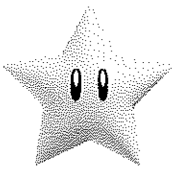
WORK AND ENERGY (2.6.3)

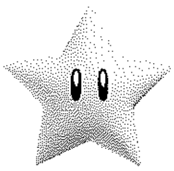
(Higher Tier)

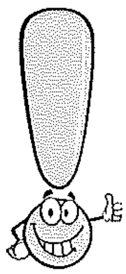
WORK, POWER AND ENERGY

Name: Date: Teacher:

Feedback:







Mark Breakdown:

Question	Mark
1	/7
2	/5
3	/9
4	/4
5	/9
6	/15
Total	/45
Grade	
%	

Equations

$\text{speed} = \dfrac{\text{distance}}{\text{time}}$	
$\text{acceleration [or deceleration]} = \dfrac{\text{change in velocity}}{\text{time}}$	$a = \dfrac{\Delta v}{t}$
acceleration = gradient of a velocity-time graph	
distance travelled = area under a velocity-time graph	
resultant force = mass × acceleration	$F = ma$
weight = mass × gravitational field strength	$W = mg$
work = force × distance	$W = Fd$
$\text{kinetic energy} = \dfrac{\text{mass x velocity}^2}{2}$	$\text{KE} = \frac{1}{2}mv^2$
change in potential energy = mass × gravitational field strength × change in height	$\text{PE} = mgh$
force = spring constant × extension	$F = kx$
work done in stretching = area under a force-extension graph	$W = \frac{1}{2}Fx$

SI multipliers

Prefix	Multiplier
p	1×10^{-12}
n	1×10^{-9}
μ	1×10^{-6}
m	1×10^{-3}

Prefix	Multiplier
k	1×10^{3}
M	1×10^{6}
G	1×10^{9}
T	1×10^{12}

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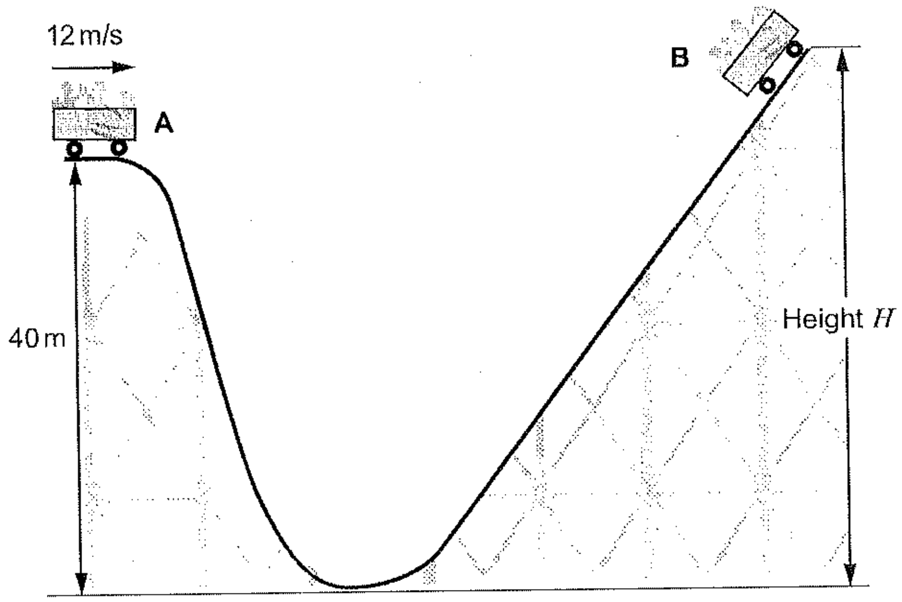
1. A roller coaster car has no engine. The car and its passengers have a total mass of 1 500 kg. The car is shown as it passes over a peak of the ride which is 40 m high at point **A**. It has a speed of 12 m/s at this point. It then rolls down the track to ground level before moving up to point **B** where it comes to rest before rolling backwards again.



(i) Calculate the **total** energy of the car at **A**. (g = 10 m/s^2 = 10 N/kg) [3]

energy = ... J

(ii) For the car moving at 12 m/s at **A**, calculate the maximum height H that the car reaches before stopping at point **B**. [2]

height = ... m

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(iii) Explain why the car would not actually reach the height you have calculated in part (ii). [2]

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TURN OVER

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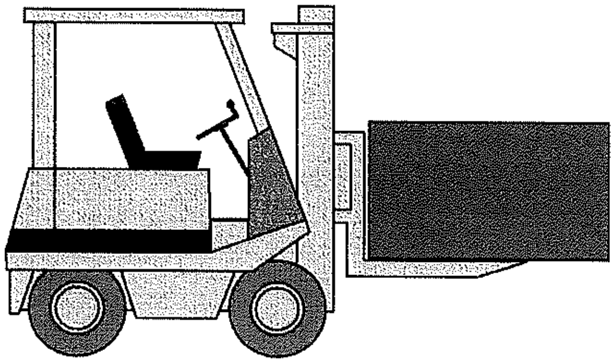
2. A forklift truck is used to lift heavy loads.



(a) The maximum mass that can be lifted by the truck is 1 800 kg. Calculate the weight of this mass. (A 1 kg mass has a weight of 10 N.) [1]

weight = ... N

(b) The forklift truck uses a force of 1 000 N to lift a load through a vertical distance of 6 m.

(i) Select an equation from page 2 and use it to calculate the work done. [2]

work done = ... J

(ii) State how much work, if any, the forklift truck does when the load is held stationary at 6 m. [1]

work done = ... J

(iii) Name the type of energy possessed by the load when it is stationary at a height of 6 m. [1]

....

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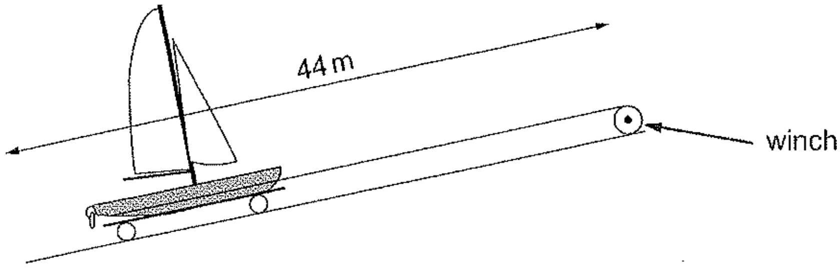
3. The diagram shows a winch that is used to pull a boat 44 m up a ramp.



(a) (i) There is a friction force of 50 N acting against the boat as it is being pulled up the ramp. Use the equation:

work = force × distance

to calculate the work done against friction. [2]

work done against friction = ... J

(ii) The boat has gained 3200 J of potential energy when it is at the top of the ramp. Calculate the total work done by the winch to move the boat up the ramp. [1]

total work done = ... J

(iii) The boat is released from the top of the ramp. It rolls down to the sea. Some of its 3200 J of potential energy is used up as work against friction. Use your answer to *(a)*(i). Calculate the energy it has left when it reaches the sea. [1]

energy = ... J

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(b) The boat of mass 80 kg hits the sea at a speed of 5 m/s and slows down to 1 m/s.

(i) Use the equation:

$$\text{momentum} = \text{mass} \times \text{velocity}$$

to calculate the change in momentum of the boat. [2]

change in momentum = ... kg m/s

(ii) Use the equation:

$$\text{force} = \frac{\text{change in momentum}}{\text{time}}$$

to calculate the force applied by the sea to slow the boat in 2 s. [2]

force = ... N

(iii) What is the value of the force applied by the boat on the sea as it slows down? [1]

force = ... N

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4. (a) When a box is lifted and placed on a shelf 0.5 m off the ground 20 J of work is done on it. Use the equation:

$$\text{force} = \frac{\text{work done}}{\text{distance}}$$

to calculate the force used to lift the box. [2]

force = ... N

(b) When work is done on the box energy is transferred to it. What type of energy does the box store when it is on the shelf? [1]

....

....

(c) What happens to this energy if the box is knocked off the shelf? [1]

....

....

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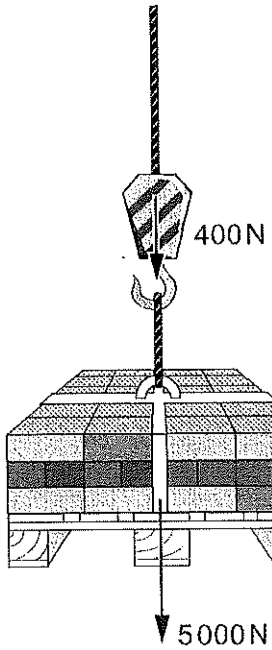
5. The diagram shows the crane holding the bricks **at rest** above the ground. The attachment hook has a weight of 400 N.



(i) The cable supports the pulley block and bricks. Write down the value of the upward force applied in the cable. [2]

force = ... N

(ii) Underline the correct term in each bracket below. [2]

I. When the bricks are accelerated upwards, the force in the cable is (**smaller than** / **equal to** / **bigger than**) the total weight.

II. When the bricks move upwards at a constant speed, the force in the cable is (**smaller than** / **equal to** / **bigger than**) the total weight.

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6. A spring is 20 cm long when a load of 10 N is hanging from it, and 30 cm long when a load of 20 N is hanging from it. What is the length of the spring when:

a) there is no load on it;

....

b) there is a load of 5 N on it.

....

[2]

7. In a spring experiment, the results were:

force (N)	0	1	2	3	4	5	6	7
length (mm)	50	58	70	74	82	90	102	125
extension (mm)			20	24	32	40		

a) Complete the table.

[2]

b) What is the length of the spring when unstretched?

....

[1]

c) Plot a graph of the data. **(Plot x = force, y = spring extension)**

[4]

d) (i)One of the results is wrong. Circle the incorrect plot.
(ii) What should the result be?

....

[2]

e) Mark the elastic limit on your graph and label it.

[1]

f) What load would give an *extension* of 30 mm?

....

[1]

g) What would be the spring *length* for a load of 4.5 N?

....

[1]

....

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