 km/h in 9.2 seconds. What was its acceleration? 1.05 $\frac{m}{s^2}$
7) How long will it take for a rock to fall to the ground if dropped from a height of 92.0m? 4.3 s
8) A rock is thrown down from a rail trestle with height 13.0 m at velocity 18.8 m/s. With what velocity will it strike the ground? 24.7 $\frac{m}{s}$
9) A car travelling at 90.0 km/h comes to a stop in 12.0s, what was its acceleration? $-2.08 \frac{m}{s^2}$
10) A car travelling at 60.0 km/h accelerates to 90.0 km/h. How long does this take and how far does the car travel in this time? 4.1s 86.5 m
11) A rock is dropped from a bridge and strikes the water below 24.0 seconds later. With what speed did it strike the water and from what height was it dropped? 235 $\frac{m}{s}$ 2822 m
12) A bullet is fired upward from a gun and reaches a maximum height of 2100 m. What is its velocity at the high point, what was its initial velocity, and how long was it **in the air**? 0 203 $\frac{m}{s}$ 41.4 s
13) A cat is thrown upward from the edge of a building with velocity 2.0 m/s. If the cat then falls the entire height of the building (30.0 m) with what velocity will it strike the ground? 24.3 $\frac{m}{s}$

Forces Review, answer on separate pages

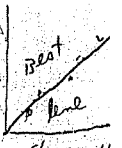
1) Calculate the force of gravity on a 5.0 kg mass at the earth's surface. 49N
2) Calculate the force of gravity on a 5.0 kg mass 10.0 km above the earth's surface. 48.8N
3) Calculate the spring constant of a spring which is stretched from 3.0 cm to 5.0 cm by a 12 N force. 6 N/cm
4) A car moves from rest to 200m in 2.5 s. What was the net force exerted by the car if its mass was 1500 kg? 9.6×10^4N
5) Sketch the diagram below showing the force of gravity, and normal force on the 10.0 kg mass.



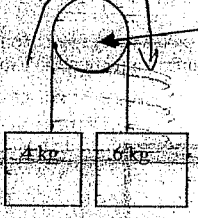
98N 80.3N

6) In the figure above calculate the magnitude of Fg and Fn, what will be the result of these two forces? 56N down ramp
7) For the figure above what force would prevent the mass from moving? What minimum value would it need to have? Ff 56N up
8) Use your answer from #7 to calculate the lowest coefficient of friction necessary to hold the object in place. 0.697
9) A 15.0 kg mass is hung from a cable. What force is acting to pull the mass down, find its magnitude and direction. Fg 147N down
10) What force is holding the mass in #10 up? What is its magnitude and direction? Fe 147N up
11) If the above cable is stretched 1.5 cm when the mass is hung on it what is the spring constant of the cable? 98 N/cm
12) On Mars several masses were hung on spring scales, and the following data collected. Determine the gravitational acceleration of Mars.

Mass (kg)	Force (N)	Mass (kg)	Force (N)
0.500	2.2	0.750	3.4
1.000	4.6	1.800	8.0
2.000	9.0	2.250	10.3
2.500	11.1	3.000	13.2



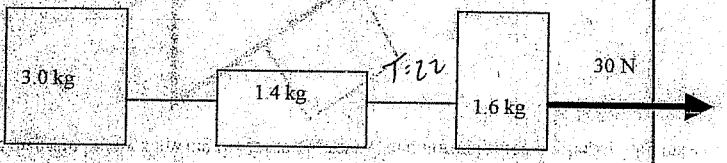
13) An elevator with mass 350 kg is accelerating upward a 1.0 m/s^2, what force must be exerted by a cable to pull the elevator up at this rate? Fg Fe 3780N up
14) A horse pulls a plow with force 1200 N to the right, the plow has mass 25 kg and is moving at a constant velocity. What is the coefficient of friction in this case? 1200N left $\mu = 4.8$N
15) Calculate the acceleration of the system below.



$6 \times 9.8 - 4 \times 9.8 = 19.6$N

10 kg 1.96 m/s^2

16) The three boxes shown below are pulled to the right by a 30 N force. If there is no friction then calculate the force of tension between each box.



a = 5 m/s^2

30

30 − T = 1.6×5

T = 30 − 1.6×5

= 22N

1.4

T

3

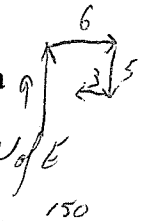
T 3×5

= 15N

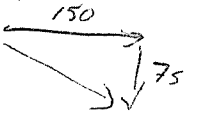
Vector Review

1) Define the following words: Magnitude # value
   Direction compass bearing

2) A car moves 9 blocks north, 6 blocks east, 5 blocks south, and 3 blocks west. Draw a diagram to represent this.



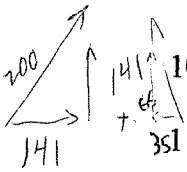
3) What is the car's displacement in #2? 5 blocks at 37° E of N or 53° N of E
4) What distance did the car travel? 23 blocks
5) A plane flies due east at 150 km/h, it encounters a wind blowing south at 75 km/h. What is the resultant ground speed of the aircraft? 167.7 km/h at 26.6° S of E



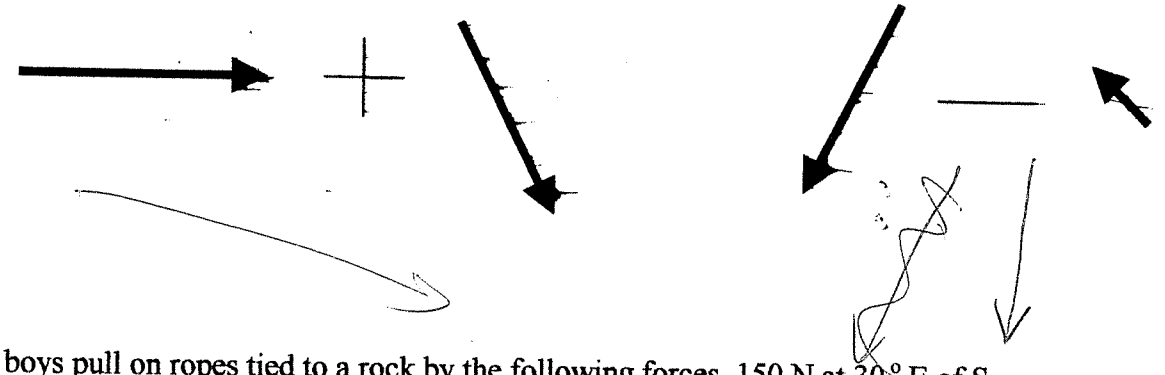
6) A boat steers across a river at 15 m/s, the current flows at 5.0 m/s. What is the resultant velocity? 15.8 m/s at 18° to ⊥

7) How long does it take to cross the river if the river in #6 is 40.0 m wide? 2 2/3 sec.
8) How far downstream does the boat end up in #7? 13 1/3 m
9) A boat wants to get directly across a stream, the engine is capable of attaining a speed of 13.0 m/s, if the current is 5.0 m/s at what angle should the boat travel, and what would its speed be as viewed from shore? 12 m/s 22.6° from ⊥

10) An airplane flies at 200 m/s at 45° E of N, a wind blows at 75 m/s at 30° W of N. What is the resultant velocity of the aircraft as seen from the ground? 231 m/s at 27° E of N

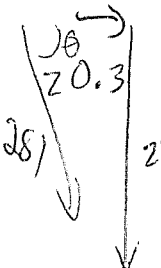


11) Sketch the answer to the following diagrams:



12) Two boys pull on ropes tied to a rock by the following forces, 150 N at 30° E of S, 160 N at 20° W of S, Sketch vectors to represent this and calculate the net force acting on the stump.
13) If the stump in the above question does not move what is the minimum force of friction (magnitude and direction) in this situation?

281 N 4.1° W of N
or 85.9° N of W



θ = 85.9° S of W
or 4.1° E of S

(9) (36) → (34)

$m_1v_1 + m_2v_2 = m_1v_{f_1} + m_2v_{f_2}$

$3x? + 0 = 0 + 3\times 15$ ← gain $= 15\ \frac{kg\,m}{s}$

gain of 2nd = loss of 1st $= 15\ \frac{kg\,m}{s}$

Projectiles, Momentum and Impulse Review

1) How many parts are there to every projectile problem, what are they?
2) A cat is thrown off a 25.0 m high building with a horizontal velocity of 5.0 m/s. How far from the base of the building will the cat hit?
3) A bomber is carpet bombing a city. If the plane is at an altitude of 12000 m, and flying at 100 m/s how far before reaching the city should the bombs be released?
4) A diver jumps from the 15m platform. If the edge of the pool extends 3.0 m from the base of the platform with what initial velocity must he/she jump in order to clear it?
5) A golfer strikes the ball with a speed of 15 m/s at an angle of 40° to the horizon, how far will the ball travel and what will be its maximum height?
6) What is the momentum of a 500 kg elephant charging at 25 km/h? $p = mv = 500\times 6.94 = 3472\ \frac{kg\,m}{s}$
7) What is the impulse applied to a ball that hits a wall at 5.0 m/s and rebounds at 5.0 m/s if it has mass 50 grams? $F\Delta t = m\Delta V = .05(-5-5) = .05\times(-10) = -0.5\ \frac{kg\,m}{s}$
8) What force was required if the change above occurred in 0.10s and the ball has mass 50 g? ← $F\Delta t = -0.5$ $F = -50N$
9) A ball of mass 3.0 kg strikes a second ball of similar mass. If the second one moves away at 5.0 m/s what was its gain in momentum? What was the loss of momentum of the first ball?
10) State the law of conservation of momentum. TOTAL MOMENTUM of a SYSTEM NEVER CHANGES
11) A 15 kg mass travelling at 5.0 m./s strikes a 20 kg mass at rest. If the 15 kg mass is moving at 2.0 m/s after the collision what is the velocity of the other mass?
12) A mass of 10 kg is travelling at v, it strikes an equal mass and is seen moving away at 0.4v. What is the velocity of the second object?
13) A mass of 10 kg is moving at v, it strikes a mass of 4.0 kg and the 4 kg moves away at 0.6v. What is the velocity of the 10 kg mass?
14) A ball of mass 250g is moving at 5.0 m/s directly toward a second ball of similar mass at rest. After the collision the first ball can be seen moving away at 0.63 m/s at 50° to its original path. What is the magnitude and direction of the velocity of the second ball after impact?

(11) $15\times 5 + 20\times 0 = 15\times 2 + 20v$

$75 + 0 = 30 + 20V$

$45 = 20V$

$V = 2.25\ \frac{m}{s}$

(12) $10V + 0 = 10\times .4V + 10?$

$10V = 4V + 10?$

$6V = 10?$

$V = 1.67$ $0.6V = ?$

1) 2, vertical & horizontal

2) 5 m/s →, 25 m

$d_y = v_{oy}t + \frac{1}{2}ayt^2$

$\sqrt{\frac{d_y}{\frac{1}{2}ay}} = t$ $t = \sqrt{\frac{-25}{-4.9}} = 2.25s$

d_x = range $= v_{ox}t + \frac{1}{2}axt^2$

$d_x = 5\times 2.25 = 11.3\ m$

3) $d_y = v_{oy}t + \frac{1}{2}ayt^2$

$\sqrt{\frac{d_y}{\frac{1}{2}ay}} = t = \sqrt{\frac{-12000}{-4.9}} = 49.5s$

$d_x = v_{ox}t + \frac{1}{2}axt^2$

$= 100\times 49.5$

$= 4950\ m$

(4) $V_0 = ?$, 15 m, |← 3 m →|

$d_y = v_{oy}t + \frac{1}{2}ayt^2$

$\sqrt{\frac{d_y}{\frac{1}{2}ay}} = t = \frac{15}{4.9} = 1.75s$

$d_x = v_{ox}t + \frac{1}{2}axt^2$

$\frac{d_x}{t} = v_{ox} = \frac{3}{1.75} = 1.71\ \frac{m}{s}$

(5) 15 m/s, 40°

$v_{oy} = v_o \sin 40 = 9.6\ \frac{m}{s}$

$v_{ox} = v_o \cos 40 = 11.5\ \frac{m}{s}$

$d_y = v_{oy}t + \frac{1}{2}ayt^2$

$-v_{oy}t = \frac{1}{2}ayt^2$

$\frac{-v_{oy}}{\frac{1}{2}a_y} = t = \frac{-9.6}{-4.9} = 1.96s$

$d_x = v_{ox}t + \frac{1}{2}axt^2$

$= 11.5\times 1.96 = 22.5\ m$

max height $t_{max} = \frac{t}{2} = 0.98s$

$d_y = v_{oy}t + \frac{1}{2}ayt^2$

$= 9.6(0.98) - 4.9(0.98)^2 = 4.7\ m$

(13) $10V + 4\times 0 = 10? + 4\times .6V$

$10V = 10? + 2.4V$

$7.6V = 10?$

$? = .76V$

(14)

$25\times 5 = .63\times 25 + ?$

$1.25 = 50° + 40°$

$.16 = \frac{x}{\sin 50} = \frac{1.25}{\sin 90} = 0.95$ $\div m = V = 3.83\ \frac{m}{s}$

3.83 m/s at 40° to original

Energy Review

1) How much energy is required to lift a 50 kg mass up to a height of 50 m from
   (a) the ground? $E_p = mgh = 50 \times 9.8 \times 50 = 24500\,J$
   (b) 30 m? $E_p = mgh = 50 \times 9.8 \times (50-30) = 9800\,J$
2) What is the kinetic energy of a 50 gram bat flying at 6.0 m/s? $E_k = \frac{1}{2}mv^2 = 0.9\,J$
3) What is the total energy of the bat above if it is at a height of 15 m? $E_p + E_k = mgh + \frac{1}{2}mv^2 = 8.25\,J$
4) If the bat above is shot and falls what would be its velocity at the ground? $E_p + E_k = E_k = mgh + \frac{1}{2}mv_0^2 = \frac{1}{2}mv_f^2$
5) A cat is dropped from a height of 15m, calculate its velocity when it hits the ground and show that its mass is not important. $E_p = E_k \quad mgh = \frac{1}{2}mv^2 \quad \sqrt{2gh} = v = 17.1\frac{m}{s} = 18.2\frac{m}{s}$
6) A 150 gram arrow is shot straight up from a bow at a velocity of 20 m/s from a height of 1.5 m, to what maximum height will the arrow climb? $E_k + E_p = E_p \quad \frac{1}{2}mv^2 + mgh_1 = mgh_2 = 22\,m$
7) In the question above the arrow was seen to rise only to a height of 17.34 m. Explain why the law of conservation of energy was not violated. Some energy was converted into heat due to friction
8) Calculate the efficiency of the arrow above. $\frac{17.34}{22} \times 100\% = 79\%$
9) A rollercoaster has a maximum height of 50m on the first hill, the cars then drop 30 m and then rise 10 m to the top of the second hill. Calculate the speed of the cars at the top of the second hill (assume they left the first hill with Vo=0 m/s. Assume 100% efficiency. $E_p = E_p + E_k \quad mgh_1 = mgh_2 + \frac{1}{2}mv^2 \quad 50 \times 9.8 = 40 \times 9.8 + \frac{1}{2}v^2 \quad v = 14\frac{m}{s}$

Skip → 10) Re-calculate the above question using an 80% efficiency.

11) A ball of mass 500 grams falls from height 5.0m and bounces up to a height of 4.0m what was the efficiency? $\frac{4}{5} \times 100\% = 80\%$
12) If a ball is thrown down at 14.0 m/s from 5.0 m to what maximum height could it bounce?

$E_p + E_k = E_p$

$mgh_1 + \frac{1}{2}mv^2 = mgh_2$

$9.8 \times 5 + \frac{1}{2}(14)^2 = 9.8\,h_2$

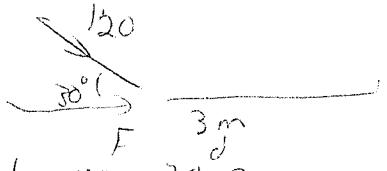
$h_2 = 15\,m$

Strachan rox

Work, Power, Nuclear and Relativity review

1) What is the work done when pulling a mass with a force of 25 N a distance of 10m?
2) Calculate the work done when pushing a shovel of snow 3.0 m if the shovel is held at an angle of 30° to the ground and a force of 120 N is applied along the handle.
3) How much work is done if a 15 kg object is lifted 2.0 meters off the ground?
4) What is the power used by a student whose mass is 75 kg and runs up 3.0 m in 4.2 s?
5) How long does it take a 100 watt light bulb to consume 75 Joules of energy?
6) A plane is flying horizontally using a 15000 N force to travel 150 km. The altitude of the plane is 3000 m.
7) How much nuclear binding energy is bound in 2.0 kg of apples?
8) How much mass of Uranium is needed to launch a 1500 kg rocket to a height of 10 km?
9) A typical hydroelectric dam generates 1.5 gigawatts of power per day. How many joules is this (giga = 10^{15}).
10) Calculate the mass of Uranium needed to generate the same power as in #7.
11) A car is seen to be moving at 0.75c, what is its length to an observer at rest if the car appeared to be 5.0 m when stopped?
12) How fast would the car above have to be moving in order to appear 1.0 cm long? (leave answer in terms of c).
13) A missile is launched from the planet Xornahcart S, which is 25 light-years from earth. If it is travelling at 0.99c how long will the missile seem to take to reach earth as viewed from:
    a) Xornahcart S 25.25 yr
    b) Earth 25.25 yr
    c) The missile $t_0 = \frac{t}{\sqrt{1-\frac{v^2}{c^2}}}$ $t_0\sqrt{1-\frac{v^2}{c^2}} = t = 3.56\,yr$
14) A bird flies at 0.8c, if it appears to have a mass of 1.0 kg to an observer at rest what is the rest mass of the bird? $m = \frac{m_0}{\sqrt{1-\frac{v^2}{c^2}}}$ $\sqrt{1-\frac{v^2}{c^2}} = m_0$ $0.6\,kg$
15) Why do we not usually factor in relativistic effects in most physics problems? Because we rarely encounter objects moving $> .1c$
16) Moving rods contract.
17) Moving clocks run slow.
18) Moving masses get bigger.

1) $W = Fd$
$= 25 \times 10 = 250\,J$

2)


$W = 120\cos 30 \times 3$
$= 312\,J$

3) $W = Fd$
$= mgh = 294\,J$

4) $P = \frac{W}{t} = \frac{mgh}{t} = 525\,W$

5) $Pt = W$
$\frac{P}{W} = \frac{1}{t}$ $t = \frac{W}{P} = 0.75\,s$

6) Add "How much work is done?" $W = Fd$
$= 15000 \times 150000$
$= 2.25 \times 10^9\,J$

7) $E = mc^2$
$= 2 \times (3 \times 10^8)^2$
$= 1.8 \times 10^{17}\,J$

8) rocket $mgh = mc^2$ uranium
$\frac{mgh}{c^2} = m = 1.63 \times 10^{-9}\,kg$

9) $W = Pt$
$= 1.5 \times 10^{15} \times (24 \times 3600)$
$= 1.296 \times 10^{20}\,J$

10) $\frac{E = mc^2}{c^2}$ $= 1440\,kg$

11) $l = l_0\sqrt{1-\left(\frac{v}{c}\right)^2}$
$= l_0\sqrt{1-\left(\frac{.75c}{c}\right)^2}$
$= l_0\sqrt{.4375}$
$= l_0 = .66$
$= 3.31\,m$

Optics Review

1) How is optical density related to a) index of refraction ← higher opt dens = high n
b) speed of light in a medium ← higher opt. dens = lower speed

2) What is the speed of light in a) vacuum $3\times10^{8}\frac{m}{s}$
b) air $2.999\times10^{8}\frac{m}{s}$
c) water $2.26\times10^{8}\frac{m}{s}$
$v=\frac{c}{n}$

3) Calculate the index of refraction of quartz if light passes through it at 1 88 x 10^{8} m/s.
$n=\frac{c}{v}=1.60$

4) Where should all angles be measured? from normal

5) As light moves from a more optically dense medium to a less optically dense one will light move away or toward normal?

6) What lenses and mirrors have positive f values, and negative f values? +f ← concave mirror, convex lens
−f ← convex mirror, concave lens

7) If an image is virtual what can be said about di, and hi? $-d_i$; $+h_i$

8) If an image is real what can be said about f, di, hi? $+f$, $+d_i$, $-h_i$

9) An image which is erect and 3 times the object's size is produced using a lens, what type of lens is it, and find the focal length if the object is 1.0 cm tall, image is

$4f=3d_o$

Convex $\quad \frac{d_i}{d_o}=3=\frac{h_i}{h_o}$

$d_i=3d_o$

$\frac{1}{f}=\frac{1}{d_o}+\frac{1}{3d_o}$

$\frac{1}{f}=\frac{4}{3d_o}$

$f=\frac{3}{4}$ cm

10) An inverted image is ½ the size of the object, if the focal length of the mirror producing it is 4.0 cm find the distances to object and image.

real

$-\frac{d_i}{d_o}=\frac{-h_i}{h_o}$

$+\frac{d_i}{d_o}=\frac{+\frac{1}{2}}{1}$

$d_i=\frac{1}{2}d_o$

$2d_i=d_o$

$\frac{1}{f}=\frac{1}{d_o}+\frac{1}{d_i}$

$\frac{1}{4}=\frac{1}{2d_i}+\frac{1}{d_i}$

$\frac{1}{4}=\frac{3}{2}d_i$

$d_i=6$ cm

$d_o=12$ cm

Waves Review

1) For any wave the angle of incidence and angle of reflection are equal

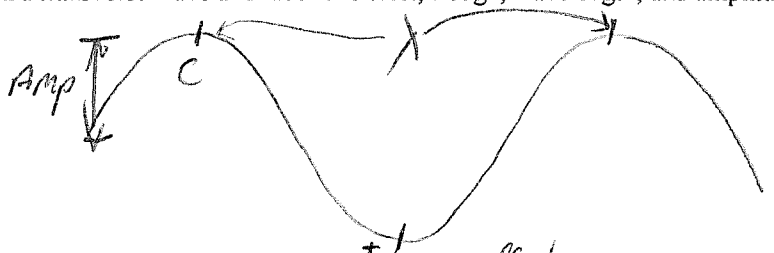
2) All angles should be measured from Normal

3) How are transverse and longitudinal waves similar and different?

direction of propagation ⊥ to particle motion

direction of prop // to particle motion

4) Sketch a transverse wave and label one crest, trough, wavelength, and amplitude.



5) A siren approaches you, as a result of doppler effect its frequency will be higher, wavelength will be shorter, and sound will be high pitch.

6) After the siren passes you what will happen to each of these?

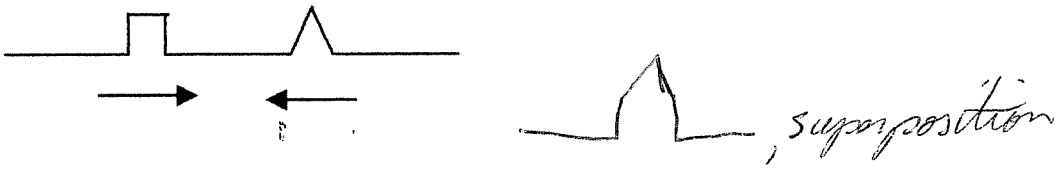
lower
longer
low pitch

7) What are blue shift and red shift of stars, relate these terms to doppler effect.

approaching compresses λ = blue shift

receding stretches λ = red shift

8) Sketch the result of the two pulses meeting, what is the principle called which causes this result?



9) What happens when a crest meets a trough? destructive interference

10) What happens when a crest meets a crest? constructive interference

11) Calculate the speed of a wave which travels 15m in 10 seconds.

$v = \frac{d}{t} = 1.5 \frac{m}{s}$

12) Calculate the speed of a wave which has a wavelength of 2.0 m and frequency of 5.0 Hz.

$v = \lambda f = 2 \times 5 = 10 \frac{m}{s}$

13) What is the period of the above wave?

$T = \frac{1}{f} = \frac{1}{5} = 0.20\,s$

14) Calculate the wavelength of a blue light ray with frequency 1.86×10^{6} Hz.

$\lambda = \frac{v}{f} = \frac{3 \times 10^{8}}{1.86 \times 10^{6}} = 161\,m$

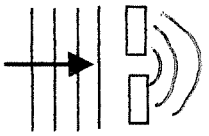
15) Waves on Okanagan Lake pass by a point every 1.5 seconds. If they travel 20 meters in 30 seconds find their speed, frequency, and wavelength.

$v = \frac{d}{t} = \frac{20}{30} = 0.67\,\frac{m}{s}$

$f = \frac{1}{T} = \frac{1}{1.5} = 0.67\,s$

$\frac{v}{f} = \lambda = 1\,m$

16) Sketch diffraction as light passes between the opening of a barrier as shown below:



17) What angle should be between polarizers to block light waves from passing through them?

90°