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AS Level Physics A
H156/02 Depth in physics
Sample Question Paper

Date – Morning/Afternoon
Version 2.0

Time allowed: 1 hour 30 minutes

You must have:
• the Data, Formulae and Relationships Booklet

You may use:
• a scientific or graphical calculator

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First name	
Last name	

Centre number						Candidate number				

INSTRUCTIONS
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Where appropriate, your answers should be supported with working. Marks may be given for a correct method even if the answer is incorrect.
- Write your answer to each question in the space provided.
- Additional paper may be used if required but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION
- The total mark for this paper is **70**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended responses will be assessed in questions marked with an asterisk (*).
- This document consists of **20** page

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Answer **all** the questions.

1 **Fig. 1.1** shows a sign hanging from a rod fixed to a vertical wall. A metal wire attached between the rod and the wall holds the rod horizontal.

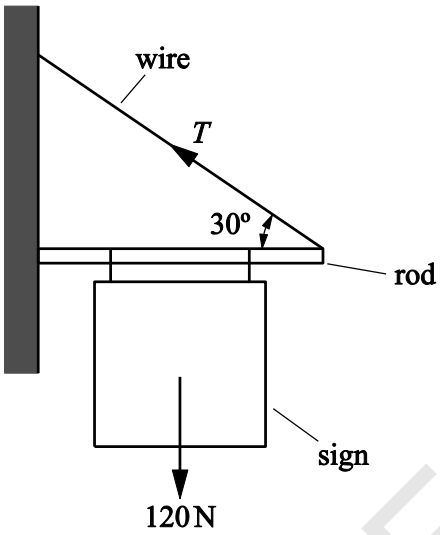

Fig.1.1

The weight *W* of the sign and rod act through the centre point of the rod. The value *W* is 120 N. The angle between wire and rod is 30º.

(a) Explain why the vertical force exerted on the rod by the wire is 60 N.

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..... **[2]**

(b) Calculate the tension *T* in the wire.

T = …… N **[2]**

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(c) **(i)** Draw an arrow on **Fig. 1.1** to show the direction of the force exerted on the rod by the wall.

[1]

(ii) State how you chose this direction.

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Question 2 begins on page 4

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2 **Fig. 2.1** shows the path of a golf ball which is struck at point **F** on the fairway landing at point **G** on the green. The effect of air resistance is negligible.

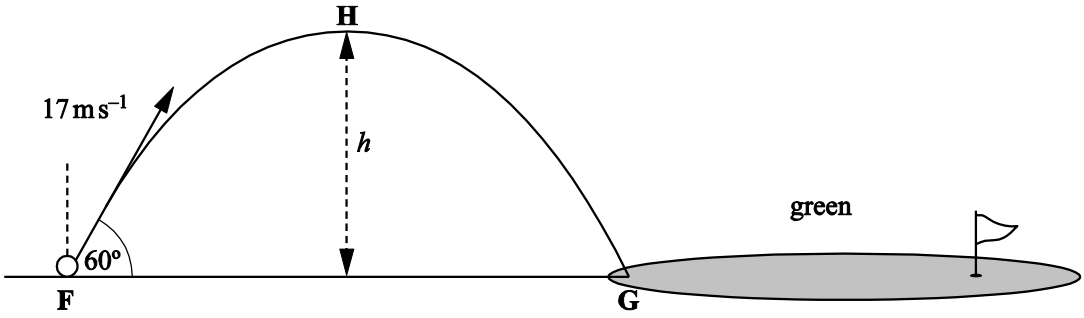

Fig. 2.1

The ball leaves the club at 17 m s^{-1} at an angle of 60° to the horizontal at time $t = 0$.

(a) Show that the speed of the ball at the highest point **H** of the trajectory is between 8 and 9 m s^{-1}.

speed = ……. m s^{-1} **[2]**

(b) At $t = 1.5$ s the ball reaches point **H**. Calculate

(i) the maximum height h of the ball

h = ……. m **[3]**

(ii) the distance between the points **F** and **G**.

distance **FG** = ……. m **[2]**

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(c) Suppose the same golfer standing at **F** had hit the ball with the same speed but at an angle of 30° to the horizontal. See **Fig. 2.2**.

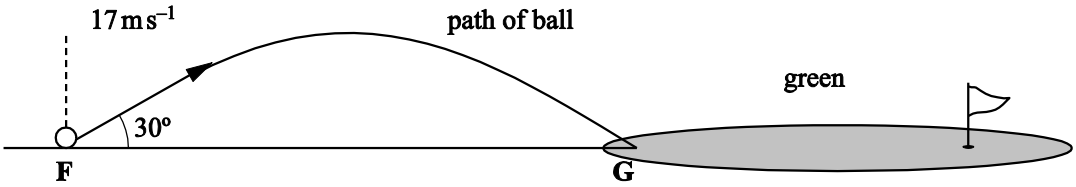

Fig. 2.2

Show that the ball would still land at **G**.

[3]

(d) Compare the magnitude and direction of the two velocities as the ball lands at G and using this information suggest, with a reason, which trajectory you would choose to travel a longer distance after hitting the green at G.

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3 A sports manufacturer is testing the quality of one of their footballs.

(a) **Fig. 3.1** shows how the force F applied to a football varies with time t whilst it is being kicked horizontally. The ball is initially at rest.

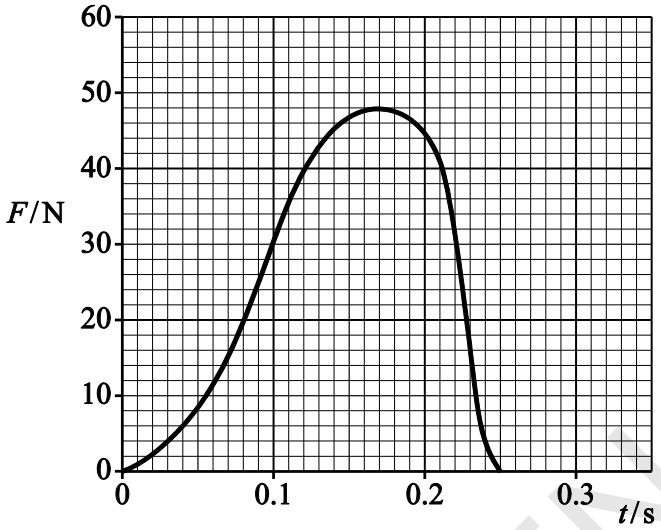

Fig. 3.1

(i) Use the graph to find:

1 the maximum force applied to the ball ……. .N

2 the time the boot is in contact with the ball …… s.

[1]

(ii) The mean force multiplied by the time of contact is called the impulse delivered to the ball. The impulse delivered to the ball is about 6.5 N s.

Explain how you would use the graph to show that the impulse has this value.

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..... **[2]**

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(b) The mass of the ball is 0.60 kg. Use your answers in **(a)** to calculate

(i) the maximum acceleration of the ball

acceleration = ……. m s^{-2} **[2]**

(ii) the final speed of the ball.

speed = …….. m s^{-1} **[2]**

(c) The ball hits a wall with a speed of 11 m s^{-1}. It rebounds from the wall along its initial path with a speed of 6.0 m s^{-1}. The impact lasts for 0.18 s.

Calculate the mean force exerted by the ball on the wall.

mean force = …… N **[3]**

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4 **(a)** Name the charge carriers responsible for electric current

in a metal …….

and in an electrolyte ……

[1]

(b) A copper rod of cross-sectional area 3.0×10^{-4} m^2 is used to transmit large currents. A charge of 650 C passes along the rod every 5.0 s. Calculate

(i) the current I in the rod

I = …….. A **[1]**

(ii) the total number of electrons passing any point in the rod per second

number per second = …….. **[1]**

(iii) the mean drift velocity of the electrons in the rod given that the number density of free electrons is 1.0×10^{29} m^{-3}.

mean drift velocity = …… m s^{-1} **[2]**

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(c) The copper rod in **(b)** labelled **X** in **Fig. 4.1** is connected to a longer thinner copper rod **Y**.

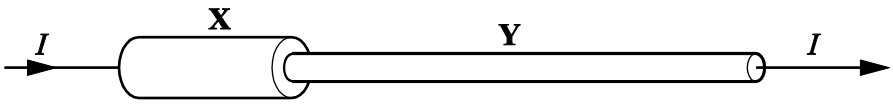

Fig. 4.1

(i) State why the current in **Y** must also be *I*.

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(ii) Rod **Y** has half the cross-sectional area of rod **X**. Calculate the mean drift velocity of electrons in **Y**.

mean drift velocity = …… m s^{-1} **[1]**

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5 **(a)** The circuit in **Fig. 5.1** consists of a d.c. supply of e.m.f. 45 V and negligible internal resistance and three resistors.

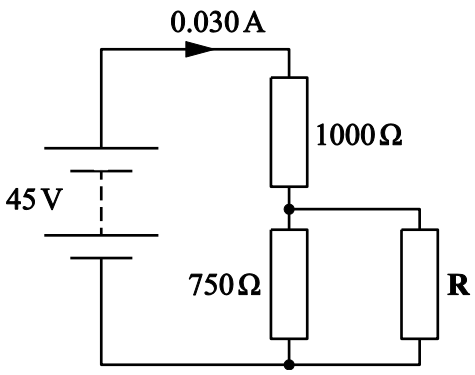

Fig. 5.1

Two of the resistors have resistances 1000 Ω and 750 Ω as shown.

The current drawn from the supply is 0.030 A. Calculate the resistance of **R**.

resistance = ……... Ω **[4]**

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(b)* Students are given a light dependent resistor (LDR) and asked to design a circuit for a light meter to monitor changes in light intensity. The meter reading must rise when the light intensity increases.

The incident light may cause the resistance of the LDR to vary between 1500 Ω and 250 Ω.

The students are asked to use the d.c. supply and one of the resistors from **(a)** above and either a voltmeter or ammeter.

Draw a suitable circuit.

Explain why the reading on the meter increases with increasing light intensity and which of the three fixed resistors gives the largest scale change on the meter for the change in light intensity. **[6]**

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6 In an investigation of standing waves, sound waves are sent down a long pipe, with its lower end immersed in water. The waves are reflected by the water surface. The pipe is lowered until a standing wave is set up in the air in the pipe. A loud note is then heard. See **Fig. 6.1**.

Length l_1 is measured. The pipe is then lowered further until a loud sound is again obtained from the air in the pipe. Length l_2 is measured.

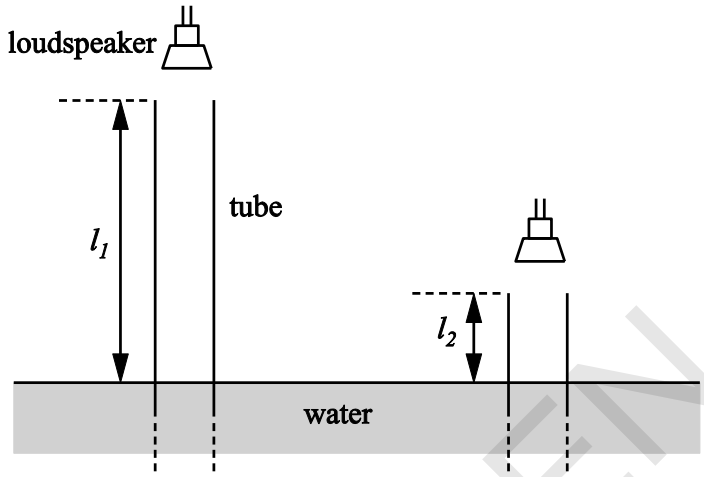

Fig 6.1

(a) A student obtained the following results in the experiment.

frequency of sound/Hz	**l_1 /m**	**l_2 /m**
500	0.506	0.170

Use data from the table to calculate the speed of sound in the pipe.

speed = …….. m s^{-1} **[4]**

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(b) The student repeats the experiment, but sets the frequency of the sound from the speaker at 5000 Hz.

Suggest and explain whether these results are likely to give a more or less accurate value for the speed of sound than those obtained in the first experiment.

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(c) The pipe is removed from the water and laid horizontally on a bench as in **Fig. 6.2**. The frequency of the sound waves sent down the pipe is adjusted until a standing wave is set up in it. Point **P** is a distance of $\lambda/4$ from point **Q** at the far end.

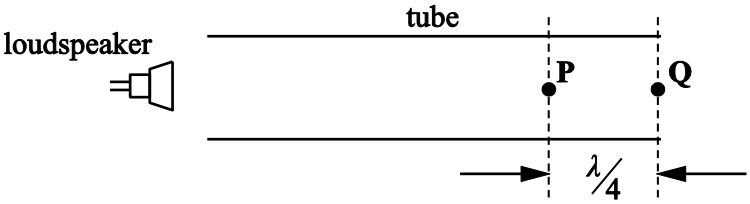

Fig. 6.2

Explain how and under what conditions a stationary sound wave is formed in the pipe. Describe and compare the motion of the air molecules at points **P** and **Q**.

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..... **[6]**

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7 **(a)*** The Planck constant h can be measured in an experiment using light-emitting diodes (LEDs).

Each LED used in the experiment emits monochromatic light. The wavelength λ of the emitted photons is determined during the manufacturing process and is provided by the manufacturer.

When the p.d. across the LED reaches a specific minimum value V_{min} the LED suddenly switches on emitting photons of light of wavelength λ.

V_{min} and λ are related by the energy equation $eV_{min} = hc/\lambda$.

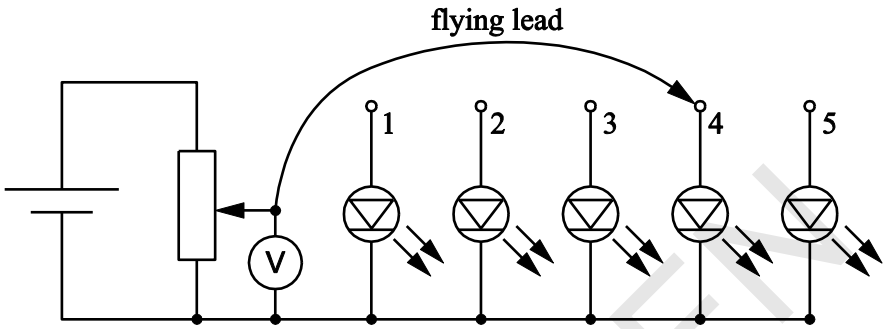

Fig. 7.1

LED	λ/nm	V_{min}/V
1 red	627	1.98
2 yellow	590	2.10
3 green	546	2.27
4 blue	468	2.66
5 violet	411	3.02

Discuss how you could use the circuit of **Fig. 7.1** to determine accurate values for V_{min} and how data from the table can be used graphically to determine a value for the Planck constant. **[6]**

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(b) A beam of ultraviolet light is incident on a clean metal surface. The graph of **Fig. 7.2** shows how the maximum kinetic energy KE_{max} of the electrons ejected from the surface varies with the frequency f of the incident light.

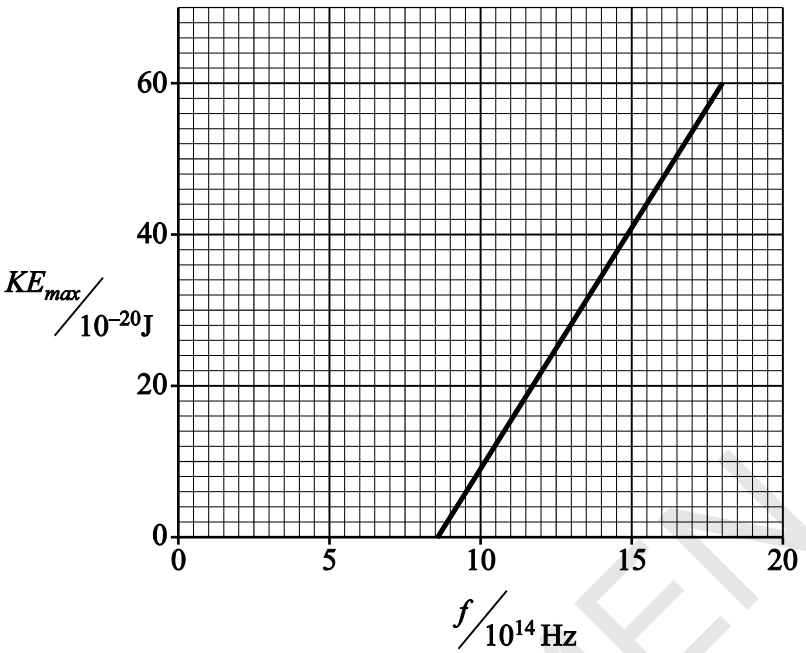

Fig.7.2

(i) Explain how the graph shown in **Fig 7.2** cannot be explained in terms of the wave-model for electromagnetic waves.

[2]

(ii) Use data from **Fig.7.2** to find a value of

1. the Planck constant

Planck constant = …… J s **[2]**

2. the threshold frequency of the metal

threshold frequency = …… Hz **[1]**

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3. the work function of the metal.

work function = …… J **[2]**

END OF QUESTION PAPER

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