# EMANUEL SCHOOL

# Physics

## Year 10 Exam

## 10th Dec 2002
## 2.00 to 3.00 p.m.

Model Answers

**Set by JN** **Return to JN**

| | |
|---|---|
| **Name** | |
| **Science Set** | |

**Instructions**

1. Write your name and set in the spaces above.
2. Answer **all** the questions.
3. Do all rough work in this booklet.
4. Cross through any work you do not want marked.

**Information**

5. The time allowed for this exam is 1 hour
6. No additional materials are required.
7. Mark allocations are shown in brackets.
8. Use a calculator if necessary
9. The maximum mark available for this paper is **60**.

# Model Answers

1 Figure 1 shows a man about to drop a brick of mass 2 kg from the top of a tall tower.

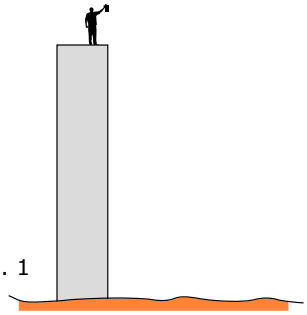
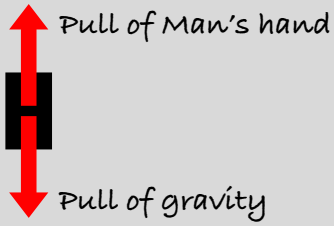


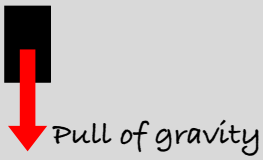
Fig. 1

(a) In the spaces A & B below draw free-body diagrams for the object
(i) just before it is released and [2]
(ii) just after it has been released. In each case name the forces acting on the object. [2]

(i): before release




(ii): just after release




(iii) Write down, in words, the equation that links weight, mass and gravitational field strength.

weight = mass x gravitational field strength [2]

(ii) In what units is weight measured? _____ Newtons _____ [1]

(iii) The Earth's gravitational field is 10 n/kg. Calculate the force acting on the object *just after* it has been dropped.

_____ weight = 2 x 10 _____

_____ weight = 20 N _____ [2]

(c) In order to calculate the height of the tower, the man measures how long it takes the object to fall to the ground. He finds that it takes 3 seconds to reach the ground.

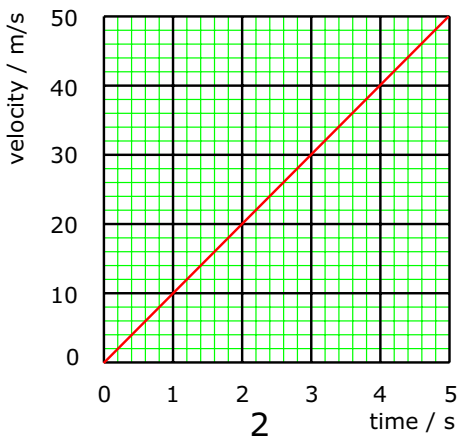



Fig. 2

# Model Answers

(i) Use the velocity/time graph for a freely falling object to calculate the height of the tower. (assume that the object is released exactly from the top of the tower.)

distance object falls = area of velocity-time graph from 0 and 3 seconds

distance = 1/2 x 3 x 30

distance = 45 m [4]

(d) When the man checks this value against the true height of the tower, which he measures using a measuring tape, he finds that the tower is actually shorter than the calculated value. Can you explain why the tower is not as tall as the above experiment suggests?

Object takes longer to fall to the ground due to air resistance

so it appears that tower is higher than it really is

[3]

(e) If the true height of the tower is 35 m and the object is held level with the top of the tower, calculate the gravitational potential energy of the object with respect to the ground just before it is dropped.

(i) In the space below write down in words the equation that links a change in g.p.e. to a change in the height of an object

Change in g.p.e. = mass x gravity pull x change in height [2]

(ii) Now calculate the g.p.e. of the brick

$\Delta$ gpe = 2 x 10 x 35

$\Delta$ gpe = 700 J [2]

(iii) How does the kinetic energy of the object just before it hits the ground compare with its gravitational potential energy at the top of the tower?

decrease in gpe = increase in k.e. [1]

(iv) In practice the object will have less kinetic energy when it reaches the ground than that which you have just calculated. Can you explain this?

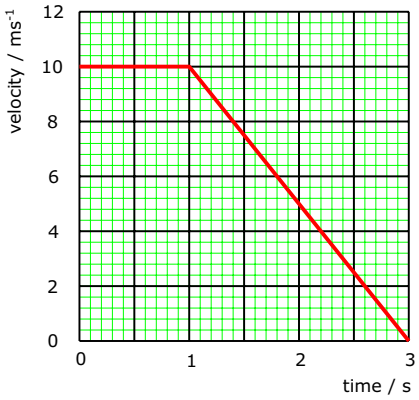
k.e. is converted into thermal energy due to air friction

[2]

# Model Answers

2 A car of mass 1200 kg is travelling at 10 m/s when the driver sees someone run out into the road ahead. He applies the brakes and brings the car to a halt.

The velocity/time graph for the car's motion from the moment the driver sees the hazard until the car stops is shown below




(a) (i) What is the driver's reaction time? _____ 1 second _____ [1]

(ii) Give one factor that could increase the driver's reaction time.

_____ driver is drunk _____ [2]

(b) Use the graph to calculate

(i) thinking distance _____ Area under graph from 0 to 1 second _____

_____ thinking distance = x 10 x 1 = 10 m _____ [2]

(ii) braking distance _____ Area under graph from 1 to 3 second _____

_____ braking distance = 1/2 x 10 x 2 _____ [3]

(iii) stopping distance __ thinking distance + braking distance = 20 m ____ [2]

(iv) the car's average speed from the moment the driver sees the hazard until the car finally stops.

_____ average speed = total distance / total time _____

_____ average speed = 20 / 3 = 6.67 m/s _____ [2]

(v) the acceleration of the car while it is braking ____ a = (v – u) / t _____

_____ acceleration = (0 – 10) – 2 = - 5 $m/s^2$ _____ [3]

(c) (i) What is the size of the force exerted on the car by the action of the brakes.

_____ force = 1200 x –5 = -6000 N _____

(ii) What road condition could reduce the size of this force. Explain your answer.

_____ force is less if road is wet or covered in ice _____

___ because in those conditions friction between tyre & road is less_____ [2]

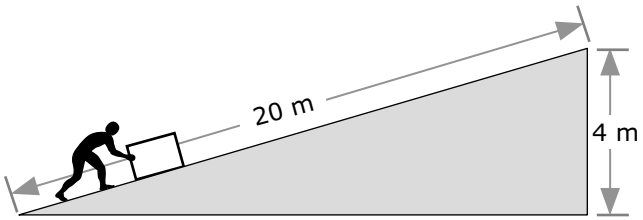
# Model Answers

4 (a) (i) Write down in words the equation that links work, force and distance in the space below

Work = force x distance [2]

(ii) In what units is work measured? _____ Joules _____ [1]

(b) A large block of stone weighs 500 newtons. It is pushed up a slope at constant speed as shown in the diagram. The force required to push the block up the slope is 200 N.




(i) How much work is done by the man in pushing the stone block up the slope?

_____ Work done pushing block up the slope = 200 x 20 _____

_____ Work = 4000 J _____ [2]

(ii) How much work is required to lift the block vertically 4 m?

_____ Work done to lift block vertically = 500 x 4 _____

_____ Work = 2000 J _____ [2]

(iii) Compare your answers to (i) and (ii) and explain why the man would choose to push the stone up the slope rather than lifting it vertically to the same height.

_____ Man finds it easier to a small force for a long time ___

_____

_____ [2]

(c) (i) Write down in words the equation that links power, work and time in the space below

Power = work done/ time taken [2]

(ii) In what units is power measured? _____ Unit of power = Watt _____ [1]

(iv) How much power is needed to lift the 500 N stone to a height of 4 m in 5 s?

_____ Power = (500 x 4) / 5 = _____

_____ Power = 400 W _____ [2]

# Model Answers

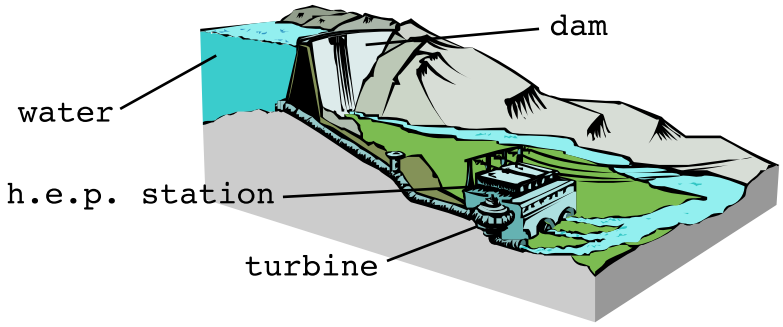
5 Read the passage and answer the questions

**Hydroelectric power**

A hydroelectric power (or h.e.p.) station harnesses the energy of water as it runs downhill, and uses it to generate electrical energy. Water gains energy when rain falls on highlands. Dams are used to collect this water, which is then allowed to run downhill through the turbines in an h.e.p. station.

Rain falls from clouds, which are formed when water vapour condenses to form huge numbers of tiny drops. The water vapour rises from the oceans and land that has been warmed by absorbing the sun's radiant energy.

H.e.p. is a major source of electrical energy in wet, mountainous areas. The British isles have plenty of water, but few mountains and so obtains most of its electrical energy from coal, oil or gas fired power stations.




(i) What kind of energy does water have at the top of a hill?

_____ gravitational potential energy _____ [1]

(ii) What kind of energy does water have as it flows down hill?

_____ kinetic energy _____ [1]

(iii) What is the ultimate source of the energy converted into electrical energy by h.e.p.?

_____ the Sun's radiant energy _____ [1]

(iv) H.e.p. makes use of a renewable resource. What is a renewable resource?

__ a renewable resource is one that does not run out /is inexhaustible _____

_____ it is replaces when it is used _____ [2]

(v) What form of energy do coal, oil and gas each possess?

_____ they possess chemical energy _____ [1]

(vi) The ultimate source of the energy possessed by coal, oil and gas is the sun. Name an energy source that is *not* derived from the sun.

_____ Nuclear or geothermal _____ [1]

(vii) Does Britain make use mainly of renewable or non-renewable resources?

_____ non renewable _____ [1]

(viii) Name another source of electrical energy *not* mentioned in the passage.

_____ geothermal _____ [1]