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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 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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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)

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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 $\text{N s}^{-1} \text{m}^2$
- B N s m^{-2}
- C Pa^{-1}
- D Pa

(Total for Question 5 = 1 mark)

TOTAL FOR SECTION A = 5 MARKS



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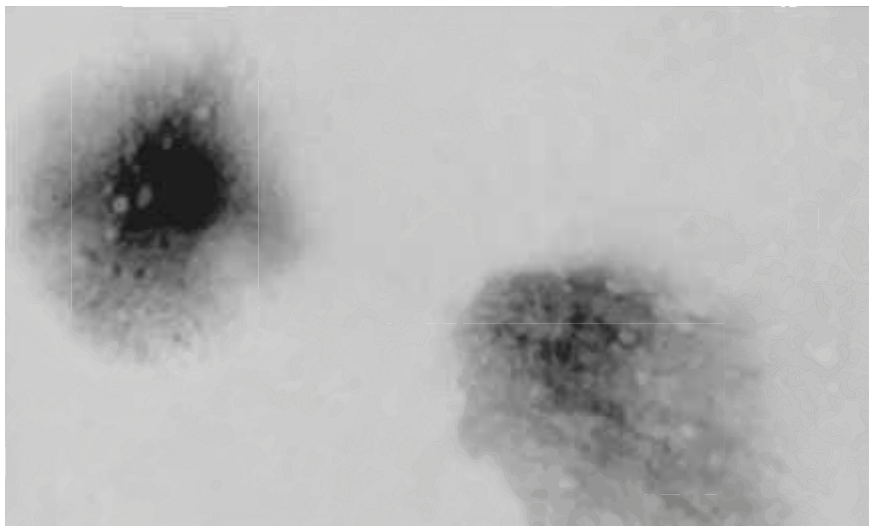
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SECTION B

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)

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(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)

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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)

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(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)

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

(2)

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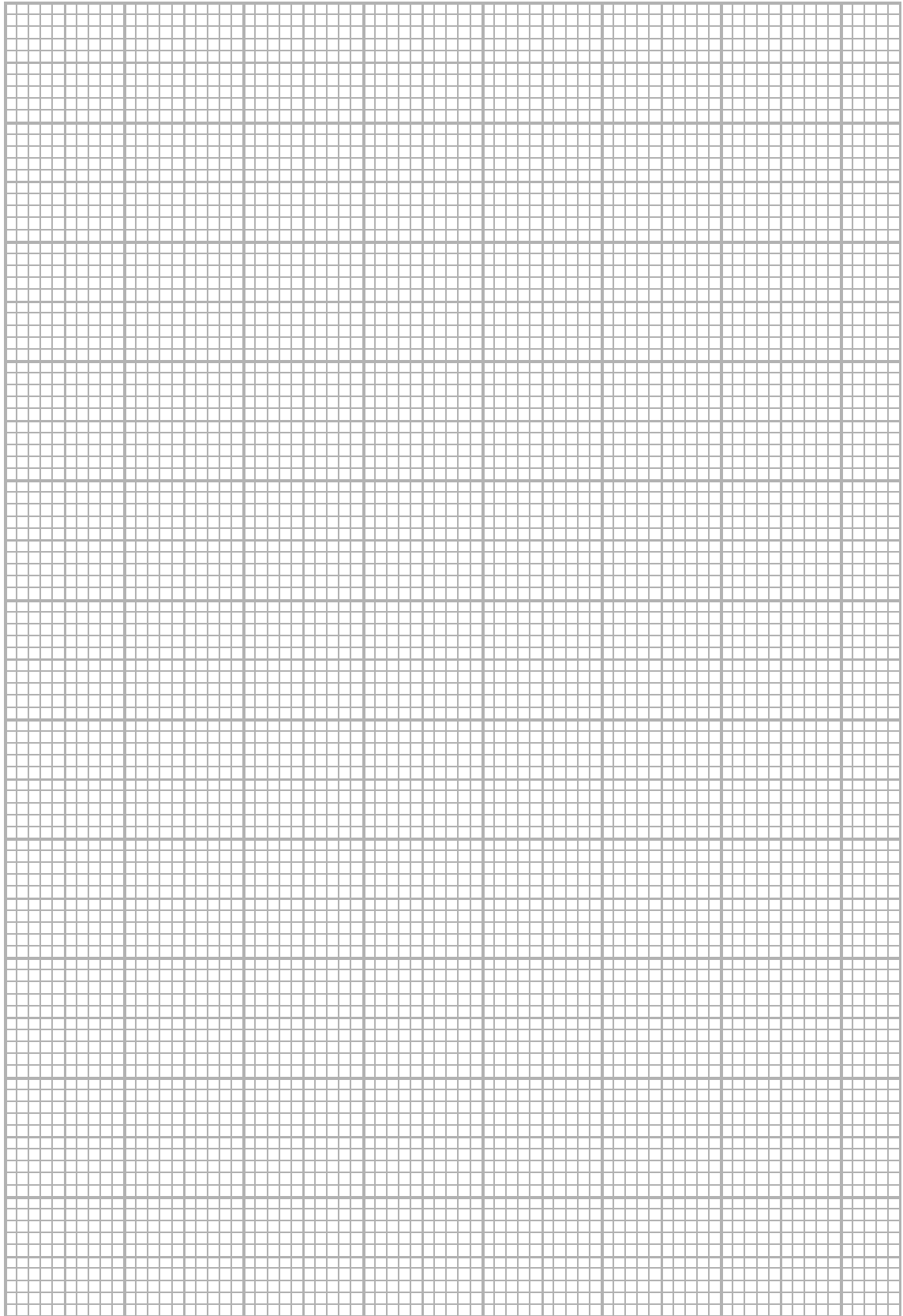
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(c) (i) Plot a graph of F on the y -axis against Δx on the x -axis on the grid provided and draw a line of best fit.

(5)



P 4 8 4 2 3 A 0 1 1 1 6

(ii) Comment on the shape of your graph.

(2)

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

(4)

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Young modulus =

(Total for Question 8 = 16 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	$E_{\text{el}} = \frac{1}{2}F\Delta x$	

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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
 $P = VI$
 $P = I^2R$
 $P = V^2/R$
 $W = VI t$

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

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

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

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