Write your name here

Surname	Other names

Pearson Edexcel
International
Advanced Level

Centre Number | | | | | |

Candidate Number | | | | |

Physics

Advanced Subsidiary
Unit 3: Exploring Physics

Wednesday 10 May 2017 – 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 4 8 4 2 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 A student measures his reaction time. He takes the following readings.

0.21 s, 0.19 s, 0.20 s, 0.09 s

Which of the following should be stated as the mean value of the time with a suitable uncertainty?

☒ **A** 0.20 ± 0.06 s

☒ **B** 0.20 ± 0.01 s

☒ **C** 0.17 ± 0.06 s

☒ **D** 0.17 ± 0.01 s

(Total for Question 2 = 1 mark)

Questions 3, 4 and 5 refer to the experiment described below.

To determine the viscosity of a liquid, a sphere is timed as it drops through a column of the liquid.

3 To determine the viscosity of the liquid, which of the following is **not** needed?

- ☒ **A** the density of the liquid
- ☒ **B** the density of the sphere
- ☒ **C** the diameter of the sphere
- ☒ **D** the volume of the liquid

(Total for Question 3 = 1 mark)

4 Which of the following instruments should be used to measure the diameter of the sphere?

- ☒ **A** half-metre rule
- ☒ **B** metre rule
- ☒ **C** micrometer screw gauge
- ☒ **D** vernier callipers

(Total for Question 4 = 1 mark)

5 Which of the following is the SI unit for viscosity?

- ☒ **A** $N\ s^{-1}\ m^2$
- ☒ **B** $N\ s\ m^{-2}$
- ☒ **C** Pa^{-1}
- ☒ **D** Pa

(Total for Question 5 = 1 mark)

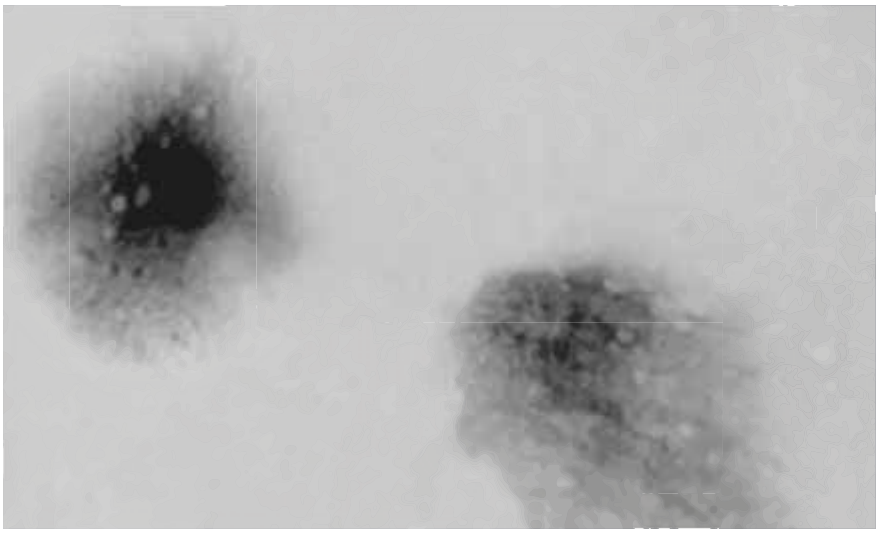
TOTAL FOR SECTION A = 5 MARKS

SECTION B

Answer ALL questions in the spaces provided.

6 A microwave oven uses standing waves to cook food.

When food is put into a microwave oven, a pattern of burn marks may be produced by the standing waves as shown.



In an experiment to determine the speed of electromagnetic waves, a student measures the distance between two adjacent burn marks as 6 cm.

(a) (i) Explain why the wavelength of the microwaves is equal to twice the distance between the burn marks. Use a labelled diagram in your answer.

(2)

(ii) The manufacturer states that the frequency of the microwaves is 2450 MHz.

Calculate the speed of the microwaves.

(3)

Speed of microwaves = ...

(b) (i) Suggest a suitable instrument for measuring the distance between burn marks. Give a reason for your choice of instrument.

(2)

(ii) Calculate the percentage uncertainty in the 6.0 cm distance when measured with your chosen instrument.

(1)

Percentage uncertainty = ...

(Total for Question 6 = 8 marks)

7 A student is asked to determine the resistance of a 12 V filament lamp at different potential differences. Plan an experiment to do this using a graphical method.

You should:

(a) draw and label a circuit diagram of the apparatus to be used,

(2)

(b) state the quantities to be measured, suggesting a suitable measuring instrument for each quantity,

(2)

(c) comment on whether repeat readings are appropriate in this case,

(1)

(d) sketch the graph to be drawn and explain how the data collected will be used to determine the resistance at a given potential difference,

(3)

(e) identify the main sources of uncertainty and/or systematic error,

(2)

(f) comment on safety.

(1)

(Total for Question 7 = 11 marks)

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8 A student investigated how the extension Δx of a wire varies with applied force F.
He obtained the following results.

mean diameter of wire = 0.245 mm
original length of wire = 1.35 m

Mass / g	F / N	Δx / cm
200	1.96	0.3
400	3.92	0.55
500	4.91	0.7
600	5.9	0.85
1000	9.81	4.2
1100	10.8	6.4

(a) Criticise his results.

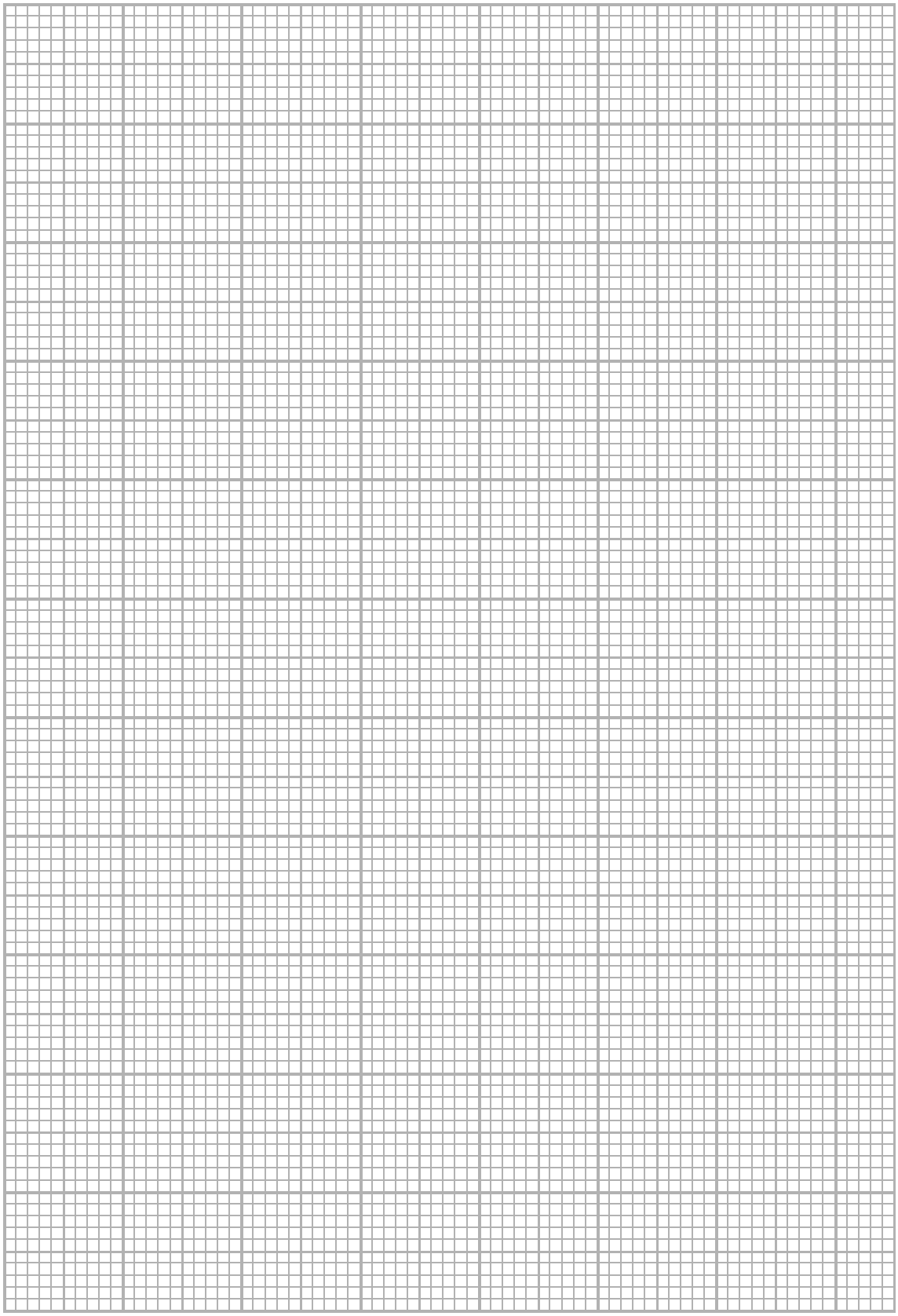
(3)

(b) Describe how the student should measure the diameter of the wire.

(2)

(c) (i) Plot a graph of F on the y-axis against Δx on the x-axis on the grid provided and draw a line of best fit.

(5)



(ii) Comment on the shape of your graph.

(2)

.....

.....

.....

.....

(iii) Use your graph to determine the Young modulus of the material the wire is made from.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

Young modulus = ...

(Total for Question 8 = 16 marks)

TOTAL FOR SECTION B = 35 MARKS

TOTAL FOR PAPER = 40 MARKS

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

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