Paper 1 style questions

SECTION A

Answer **all** the questions.

1 A student investigating an electrical experiment records the following measurements in the lab book.

- current in the LED = 120 ± 8 mA
- potential difference across the LED = 1.8 ± 0.2 V

What is the percentage uncertainty in the resistance of the LED?

A 4.4 %

B 6.7%

C 11%

D 18%

(1 mark)

2 A spring of original length 3.0 cm and force constant 100 N m^{-1} is placed on a smooth horizontal surface. Its length is changed from 6.0 cm to 8.0 cm.

What is the change in the energy stored by the spring?

A 0.020 J

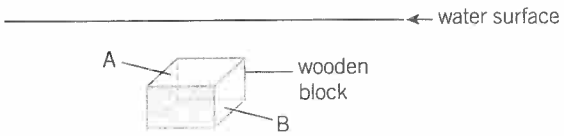
B 0.080 J

C 0.140 J

D 1.00 J

(1 mark)

3 A wooden block is held under water and then released, as shown in Figure 1.



▲ Figure 1

The wooden block moves towards the surface of the water.

Which of the following statements is/are true about the block as soon as it is released?

1 The force experienced by the face B due to water is greater than the force experienced by the face A.

2 The upthrust on the block is equal to its weight.

3 The mass of the water displaced is equal to the weight of the block.

A 1, 2 and 3 are correct

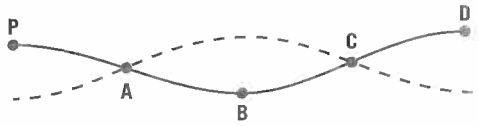
B Only 1 and 2 are correct

C Only 2 and 3 are correct

D Only 1 is correct

(1 mark)

4 Figure 2 shows a stationary wave pattern formed in an air column.

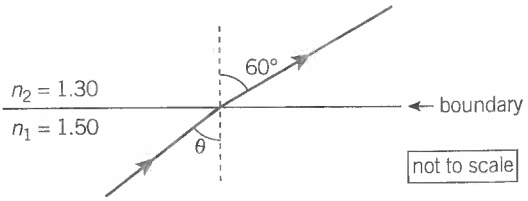


▲ Figure 2

Which point **A**, **B**, **C**, or **D** has a phase difference of 180° with reference to **P**?

(1 mark)

5 A ray of monochromatic light is incident at a boundary between two transparent materials. The refractive index of the materials is 1.30 and 1.50. The angle of refraction for the emergent ray is 60°.



▲ Figure 3

What is the angle θ of incidence?

A 42°

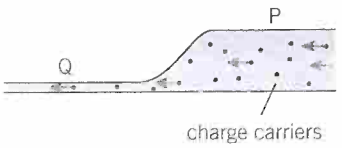
B 49°

C 60°

D 88°

(1 mark)

6 Figure 4 shows the cross-section of a metal wire connected to a power supply. The charge carriers within the metal wire move from right to left.



▲ Figure 4

The section Q of the wire is thinner than section P.

Which statement is correct?

A The direction of the conventional current is from right to left.

B The section Q of the wire has fewer charge carriers per unit volume.

C The current in both sections is the same.

D The charge carriers are negative ions.

(1 mark)

7 A resistor **R** is connected in parallel with a resistor of resistance 10Ω. The total resistance of the combination is 6.0Ω. What is the resistance of resistor **R**?

A 0.067Ω

B 3.8Ω

C 4.0Ω

D 15Ω

(1 mark)

8 What is a reasonable estimate for the energy of a photon of visible light?

A 4×10^{-19} J

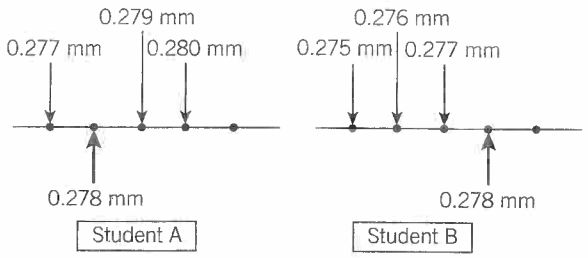
B 4×10^{-18} J

C 4×10^{-16} J

D 4×10^{-11} J

(1 mark)

9 Students A and B use micrometer screw gauges to measure the diameter of a copper wire in three different places along its length. The diameter of the wire according to the manufacturer is 0.278 mm. The results recorded by students A and B are shown in Figure 5.



▲ Figure 5

Which statement is correct about the measurements made by the student B compared with those of student A?

A The measurements are more accurate.

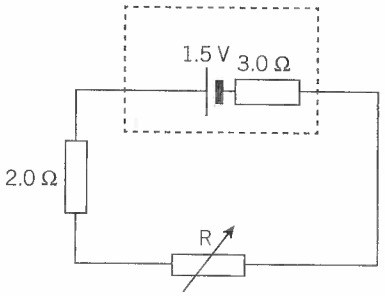
B The measurements are not as precise.

C The measurements are both more accurate and more precise.

D The measurements are not accurate but are more precise.

(1 mark)

10 The circuit in Figure 6 is constructed by a student in the laboratory.



▲ Figure 6

The e.m.f. of the cell is 1.5 V and it has an internal resistance of 3.0Ω. A resistor of resistance 2.0Ω and a variable resistor R are connected in series to the terminals of the cell. The variable resistor is set to a resistance value of 7.0Ω.

What is the value of the ratio $\frac{\text{power dissipated in R}}{\text{power supplied by the cell}}$?

A 0.17

B 0.25

C 0.58

D 0.75

(1 mark)

SECTION B

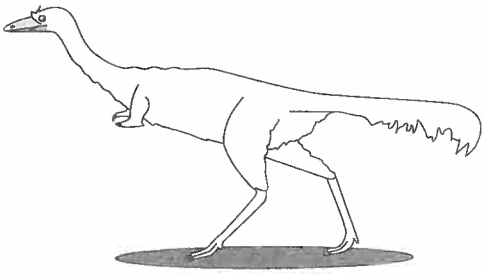
Answer **all** the questions

11 a Define *velocity*. *(1 mark)*

b The mass of an ostrich is 130 kg. It can run at a maximum speed of 70 kilometers per hour.

(i) Calculate the maximum kinetic energy of the ostrich when it is running. *(3 marks)*

(ii) Scientists have recently found fossils of a prehistoric bird known as Mononykus. Figure 7 shows what the Mononykus would have looked like.



▲ Figure 7

According to a student, the Mononykus looks similar to our modern day ostrich. The length, height and width of the Mononykus were all **half** that of an ostrich. Estimate the mass of the Mononykus. Explain your reasoning. *(2 marks)*

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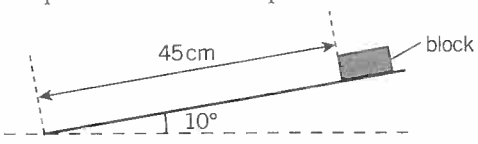
12 Figure 8 shows a block of wood held at rest at the top of a smooth ramp.



▲ Figure 8

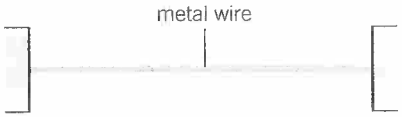
The ramp makes an angle of 10° to the horizontal. The block is released and it slides down the ramp.

a Calculate the acceleration of the block along the length of the ramp. *(2 marks)*

b The block travels a total distance of 45 cm down the ramp. Calculate the time it takes to reach the bottom of the ramp. *(3 marks)*

c The speed of the block at the bottom of the ramp is v. Describe a simple experiment a student can carry out to determine an approximate value of the speed v. The student only has a metre rule and a stopwatch. *(3 marks)*

13 Figure 9 shows a metal wire stretched horizontally between two supports on a laboratory bench.



▲ Figure 9

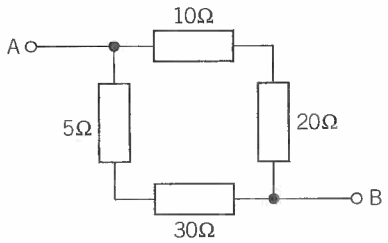
The tension in the wire is 15 N and it has a cross-sectional area $3.1 \times 10^{-7}\,m^2$. The Young modulus of the wire is 4.2×10^{10} Pa.

a Calculate the strain of the wire. *(3 marks)*

b Design a simple electrical circuit to determine the resistivity of the metal used to make the wire. *(4 marks)*

c Figure 10 shows an electrical circuit.

Calculate the total resistance between **A** and **B**. *(3 marks)*



▲ Figure 10

14 a Explain what is meant by coherent waves. *(1 mark)*

b State two ways in which a stationary waves differs from a progressive wave. *(2 marks)*

c Figure 11 shows a stationary pattern on a length of stretched string.

▲ Figure 11

The distances shown in Figure 11 are **drawn to scale**. The frequency of vibration of the string is 110 Hz.

(i) By taking measurements from Figure 11, determine the wavelength of the progressive waves on the string. *(2 marks)*

(ii) Calculate the speed of the progressive waves on the string. *(2 marks)*

15 a Sketch a graph of energy E of a photon against frequency f of the electromagnetic radiation. *(1 mark)*

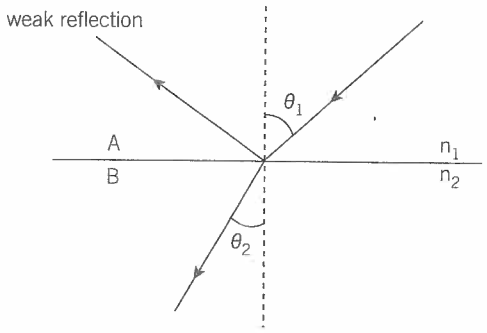
b Electromagnetic waves of frequency 8.93×10^{14} Hz are incident on the surface of metal. The work function of the metal is 3.20×10^{-19} J.

(i) Calculate the energy of the photons. *(2 marks)*

(ii) Calculate the maximum speed v_{max} of the photoelectrons emitted from the metal surface. *(3 marks)*

16 a Define *refractive index* of a material. *(1 mark)*

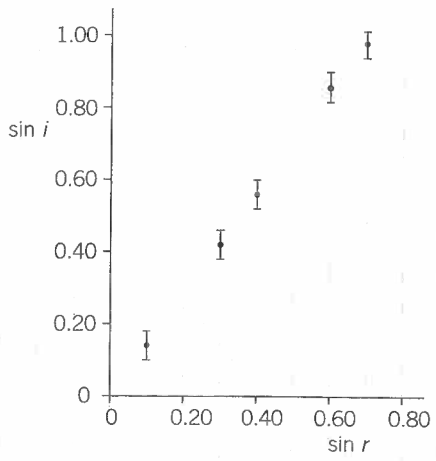
b Figure 12 shows the path of a ray of light as it crosses the boundary between two materials A and B.



▲ Figure 12

The refractive index of material A is n_1 and the angle of incidence of the ray of light is θ_1. The angle of refraction in material B is θ_2 and the refractive index of material B is n_2. Write an equation that relates n_1, n_2, θ_1 and θ_2. *(1 mark)*

c A student is investigating the refraction of light by a transparent material by measuring the angles of incidence i and refraction r. Figure 13 show the results from the experiment.



▲ Figure 13

Use Figure 13 to determine

(i) the refractive index of the material *(2 marks)*

(ii) the critical angle for this material. *(2 marks)*

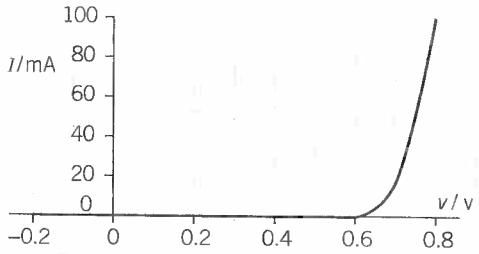
d You are provided with a semi-circular glass block and a ray-box with a suitable supply.

Design a laboratory experiment to determine the critical angle of the glass of the semi-circular block and hence the refractive index of the glass. You may use other equipment available in the laboratory. In your description pay particular attention to

- how the apparatus is used
- what measurements are taken
- how the data is analysed. *(4 marks)*

17 a State *Ohm's law*. *(1 mark)*

b The *I-V* characteristic of a particular component is shown in Figure 14.

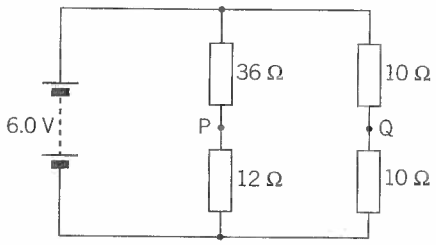


▲ Figure 14

(i) Use Figure 14 to describe how the resistance of this component depends on the potential difference (p.d.) across it. You may do calculations to support your answer. *(3 marks)*

(ii) Draw a circuit diagram for an arrangement that could be used to collect results to plot the graph shown in Figure 14. *(3 marks)*

c Figure 15 shows an electrical circuit.



▲ Figure 15

The e.m.f. of the battery is 6.0 V and it has negligible internal resistance.

Calculate

(i) the current in the 36 Ω resistor *(2 marks)*

(ii) the potential difference across the 12 Ω resistor *(1 mark)*

(iii) the potential difference between points **P** and **Q**. *(2 marks)*