Work & Power

Work is done when energy changes

$W = \Delta E$

A change in Ep or Ek

W = ΔE <= the work/ energy therorem
Units of work are joules

How much work is done in lifting a 4.0 kg cat carcass to height 2.0 m?

$W = \Delta E_p$
$= E_{pf} - E_{p0}$
$= mgh_f - mgh_i = 4(9.8)2 - 4(9.8)0 = 78.4J$

Some random non-physics loser kid of mass 60 kg rides their bike at 6.0 m/s and accelerates
To 10 m/s, how much work was done before they got hit by a bus?

$W = \Delta E_k$
$= E_{kf} - E_{k0}$
$= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_0^2 = \frac{1}{2}(60)10^2 - \frac{1}{2}(60)6^2$
$= 3000 - 1080 = 1920J$

A cat at rest with mass 5.0 kg is kicked and seen moving at 4.0 m/s and height 3.0 m,
What work was done on the cat?

$W = \Delta E_k + \Delta E_p$
$W = E_{kf} - E_{k0} + E_{pf} - E_{p0}$
$= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_0^2 + mgh_f - mgh_i$
$= 40 - 0 + 147 - 0 = 187J$

Work is done when a force moves an object across a distance

$W = F \cdot d$


$\frac{adj}{hyp} = \cos\theta$
$adj = 100\cos 30$
$= 86.6$

rectangle
$50 = 75J$

Force and distance MUST be parallel AND the force must stay constant

Find the work done!

$W = F \cdot d$
$= 86.6\ (20)$
$= 1730J$

A cat is pushed 10m along the floor using a force of 4.0 N, what work is done?

F = 4N  d (m)

$W = Fd$
$= 40$

60 J

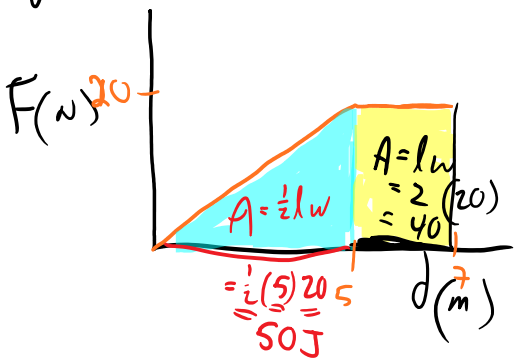
A shovel is pushed using a force of 100 N along the handle as Shown at 30° to the ground, for 3.0 m to move snow. What work is done?

GRAPHS:

Force is not constant

Work = AREA of The graph

Force vs distance

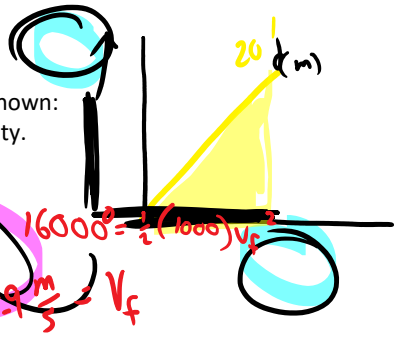



50
+40
90 J

Area = Work

$\frac{bh}{2} = \frac{20\ 16000}{2} = 60000$

A car is accelerated from rest with a ~~force as~~ shown:
If the car has mass ~~1000 kg~~ find the final velocity.




$W = \Delta E_k + \Delta E_p$

$= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_0^2$

$16000 = \frac{1}{2}(1000)v_f^2$

$19.9 \frac{m}{s} = v_f$

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

$A_1 \quad \Delta E_k \quad 4k \times 20 = 40$

$0 = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_0^2$

$= \frac{1}{2}(4k)v_f^2 = 2000 + 20$

$v_f = 11.2 \frac{m}{s}$

$W = \Delta E_k$

$\Delta E_p$ ← look for vertical motion changing

AJ's mass 48kg and jumps up on a desk of height 1.5 m in 2.0 sec find the work done!!!!!!

Area F vs d

$W = \Delta E_p$

$W = mgh_f - mgh_0$

$= 48(9.8)2 = 705 J$

$3(9.8)[6-2]$

$= 118 J$

$\frac{mg\Delta h}{t} = \frac{84(9.8)(1.5)}{2}$

$= 615 W$

power required for this!!!

= 615 W

power required for this!!!

A cat of mass 8.0 kg is accelerated from 5.0 m/s according to the graph, find the final velocity

t

A 1000 kg car accelerates from rest
To a velocity of 12 m/s in 4.0 s, find the power of the engine!!!!

$\frac{12}{4} = 3$

x

POWER: Work done per unit of time <= how fast you work

$P = \frac{W}{t}$

A cat of mass 10 kg at rest is kicked slowly until a speed of 6.0 m/s is reached in 18 seconds, find the power needed to do this.

$P = \frac{W}{t}$ $\quad W = \Delta E_k$

$W = E_{kf} - E_{k0}$
$= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_0^2$
$= \frac{1}{2}(10)6^2 = 180$

$P = \frac{180}{18} = 10\ W$

Watts ← unit of power

Finish + sheets or cas in your house

$V_f = 12$
$(1000)\ 12^2$
$V_0 = 0$
$t = 4$
$t$
$= 18000\ W$

ENERGY: energy is the ability to change some conditions in the universe
Units are Joules, same as work
2 main categories for energy

| POTENTIAL ENERGY (Ep) | KINETIC ENERGY (Ek) |
|---|---|
| Energy stored, waiting to cause a change | energy in use causing a change |
| Gravitational Ep = $mg\Delta h$ | energy in a moving mass Ek = $1/2mv^2$ |

Energy stored, waiting to cause a change

Gravitational Ep = $mg\Delta h$

Elastic Ep = $1/2\ kx^2$

Energy stored in mass $E = mc^2$

energy in use causing a change

energy in a moving mass $Ek = 1/2mv^2$

Heat energy in moving molecules
$Eh = mc\Delta T$

m = mass in kilograms
g = gravitational field (9.8 $m/s^2$ on Earth)
$\Delta h$ = change in height from low point
V = velocity in m/s
K = spring constant in N/m
X = extension or compression in meters
C = speed of light ($3.00 \times 10^8$ m/s)
$\Delta T$ = change in temperature ($^\circ C$)

The WORK/ENERGY THEOREM states work done on an object changes its energy

$W = \Delta E$

Example 1: a spring with constant 25 N/m is stretched from 15 cm to 20 cm, what Is the work done on the spring?

$W = \Delta E$
$W = Epf - Epo$
$W = 1/2\ k\ x^2 - 0$
$W = 1/2\ (25)(0.20 - 0.15)^2$
$W = 0.0313$ J

Example 2: 90 J of work are done accelerating a 10 kg cat from 3.0 m/s, What is its final velocity?

$W = \Delta E$
$W = Ekf - Eko$
$W = 1/2\ mv_f^2 - 1/2mv_o^2$
$90 = 1/2\ (10)(v_f^2) - 1/2(10)(3^2)$
$90 = 5v_f^2 - 45$
$135 = 5v_f^2$
$27 = v_f^2$
$v_f = 5.2$ m/s

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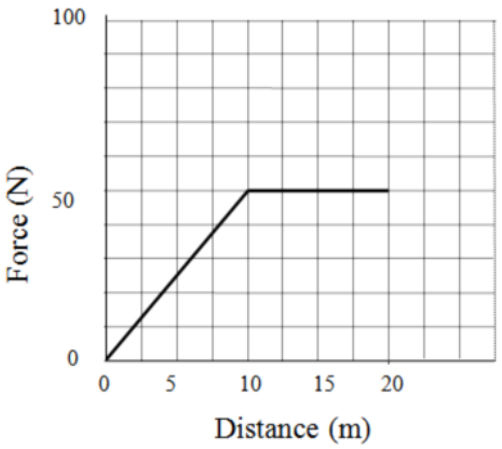
The work / energy theorem states that the work done on an object
Is equal to the change in energy it receives!
A cat on fire has mass 3.0 kg is lifted from 2.0 m above a spike to 3.5 m above the sam




Thursday ← Lab

POWER <= the rate at which work is done

P = W / t

Power is measured in units of J/s which is the WATT.
For large amounts of power a larger unit

Known as horsepower was used,

1.0 horsepower (or 1.0 hp) = 750 W

A 100W light bulb operates for 1.0 hour. How much work was done?

Greta pulls a wagon 10m using a force of 300N along the handle which is inclined at $60^{o}$ to the horizontal for 20 seconds, what power does Greta produce?