Work, Energy & Power

Question paper 4

Level	International A Level
Subject	Physics
Exam Board	CIE
Topic	Work, Energy & Power
Sub Topic	
Paper Type	Theory
Booklet	Question paper 4

Time Allowed: **48 minutes**

Score: **/40**

Percentage: **/100**

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 **(a)** A stone of mass 56 g is thrown horizontally from the top of a cliff with a speed of 18 m s^{-1}, as illustrated in Fig. 4.1.

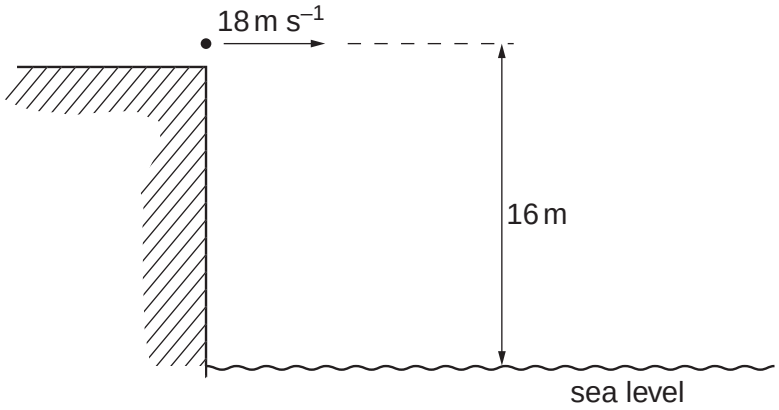

Fig. 4.1

The initial height of the stone above the level of the sea is 16 m. Air resistance may be neglected.

(i) Calculate the change in gravitational potential energy of the stone as a result of falling through 16 m.

change = ... J [2]

(ii) Calculate the total kinetic energy of the stone as it reaches the sea.

kinetic energy = ... J [3]

(b) Use your answer in **(a)(ii)** to show that the speed of the stone as it hits the water is approximately 25 m s^{-1}.

[1]

(c) State the horizontal velocity of the stone as it hits the water.

horizontal velocity = ... m s^{-1} [1]

(d) **(i)** On the grid of Fig. 4.2, draw a vector diagram to represent the horizontal velocity and the resultant velocity of the stone as it hits the water. [1]

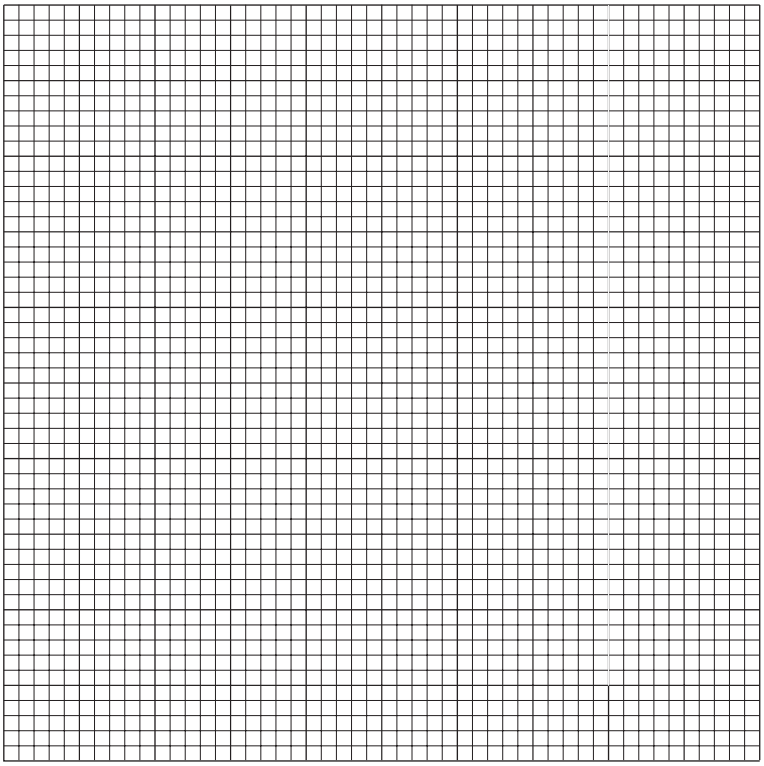

Fig. 4.2

(ii) Use your vector diagram to determine the angle with the horizontal at which the stone hits the water.

angle = ... ° [2]

2 **(a)** Define what is meant by

(i) *work done*,

.....

.....

..... [2]

(ii) *power*.

.....

..... [1]

(b) A force F is acting on a body that is moving with velocity v in the direction of the force.

Derive an expression relating the power P dissipated by the force to F and v.

[2]

(c) A car of mass 1900 kg accelerates from rest to a speed of 27 m s^{-1} in 8.1 s.

(i) Calculate the average rate at which kinetic energy is supplied to the car during the acceleration.

rate = ... W [2]

(ii) The car engine provides power at a constant rate. Suggest and explain why the acceleration of the car is **not** constant.

.....

.....

..... [2]

3 **(a)** Explain the concept of *work*.

.....

.....

..... [2]

(b) A table tennis ball falls vertically through air. Fig. 8.1 shows the variation of the kinetic energy E_K of the ball with distance h fallen. The ball reaches the ground after falling through a distance h_0.

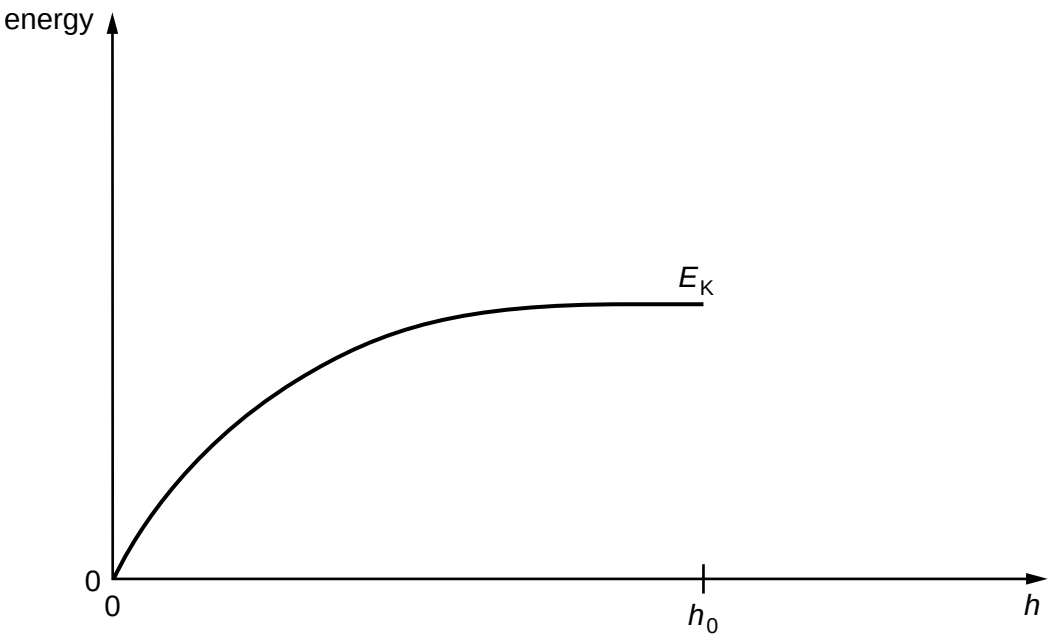

Fig. 8.1

(i) Describe the motion of the ball.

.....

.....

.....

.....

..... [3]

(ii) On Fig. 8.1, draw a line to show the variation with h of the gravitational potential energy E_P of the ball. At $h = h_0$, the potential energy is zero. [3]

4 A bullet of mass 2.0 g is fired horizontally into a block of wood of mass 600 g. The block is suspended from strings so that it is free to move in a vertical plane.
The bullet buries itself in the block. The block and bullet rise together through a vertical distance of 8.6 cm, as shown in Fig. 3.1.

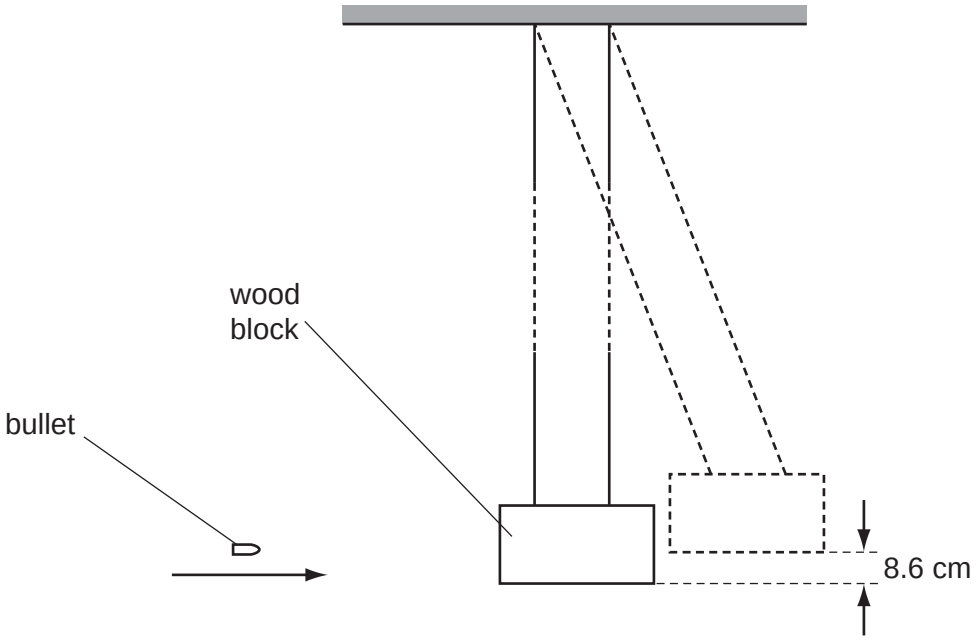

Fig. 3.1

(a) (i) Calculate the change in gravitational potential energy of the block and bullet.

change = ... J [2]

(ii) Show that the initial speed of the block and the bullet, after they began to move off together, was 1.3 m s^{-1}.

[1]

(b) Using the information in **(a)(ii)** and the principle of conservation of momentum, determine the speed of the bullet before the impact with the block.

speed = ... $m\,s^{-1}$ [2]

(c) **(i)** Calculate the kinetic energy of the bullet just before impact.

kinetic energy = ... J [2]

(ii) State and explain what can be deduced from your answers to **(c)(i)** and **(a)(i)** about the type of collision between the bullet and the block.

.....

.....

.....[2]

5 **(a)** Explain what is meant by the concept of *work*.

.....

.....

.....[2]

(b) Using your answer to **(a)**, derive an expression for the increase in gravitational potential energy ΔE_p when an object of mass m is raised vertically through a distance Δh near the Earth's surface.

The acceleration of free fall near the Earth's surface is g. [2]