WORK & ENERGY

When a force moves an object, energy is transferred, and work is done.

Work done = energy transferred

(Joules, J) (Joules, J)

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To calculate the work done (energy transferred)

Word done = Force x distance moved

(joules, J) (newtons, N) (metres, m)

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$$Work = Fd$$

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Example: How much energy is transmitted if a force of 2N moves through a distance of 10 m?

Work = F.d Work = 2 x 10 = 20 J

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Gravitational potential energy – is gained by an object when work is done lifting a weight against gravity

$$E_p = mgh$$

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Example: A man lifts a brick of mass 5 kg from the floor to a shelf 2 metres high. What is the change in gravitational potential energy?

E_P = mgh E_P = 5 x 10 x 2 = 100 J

ENERGY IDEAS

- a moving object has movement energy or kinetic energy E_K.
- when an object is lifted to a higher place it is given gravitational potential energy E_P.
- energy can be transferred from one form to another
- a falling object or an object rolling/sliding down a hill is transferring E_P to E_K

ENERGY

Kinetic energy E_k can be transformed into other forms eg

- A car braking E_k to heat energy in brakes + tyres
- A wind turbine E_k to electrical energy, heat & sound
- A roller coaster car going up a ramp E_k to E_p and heat energy

ENERGY An object has more kinetic energy E_K….. • The greater its mass • The greater its speed	**ENERGY** E_K in J, mass, m, in kg & speed (v) in ms^{-1} $E_k = \frac{1}{2}mv^2$
ENERGY An object has more kinetic energy E_K….. • The greater its mass • The greater its speed • Double speed = 4 x $E_{K,}$ triple speed = 9 x E_K	**ENERGY** *Example: A car of mass 800 kg is travelling at 10 ms^{-1}. How much kinetic energy does it have?* **E_K = ½ mv^2** E_K = ½ x 800 x 10^2 E_K = ½ x 800 x 100 = 40 000 J
WORK & ENERGY *Example: A car of mass 800 kg is travelling at 10 ms^{-1}. It has 40 000 J of kinetic energy. How much work must be done to stop it?* To stop the car work done = energy transferred = 40 000 J. This energy will be transferred to heat in the brakes / tyres.	**WORK & ENERGY** *Example: A car of mass 800 kg is travelling at 10 ms^{-1}. It has 40 000 J of kinetic energy. When the brakes are applied, it comes to rest in 8 m. What is the average force exerted by the brakes?* **Work = F.d** 40 000 = F x 8, therefore F = 40 000 / 8 = 5000 N
WORK & ENERGY *Remember* *Work done against frictional forces is transferred mainly as HEAT.*	**WORK & ENERGY** *Remember* *In calculations always show the formula you are using, and show your working – so you may get some marks even if the final answer is wrong.*

WORK & ENERGY

$$Work = Fd$$

F = Force in N

d = distance, in m

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$$E_k = \frac{1}{2}mv^2$$

m = mass in kg

v = speed in ms^{-1}

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$$E_p = mgh$$

m = mass in kg

g = 10 ms^{-2}

h = height in m

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

Power is the rate of doing work or how quickly energy is transferred, Power = energy / time. Power is measured in Js^{-1} (Joules per second) or Watts (W), Energy, E in J, and time, t, is in seconds (s).

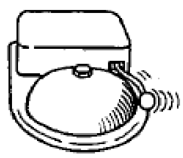
ENERGY

Example: A 0.1 kg ball is dropped from a height of 1.5 m. Assuming all the E_P is turned into E_K, how fast is it travelling just before it hits the ground?

- First calculate E_P using **E_P = mgh**
- Just before impact all its **E_P** is now converted to **E_K** and is equal to **½ mv^2 – So calculate v.**

ENERGY

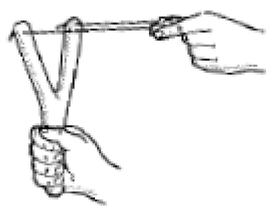
Chemical potential



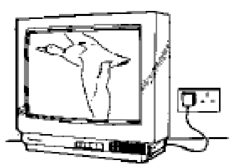
Kinetic & sound

Chemical potential

ENERGY



elastic potential energy



electrical energy converted to heat, light & sound

ENERGY

heat

E_P (decreasing) and E_K (increasing – until reaches terminal velocity)
