

Please check the examination details below before entering your candidate information

Candidate surname

Other names

**Pearson Edexcel**  
**International**  
**Advanced Level**

Centre Number

Candidate Number

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**Thursday 25 October 2018**

Morning (Time: 1 hour 20 minutes)

Paper Reference **WPH03/01**

**Physics**

**Advanced Subsidiary**

**Unit 3: Exploring Physics**

**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.

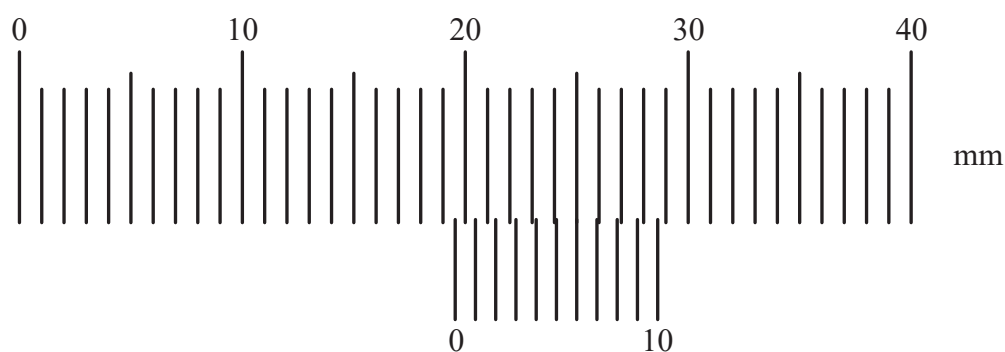
For questions 1–5, in Section A, select one answer from A to D and put a cross in the box . If you change your mind put a line through the box  and then mark your new answer with a cross .

1 Which of the following is **not** an SI base unit?

- A ampere
- B kelvin
- C second
- D watt

(Total for Question 1 = 1 mark)

2 The diagram shows a Vernier scale.



Which of the following is the reading on the scale?

- A 10.9 mm
- B 19.5 mm
- C 19.6 mm
- D 20.1 mm

(Total for Question 2 = 1 mark)

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**Questions 3, 4, and 5 refer to an experiment to determine the viscosity of a liquid.**

A student dropped a sphere into a measuring cylinder containing the liquid. She measured the time taken for the sphere to fall through a given distance in the liquid and repeated this several times.

3 She recorded the times as

2.4 s    2.5 s    1.9 s    2.5 s

Which of the following is the best statement of the time the sphere took to fall?

- A 2.33 s
- B 2.4 s
- C 2.47 s
- D 2.5 s

**(Total for Question 3 = 1 mark)**

4 Which of the following quantities is required in the calculation of viscosity?

- A density of the liquid
- B mass of the liquid
- C temperature of the liquid
- D temperature of the room

**(Total for Question 4 = 1 mark)**

5 Which of the following should the student **not** do?

- A Keep the temperature of the liquid constant.
- B Drop the sphere close to the side of the cylinder.
- C Allow the sphere to reach terminal velocity before timing starts.
- D Check for a zero error on the micrometer used to measure the diameter of the sphere.

**(Total for Question 5 = 1 mark)**

**TOTAL FOR SECTION A = 5 MARKS**



**SECTION B**

**Answer ALL questions in the spaces provided.**

- 6 A student determined the acceleration of free fall by dropping a cricket ball from an upstairs window. The student timed the fall using a stopwatch.
- (a) Explain why dropping the ball from an upstairs window, rather than from one closer to the ground, improved the accuracy of the experiment.

(2)

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- (b) A second student stood outside and recorded the motion of the ball using the video camera on a smartphone.

Explain why this method would produce a more accurate result for the time than using a stopwatch.

(2)

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**(Total for Question 6 = 4 marks)**

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- 7 A student is asked to determine the Young modulus of a metal in the form of a wire, using a graphical method. Standard laboratory apparatus is available.

Write a plan for the experiment.

You should:

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



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(Total for Question 7 = 16 marks)





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- 8 In an experiment to determine the resistivity  $\rho$  of a metal in the form of a wire the following results were recorded.

Length $l/\text{m}$	Current $I/\text{A}$	Potential difference $V/\text{V}$	Resistance $R/\Omega$
1.00	6.8	2.00	0.294
1.50	4.5	2.00	0.444
2.00	3.4	2.00	0.59
2.50	2.7	2.00	0.74
3.00	2.3	2.00	

- (a) Criticise these results.

(2)

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- (b) Complete the last row of the table.

(1)

- (c) Explain why a graph of  $R$  on the  $y$ -axis against  $l$  on the  $x$ -axis should be a straight line through the origin.

(2)

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

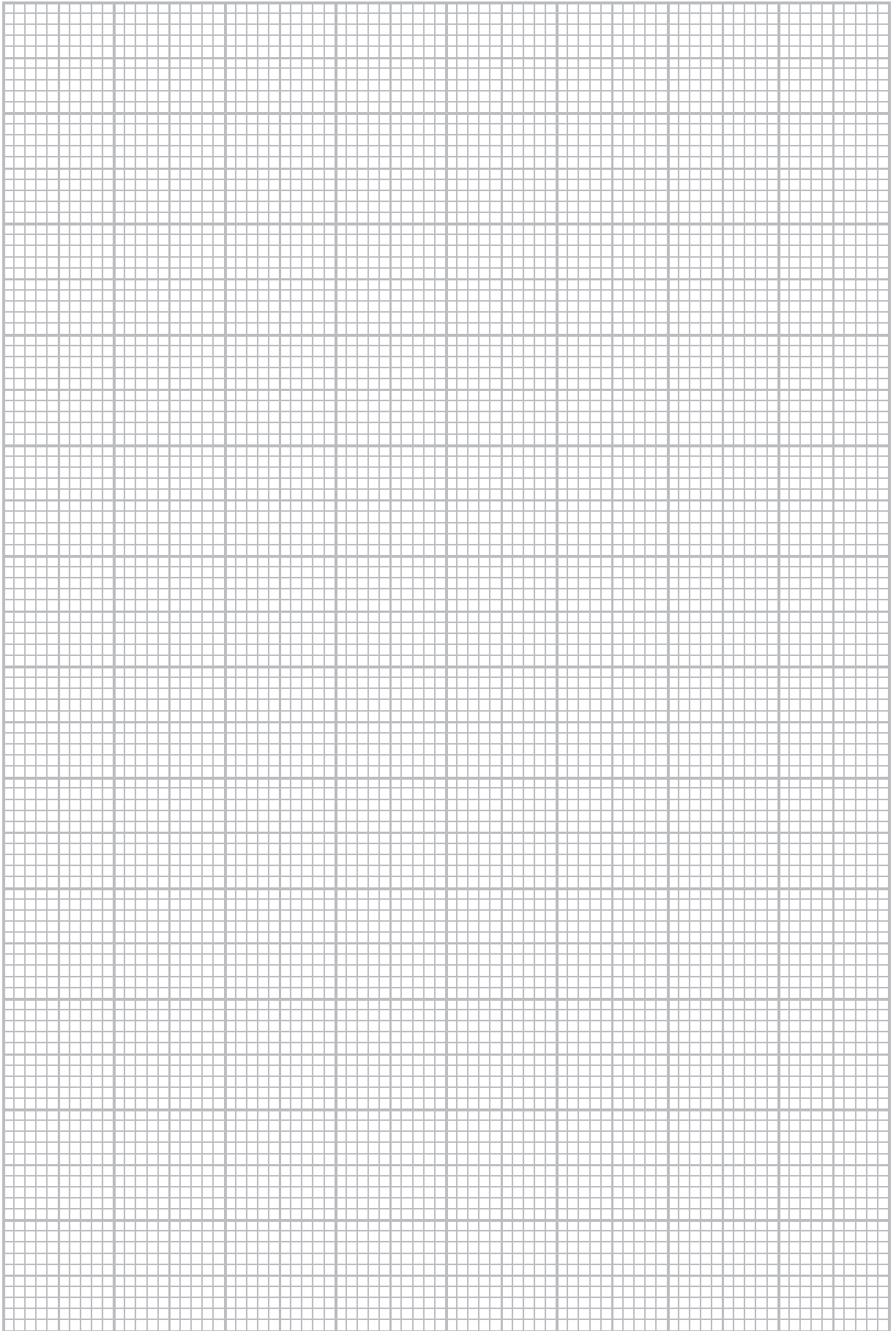
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(ii) The wire has a diameter of 0.27 mm.

Use your graph to determine the resistivity of the metal.

(4)

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Resistivity = .....

(e) Suggest two techniques which would ensure that accurate results are obtained.

(2)

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

Stokes' law	$F = 6\pi\eta r v$
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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	$E = \sigma/\epsilon \text{ where}$ $\text{Stress } \sigma = F/A$ $\text{Strain } \epsilon = \Delta x/x$
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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

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

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

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

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

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