

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 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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## 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  $\lambda^{-1}$ ?

- 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)

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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  $\Omega$
- B  $\Omega\text{m}^{-1}$
- C  $\Omega\text{m}$
- D  $\Omega\text{m}^2$

(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  $0.150 \text{ mm} \pm 0.005 \text{ mm}$ .

(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  $0.075 \text{ mm}$  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)**

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- 7 A student is to determine the viscosity  $\eta$  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,  $\rho_s$  is the density of steel and  $\rho_l$  is the density of the liquid. The values of both  $\rho_s$  and  $\rho_l$  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)

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(Total for Question 7 = 17 marks)





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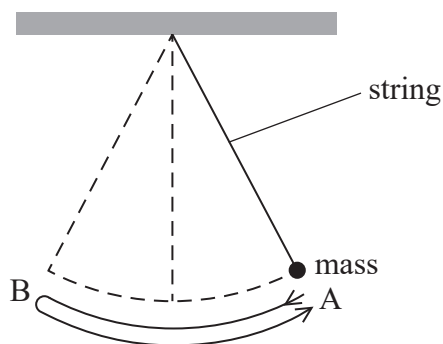
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- 8 A student determined the acceleration of free fall  $g$  using a simple pendulum. The pendulum consists of a mass attached to a string, which is suspended from a support as shown.



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.

| $l / \times 10^{-2} \text{ m}$ | $T / \text{ s}$ | $T^2 / \text{ s}^2$ |
|--------------------------------|-----------------|---------------------|
| 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)

.....

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

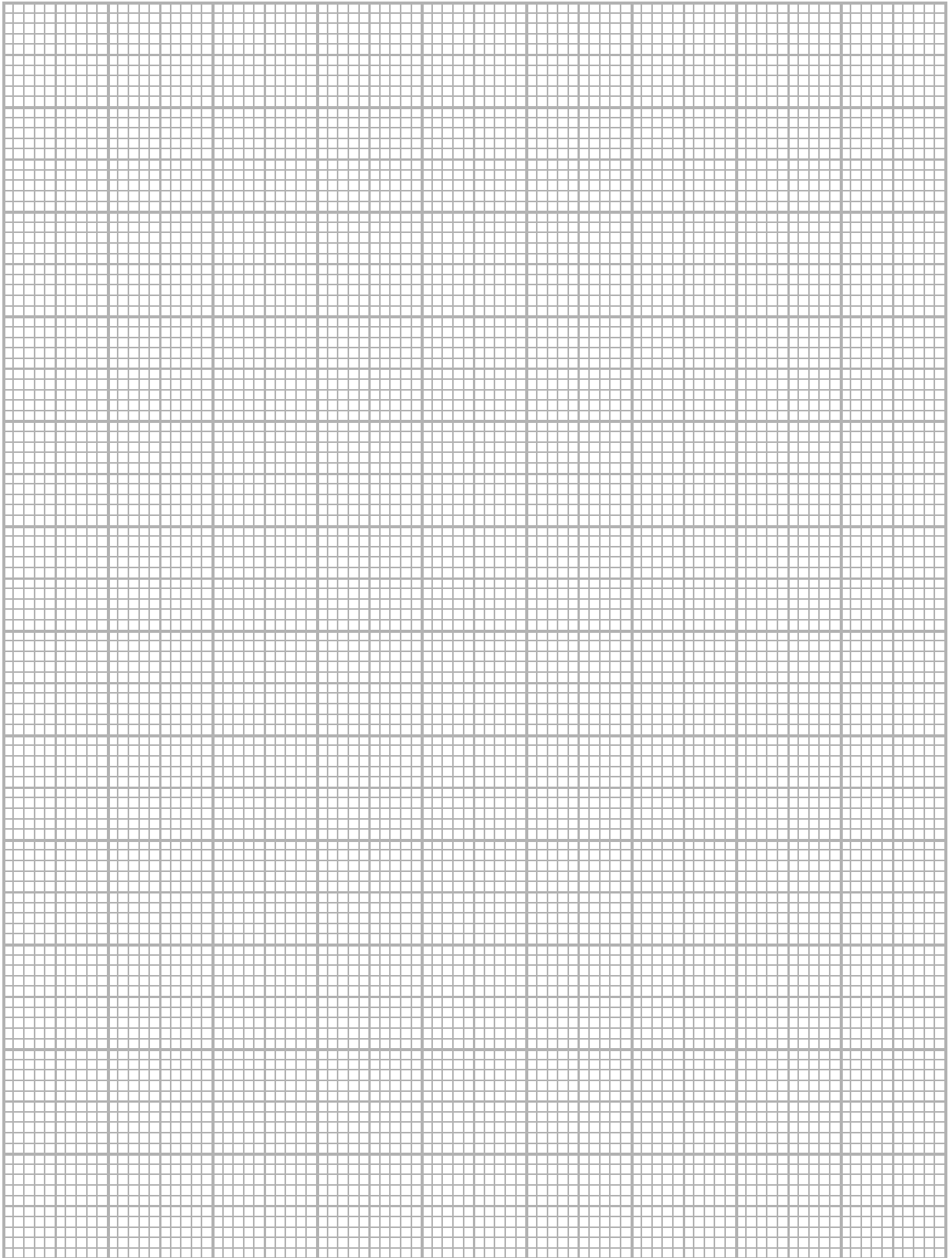
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(ii) Determine the gradient of the graph.

(2)

Gradient = .....

(iii) Use your value of the gradient to calculate a value for  $g$ .

(2)

$g = \dots\dots\dots$

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

#### Materials

|             |                    |
|-------------|--------------------|
| Stokes' law | $F = 6\pi\eta r v$ |
|-------------|--------------------|

|             |                 |
|-------------|-----------------|
| Hooke's law | $F = k\Delta x$ |
|-------------|-----------------|

|         |              |
|---------|--------------|
| Density | $\rho = m/V$ |
|---------|--------------|

|          |           |
|----------|-----------|
| Pressure | $p = F/A$ |
|----------|-----------|

|               |  |
|---------------|--|
| Young modulus | $E = \sigma/\epsilon \text{ where}$ $\text{Stress } \sigma = F/A$ $\text{Strain } \epsilon = \Delta x/x$ |
|---------------|--|

|                       |  |
|-----------------------|--|
| 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

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

