

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 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  $0.20 \pm 0.06$  s
- B  $0.20 \pm 0.01$  s
- C  $0.17 \pm 0.06$  s
- D  $0.17 \pm 0.01$  s

(Total for Question 2 = 1 mark)

2

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

(Total for Question 5 = 1 mark)

**TOTAL FOR SECTION A = 5 MARKS**

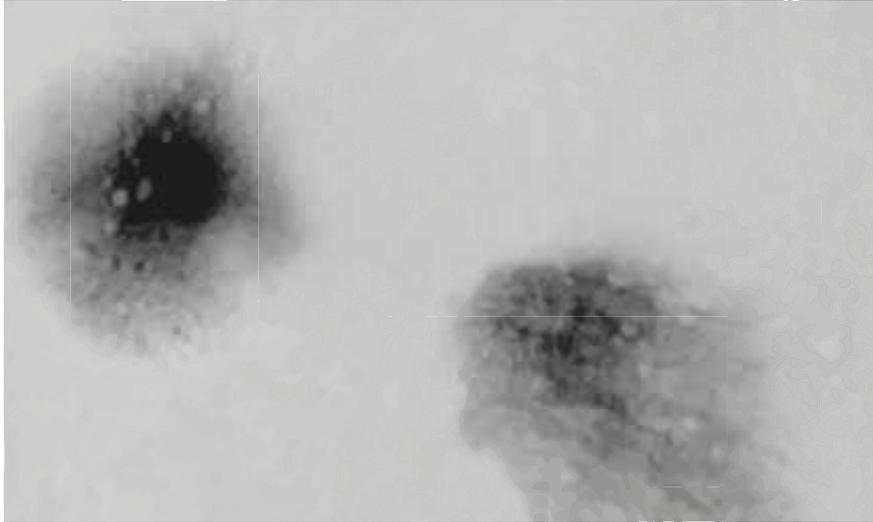


## SECTION B

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)

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

(3)

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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)

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

(1)

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Percentage uncertainty = .....

**(Total for Question 6 = 8 marks)**

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(Total for Question 7 = 11 marks)



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- 8 A student investigated how the extension  $\Delta x$  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	$\Delta x$ / 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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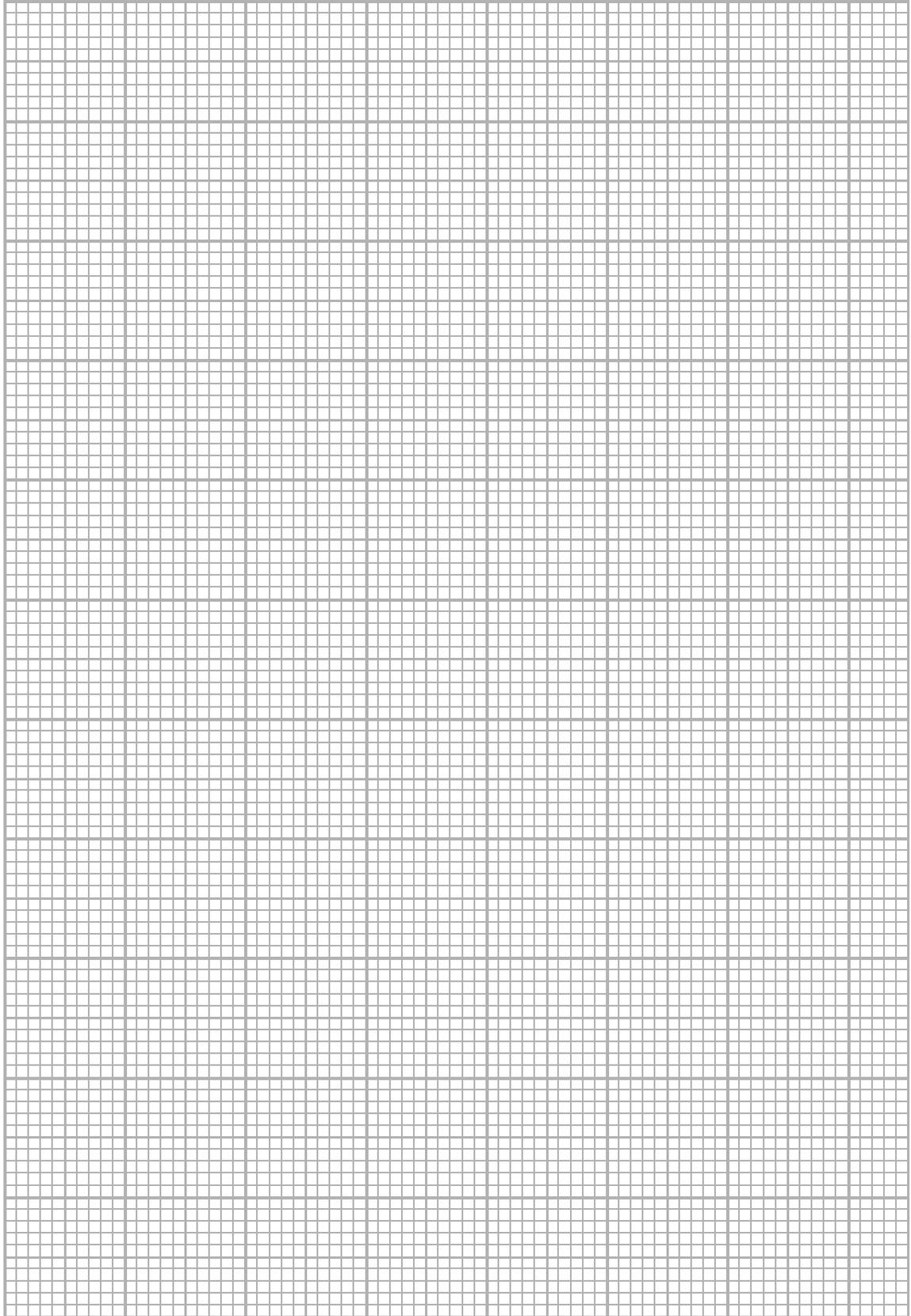
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(c) (i) Plot a graph of  $F$  on the  $y$ -axis against  $\Delta x$  on the  $x$ -axis on the grid provided and draw a line of best fit.

(5)



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(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)**

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**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	$F = 6\pi\eta rv$
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Hooke's law	$F = k\Delta x$
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Density	$\rho = m/V$
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Pressure	$p = F/A$
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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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