Rewarding Learning

Centre Number

Candidate Number

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2017

Physics

Assessment Unit AS 1

assessing

Module 1: Forces, Energy and Electricity

AY111

[AY111]

TUESDAY 23 MAY, MORNING

TIME

1 hour 30 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided.
Do not write outside the boxed area on each page or on blank pages.
Complete in black ink only. **Do not write with a gel pen.**
Answer **all ten** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 75.
Quality of written communication will be assessed in Question **4(b)**.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each part of the question.
Your attention is drawn to the Data and Formulae Sheet which is inside this question paper.
You may use an electronic calculator.

1 **(a)** Complete **Table 1.1** by filling in the blanks where necessary.

Table 1.1

Quantity	S.I. base unit
Work Done	
	kg m^{-3}
Resistance	
	m s^{-1}

[2]

(b) State one similarity and one difference between *distance* and *displacement*.

(i) Similarity: _____

_____ [1]

(ii) Difference: _____

_____ [1]

(c) **Table 1.2** shows two sets of quantities listed as 'scalar' and 'vector' by a student.

Table 1.2

SCALAR	VECTOR
speed	power
mass	energy
acceleration	force
volume	weight
time	velocity

(i) State the **one** quantity that has been incorrectly listed as a scalar.

_____ [1]

(ii) State **two** quantities that have been incorrectly listed as vector.

1. _____

2. _____ [1]

(iii) State **two** quantities listed as vector that have the same unit. Name this unit.

1. _____

2. _____

Unit: _____ [2]

[Turn over

2 **Fig. 2.1** shows an experimental arrangement for determining the acceleration of free fall using light gates.

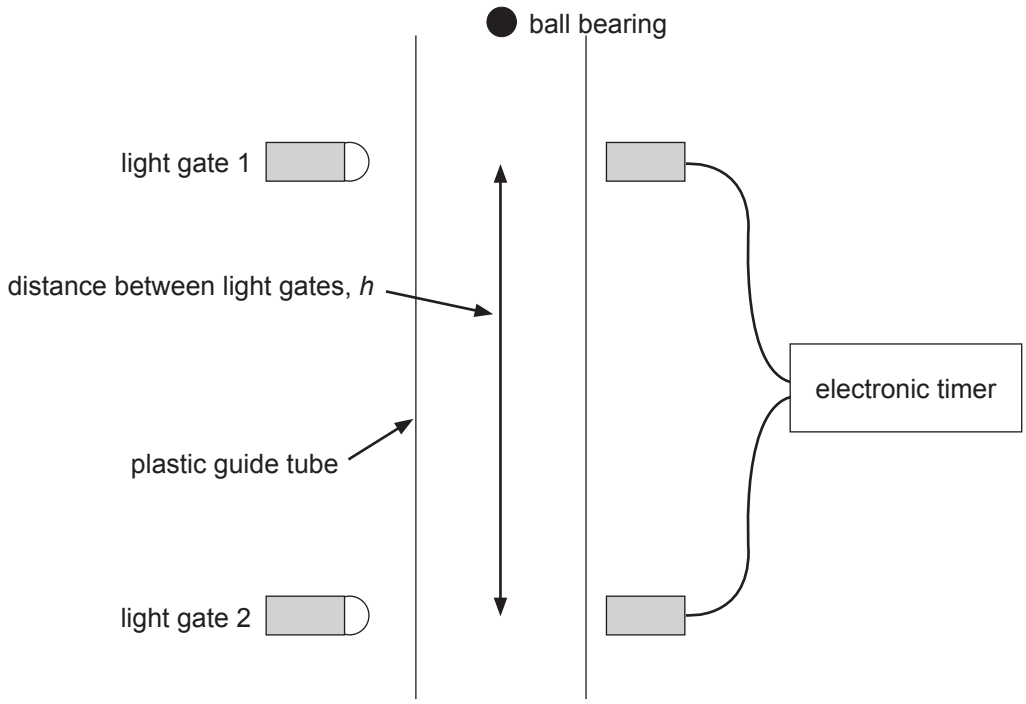

Fig. 2.1

The distance between the light gates is measured accurately. The ball bearing is allowed to fall from the top of the guide tube. The time taken for the ball bearing to fall between the two light gates (t) is measured using the timer. This procedure is repeated for four different distances, h.

(a) The relationship between h and t is given by **Equation 2.1**.

$$\frac{2h}{t} = gt + 2u \qquad \textbf{Equation 2.1}$$

where u is the velocity of the ball bearing as it passes through light gate 1.

(i) Using the results of the experiment, what graph should be plotted to enable 'g' to be determined?

Y axis _____

X axis _____ [1]

(ii) On the axes below sketch the graph you would expect to obtain.

[2]

(iii) How would the acceleration of free fall be obtained from the graph?

_____

_____ [1]

(iv) How would the velocity, *u*, of the ball bearing be obtained from the graph?

_____

_____ [1]

(b) Explain why only light gate 2 should be adjusted in varying distance *h*.

_____

_____

_____ [2]

[Turn over

3 **Fig. 3.1** shows the basketball player Michael Jordan performing a basketball manoeuvre called a 'slam dunk'.

Fig. 3.1

During a basketball match, a player, who wishes to perform a 'slam dunk', runs and jumps to put the ball in the basket. The motion of the player may be compared to that of a projectile as illustrated in **Fig. 3.2**. The player rises 1.2 m during the jump.

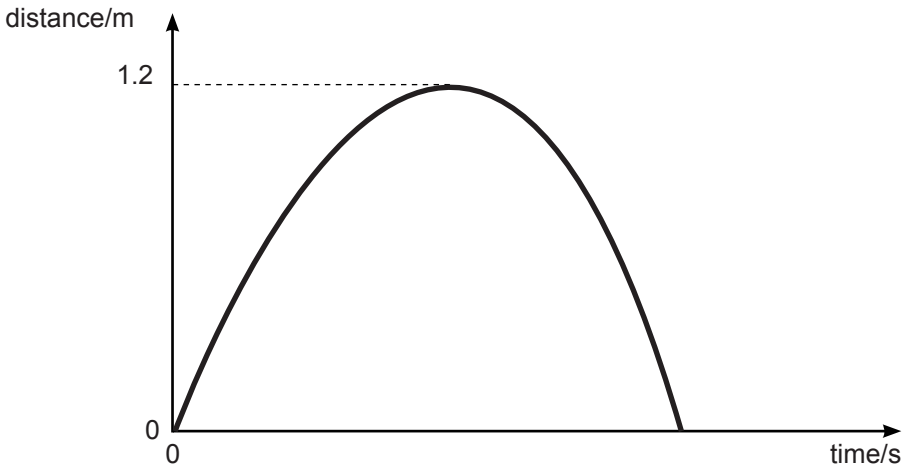

Fig. 3.2

(a) (i) Calculate the player's initial vertical velocity.

Initial vertical velocity = _____ m s^{-1} [2]

The time that the player is in the air is called the 'hang time'.

(ii) Calculate the player's 'hang time'.

Time = _____ s [3]

(b) Explain how a basketball player could increase the time that he is in the air.

_____

_____ [1]

[Turn over

Where appropriate in this question you should answer in continuous prose. You will be assessed on the quality of your written communication.

4 **Fig. 4.1** shows a mass of 65 kg being lifted vertically upwards by a rope attached to a hot air balloon.

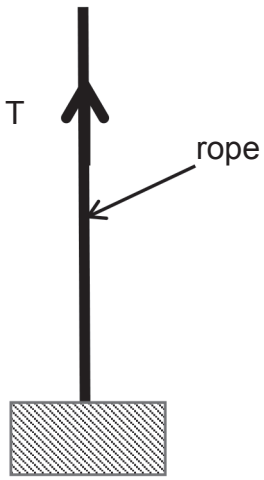

Fig. 4.1

(a) The upward vertical acceleration of the mass is 1.4 m s^{-2}. Calculate the tension, T, in the rope.

T = _____ N [3]

(b) The hot air balloon now becomes stationary. A parachutist jumps from the balloon when it is stationary and several kilometres above the ground. Describe and compare the forces acting on the parachutist: just after he jumps, when he reaches a constant velocity and just after he opens his parachute.

[5]

Quality of written communication [2]

5 **(a)** **(i)** Define work done.

_____

_____ [2]

(ii) Define efficiency.

_____

_____ [1]

(b) The head of a hammer, of mass 0.6 kg, moves at a speed of 5 m s^{-1} when it strikes a nail. If the nail is driven 5 mm into a wooden board and 15% of the head's energy is converted to sound and heat when it strikes the nail, what is the average force of the hammer head on the nail?

Average force = _____ N [3]

6 **(a)** State Hooke's law.

_____

_____ [2]

(b) **Fig. 6.1** shows a graph of applied force against extension produced for a certain material.

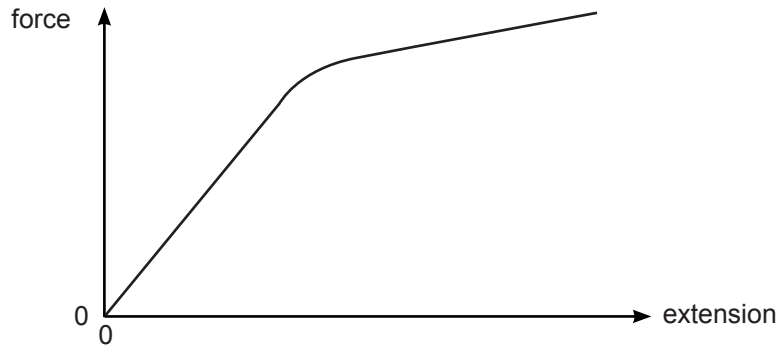

Fig. 6.1

On **Fig. 6.1** mark and label clearly the points which represent

(i) the limit of proportionality, P, [1]

(ii) the elastic limit, E. [1]

(c) **(i)** What is meant by plastic behaviour?

_____

_____ [1]

(ii) Mark clearly on **Fig. 6.1** the region of the graph which corresponds to plastic behaviour. [1]

[Turn over

(d) **Fig. 6.2** shows the mechanism used in a pin ball machine to fire a ball bearing horizontally.

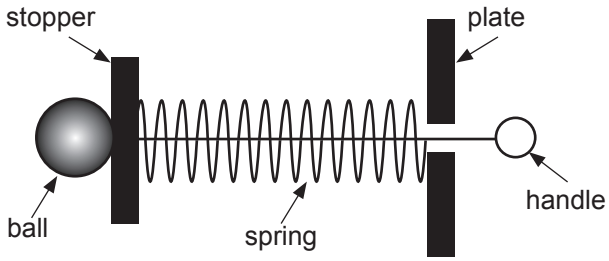

Fig. 6.2

The spring has a force constant of 7.5 N m^{-1}. The ball bearing rests against the stopper at the end of the spring. The spring is compressed by 8.5 cm by pulling the handle at the end of the spring.

(i) The handle is released. Calculate the force exerted by the compressed spring on the ball.

Force = _____ N [2]

(ii) The mass of the ball is 25 g. Calculate the initial acceleration of the ball.

Acceleration = _____ m s^{-2} [1]

7 **(a)** A current of 15 mA flows along a wire. Calculate the number of electrons that pass any point in the wire in 2 minutes.

Number of electrons = _____ [2]

(b) A filament bulb, designed to be used with a 12 V supply, has a power rating of 36 W.

(i) Calculate the resistance of the filament when the potential difference across its terminals is 12 V.

Resistance = _____ Ω [2]

(ii) A student predicts that if the potential difference across the bulb is reduced to 6.0 V, the power of the bulb would be 9.0 W. Explain how in practice the power will be greater than this value.

_____

_____

_____ [2]

[Turn over

8 **(a)** State Ohm's law.

_____

_____

_____ [2]

(b) **(i)** On the axes of **Fig. 8.1**, sketch the current–voltage (I/V) characteristic for an ohmic conductor:

Fig. 8.1

[1]

(ii) A negative thermal coefficient (ntc) thermistor is an example of a non-ohmic conductor. On the axes of **Fig. 8.2**, sketch the I/V characteristic for the thermistor.

Fig. 8.2

[1]

(c) The circuit shown in **Fig. 8.3** shows an arrangement of four resistors P, Q, R, S, with an ammeter, connected to a battery of negligible resistance.

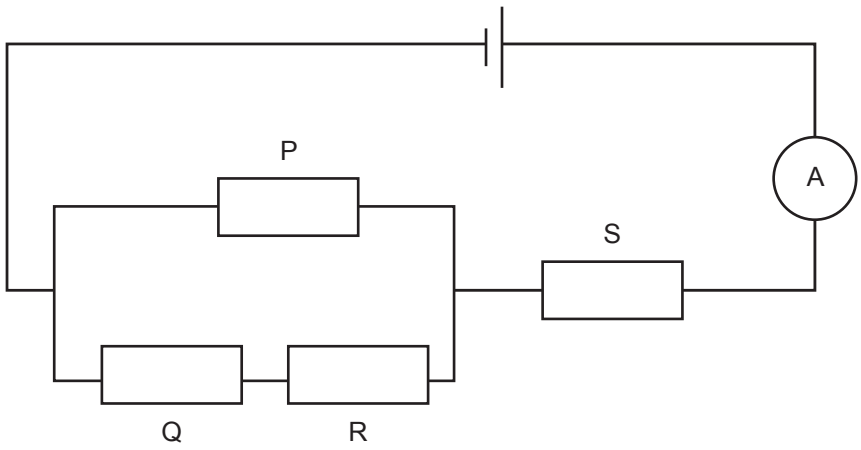

Fig. 8.3

The e.m.f. of the battery is 10 V and the reading on the ammeter is 1.2 A.

(i) The resistance of each of the four resistors is the same. What is the value of each resistance?

Resistance = _____ Ω [3]

(ii) Calculate the potential difference across the resistor P.

Potential difference = _____ V [1]

[Turn over

9 **(a)** A student is asked to carry out an experiment to determine the resistivity of a metal by the two meter method. The student is provided with five different unknown lengths of a certain metal wire each with the same cross-sectional area.

Fig. 9.1 shows a diagram of the electrical circuit which is to be used.

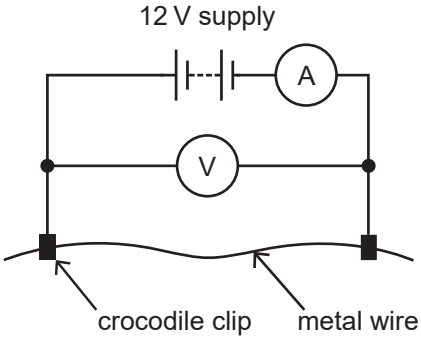

Fig. 9.1

(i) Outline the method that should be used to obtain a set of results enabling a graph to be plotted, from which a value of the resistivity of the metal can be found.

[4]

(ii) State what the axes of the graph should be and explain how the graph is used to determine the resistivity.

[2]

(b) The experiment is repeated using wires which are twice the cross-sectional area of the first. These wires are made of the same metal and have the same lengths as the original wires.

(i) Explain how the graph outlined in **(a)(ii)** will change, if at all.

_____

_____

_____ [1]

(ii) Explain whether the value of the resistivity will change, if at all.

_____

_____

_____ [1]

[Turn over

10 **(a)** **Fig. 10.1** shows two 10 kΩ resistors connected to a 12 V battery. A switch S connected between A and B is open.

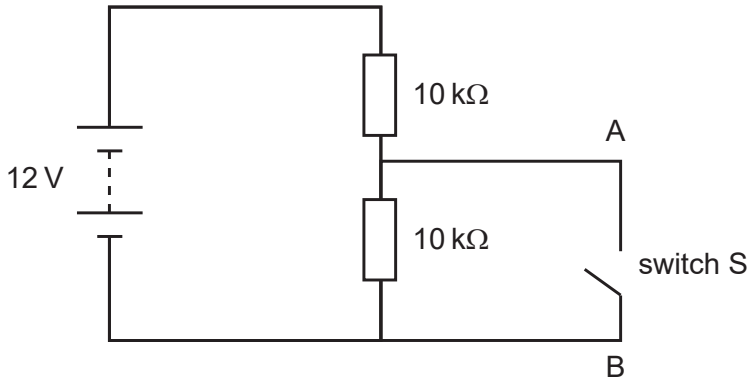

Fig. 10.1

(i) What is the voltage between A and B?

Voltage = _____ V [2]

(ii) A voltmeter of resistance 15 kΩ is now connected across one of the resistors as shown in **Fig. 10.2**.

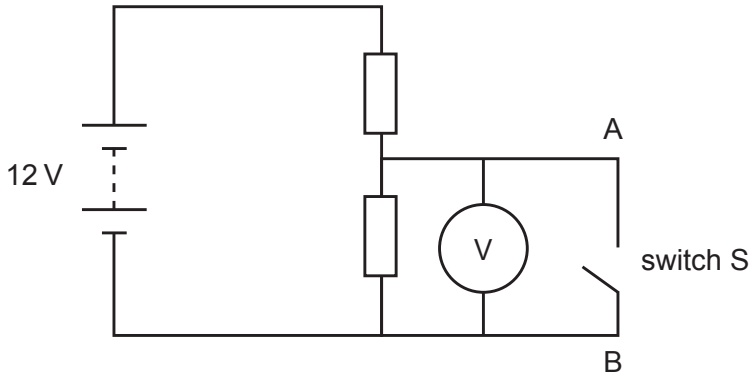

Fig. 10.2

What is the reading on the voltmeter?

Voltmeter reading = _____ V [3]

(b) The switch S is now closed.

(i) Calculate the new reading on the voltmeter.

Voltmeter reading = _____ V [1]

(ii) Explain your answer.

_____

_____

_____ [1]

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For Examiner's use only		
Question Number	**Marks**	**Remark**
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Total Marks		