Write your name here

Surname	Other names

Pearson Edexcel
International
Advanced Level

Centre Number | | | | | |

Candidate Number | | | | |

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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P 5 1 6 3 3 A 0 1 1 6

Pearson

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** $2.12\,\text{nm}$

☒ **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)

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** $\Omega\,m^{-1}$
- ☒ **C** Ωm
- ☒ **D** $\Omega\,m^{2}$

(Total for Question 5 = 1 mark)

TOTAL FOR SECTION A = 5 MARKS

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SECTION B

Answer ALL questions in the spaces provided.

6 An experiment report states that the mean diameter of a nylon thread is 0.150 mm ± 0.005 mm.

(a) State the range of the measurements.

(1)

.....

.....

(b) Calculate the percentage uncertainty in the measurement of the diameter.

(1)

.....

.....

.....

Percentage uncertainty = ...

(c) The report states that the mean diameter of a human hair was measured as 0.075 mm with a percentage uncertainty of 5%.

Calculate the uncertainty in the measurement of the diameter of the hair.

(1)

.....

.....

Uncertainty = ...

(Total for Question 6 = 3 marks)

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)

(Total for Question 7 = 17 marks)

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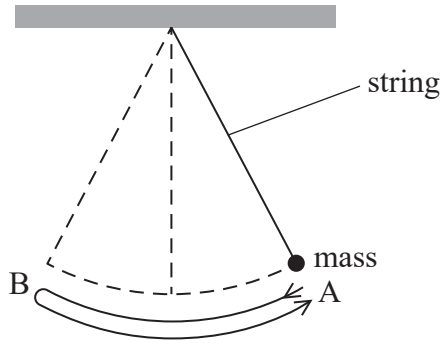
8 A student determined the acceleration of free fall g using a simple pendulum.
The pendulum consists of a mass attached to a string, which is suspended from a support as shown.



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} m	T / s	T^2 / 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)

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.....

(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)

(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	$\Delta W = F\Delta s$ $E_k = \frac{1}{2}mv^2$ $\Delta E_{grav} = mg\Delta h$

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	$E = \sigma/\varepsilon$ where Stress $\sigma = F/A$ Strain $\varepsilon = \Delta x/x$
Elastic strain energy	$E_{el} = \frac{1}{2}F\Delta x$

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	$P = VI$ $P = I^2R$ $P = V^2/R$ $W = VIt$
	$\%\ \text{efficiency} = \dfrac{\text{useful energy output}}{\text{total energy input}} \times 100$
	$\%\ \text{efficiency} = \dfrac{\text{useful power output}}{\text{total power input}} \times 100$
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	$\dfrac{1}{R} = \dfrac{1}{R_1} + \dfrac{1}{R_2} + \dfrac{1}{R_3}$

Quantum physics

Photon model	$E = hf$
Einstein's photoelectric equation	$hf = \phi + \frac{1}{2}mv^2_{max}$