

Write your name here

Surname

Other names

Pearson Edexcel
International
Advanced Level

Centre Number

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Candidate Number

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Physics

Advanced Subsidiary
Unit 3: Exploring Physics

Wednesday 9 May 2018 – Afternoon

Time: 1 hour 20 minutes

Paper Reference

WPH03/01

You must have:

Ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
– *there may be more space than you need.*

Information

- The total mark for this paper is 40.
- The marks for **each** question are shown in brackets
– *use this as a guide as to how much time to spend on each question.*
- The list of data, formulae and relationships is printed at the end of this booklet.
- Candidates may use a scientific calculator.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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SECTION A

Answer ALL questions.

For questions 1–5, in Section A, select one answer from A to D and put a cross in the box ☐.
If you change your mind put a line through the box ☒ and then
mark your new answer with a cross ☐.

1 Which of the following is an SI base quantity?

- ☐ A ampère
- ☐ B charge
- ☐ C current
- ☐ D volt

(Total for Question 1 = 1 mark)

2 In an experiment to determine the Planck constant a student uses light of wavelength $\lambda = 471 \text{ nm}$.

Which of the following is the correct value of λ^{-1} ?

- ☐ A 2.12 nm
- ☐ B $2.12 \times 10^{-6} \text{ nm}^{-1}$
- ☐ C $2.12 \times 10^6 \text{ nm}^{-1}$
- ☐ D $2.12 \times 10^6 \text{ m}^{-1}$

(Total for Question 2 = 1 mark)

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Questions 3, 4 and 5 refer to an experiment to determine the resistivity of a material.

A student has a sample of the material in the form of a wire with a diameter of about 1 mm.

- 3 To determine the resistivity of the material, which of the following quantities would **not** be needed?

- ☐ A density
- ☐ B resistance
- ☐ C area
- ☐ D length

(Total for Question 3 = 1 mark)

- 4 Which of the following instruments should the student use to measure the diameter of the wire?

- ☐ A electronic balance
- ☐ B metre rule
- ☐ C micrometer screw gauge
- ☐ D vernier calipers

(Total for Question 4 = 1 mark)

- 5 Which of the following is the SI unit for resistivity?

- ☐ A Ω
- ☐ B $\Omega \text{ m}^{-1}$
- ☐ C $\Omega \text{ m}$
- ☐ D $\Omega \text{ m}^2$

(Total for Question 5 = 1 mark)

TOTAL FOR SECTION A = 5 MARKS



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- 7 A student is to determine the viscosity η of a liquid using falling steel spheres and a graphical method.

The student has a measuring cylinder filled with the liquid and some steel spheres of different diameters.

The terminal velocity v of a sphere falling through the liquid is given by

$$v = 2 \frac{r^2(\rho_s - \rho_l)g}{9\eta}$$

where r is the radius of the sphere, ρ_s is the density of steel and ρ_l is the density of the liquid. The values of both ρ_s and ρ_l are known.

Write a plan for this experiment.

You should:

- (a) draw and label a diagram showing how the apparatus will be used, (1)
- (b) list any additional measuring instruments required that are not shown in your diagram, (1)
- (c) list the quantities to be measured, (1)
- (d) for two quantities listed in (c) explain your choice of measuring instrument, (4)
- (e) state which is the independent variable and which is the dependent variable, (2)
- (f) for one quantity comment on whether repeat readings are appropriate in this case, (1)
- (g) explain how the data collected will be used to determine the viscosity including a sketch of the expected graph, (4)
- (h) identify the main sources of uncertainty and/or systematic error, (2)
- (i) comment on safety. (1)

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(Total for Question 7 = 17 marks)



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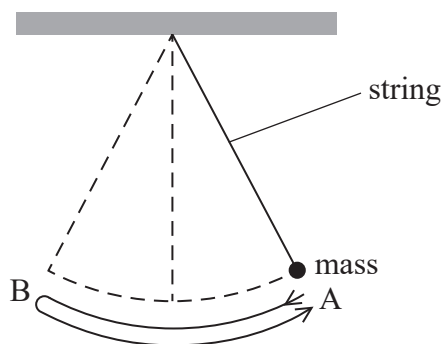
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- 8 A student determined the acceleration of free fall g using a simple pendulum. The pendulum consists of a mass attached to a string, which is suspended from a support as shown.



The equation for a simple pendulum is $T = 2\pi\sqrt{\frac{l}{g}}$

where T is the time taken for the mass to make one complete swing from A to B and back to A, and l is the length of the string.

The student recorded the following results.

$l / \times 10^{-2} \text{ m}$	$T / \text{ s}$	$T^2 / \text{ s}^2$
40	1.14	1.30
35	1.05	1.10
30	1	1
25	0.91	0.83
20	0.8	0.64

- (a) Criticise these results.

(2)

- (b) Explain why a graph of T^2 on the y -axis against l on the x -axis should be a straight line through the origin.

(2)

- (c) (i) Plot this graph on the grid provided and draw a line of best fit.

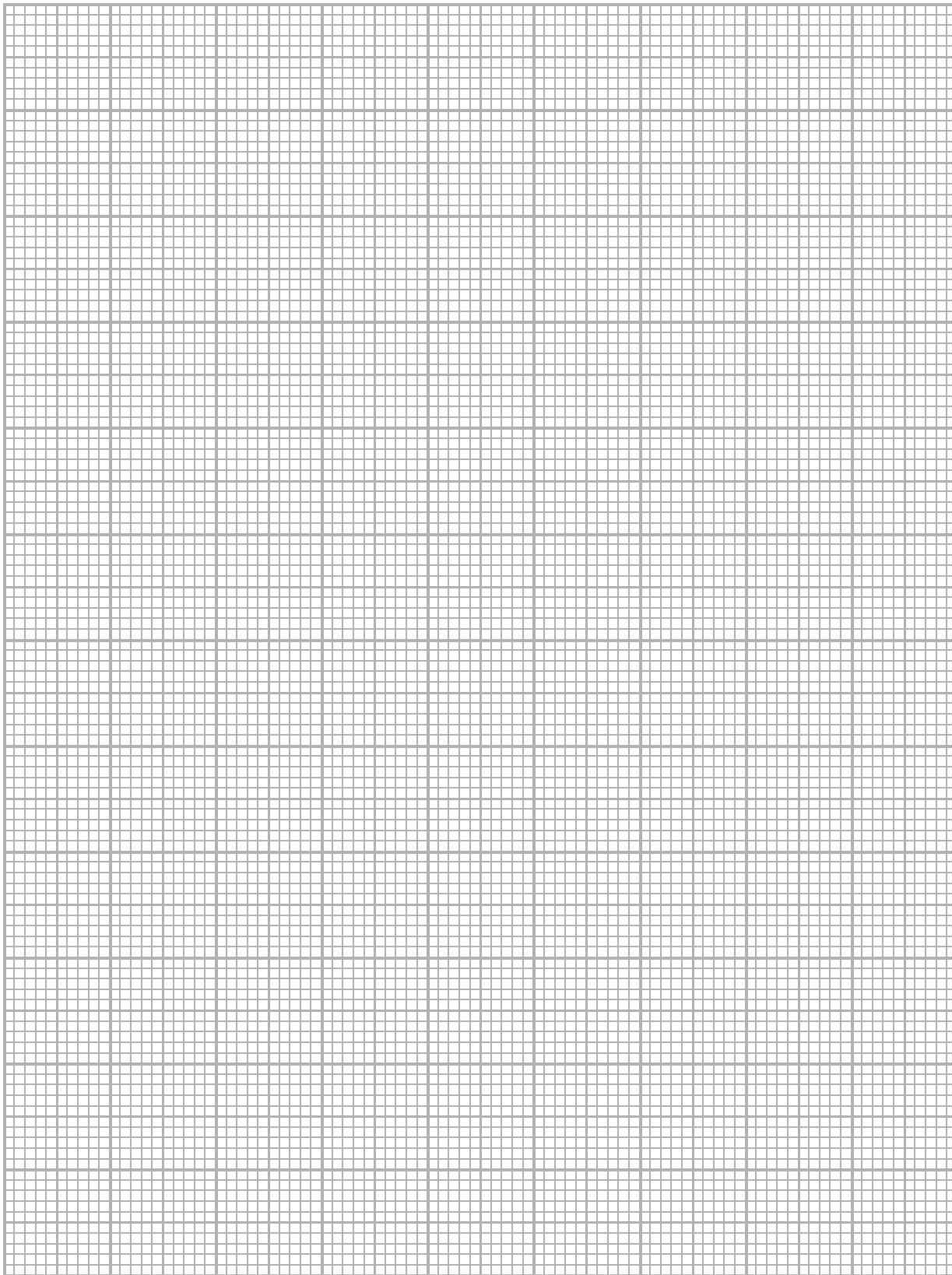
(5)



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P 5 1 6 3 3 A 0 1 1 1 6

(ii) Determine the gradient of the graph.

(2)

Gradient = ...

(iii) Use your value of the gradient to calculate a value for g .

(2)

g = ...

(d) Calculate the percentage difference between the value for g calculated in (c)(iii) and the accepted value for g .

(2)

Percentage difference = ...

(Total for Question 8 = 15 marks)

TOTAL FOR SECTION B = 35 MARKS

TOTAL FOR PAPER = 40 MARKS



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List of data, formulae and relationships

Acceleration of free fall	$g = 9.81 \text{ m s}^{-2}$	(close to Earth's surface)
Electron charge	$e = -1.60 \times 10^{-19} \text{ C}$	
Electron mass	$m_e = 9.11 \times 10^{-31} \text{ kg}$	
Electronvolt	$1 \text{ eV} = 1.60 \times 10^{-19} \text{ J}$	
Gravitational field strength	$g = 9.81 \text{ N kg}^{-1}$	(close to Earth's surface)
Planck constant	$h = 6.63 \times 10^{-34} \text{ J s}$	
Speed of light in a vacuum	$c = 3.00 \times 10^8 \text{ m s}^{-1}$	

Unit 1

Mechanics

Kinematic equations of motion	$v = u + at$ $s = ut + \frac{1}{2}at^2$ $v^2 = u^2 + 2as$
Forces	$\Sigma F = ma$ $g = F/m$ $W = mg$
Work and energy	$\Delta W = F\Delta s$ $E_k = \frac{1}{2}mv^2$ $\Delta E_{\text{grav}} = mg\Delta h$

Materials

Stokes' law	$F = 6\pi\eta rv$
Hooke's law	$F = k\Delta x$
Density	$\rho = m/V$
Pressure	$p = F/A$
Young modulus	$E = \sigma/\epsilon$ where Stress $\sigma = F/A$ Strain $\epsilon = \Delta x/x$
Elastic strain energy	$E_{\text{el}} = \frac{1}{2}F\Delta x$



Unit 2*Waves*

Wave speed

$$v = f\lambda$$

Refractive index

$${}_1\mu_2 = \sin i / \sin r = v_1 / v_2$$

Electricity

Potential difference

$$V = W/Q$$

Resistance

$$R = V/I$$

Electrical power, energy and efficiency

$$P = VI$$

$$P = I^2 R$$

$$P = V^2 / R$$

$$W = VIt$$

$$\% \text{ efficiency} = \frac{\text{useful energy output}}{\text{total energy input}} \times 100$$

$$\% \text{ efficiency} = \frac{\text{useful power output}}{\text{total power input}} \times 100$$

Resistivity

$$R = \rho l / A$$

Current

$$I = \Delta Q / \Delta t$$

$$I = nqvA$$

Resistors in series

$$R = R_1 + R_2 + R_3$$

Resistors in parallel

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

Quantum physics

Photon model

$$E = hf$$

Einstein's photoelectric equation

$$hf = \phi + \frac{1}{2}mv_{\max}^2$$

