Write your name here

| Surname | Other names |
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| | |

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

Centre Number | | | | | |

Candidate Number | | | | |

# Physics

## Advanced Subsidiary
## Unit 3: Exploring Physics

Thursday 26 October 2017 – Morning
**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 5 0 7 9 3 A 0 1 1 6

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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** force

☒ **B** newton

☒ **C** current

☒ **D** ampere

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

**2** A student measures a length as 2.74 m.

Which of the following is the uncertainty in this measurement?

☒ **A** ±0.001 m

☒ **B** ±0.005 m

☒ **C** ±0.01 m

☒ **D** ±0.05 m

**(Total for Question 2 = 1 mark)**

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

In an experiment to determine the viscosity of a liquid, a student releases a sphere from rest into the liquid in a tall measuring cylinder. The sphere reaches terminal velocity. She records the distance through which the sphere falls at terminal velocity and the time taken.

**3** The times she records are

0.41 s 0.43 s 0.29 s 0.38 s

Which of the following should she use as the mean time in her calculation?

☒ **A** 0.378 s

☒ **B** 0.38 s

☒ **C** 0.407 s

☒ **D** 0.41 s

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

**4** Which of the following would be most suitable for measuring the distance, in millimetres, through which the sphere travelled?

☒ **A** metre rule

☒ **B** micrometer screw gauge

☒ **C** scale on the measuring cylinder

☒ **D** vernier calipers

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

**5** Which of the following should she use to measure the diameter of the sphere?

☒ **A** metre rule

☒ **B** micrometer screw gauge

☒ **C** scale on the measuring cylinder

☒ **D** vernier calipers

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

**TOTAL FOR SECTION A = 5 MARKS**

## SECTION B

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

**6** A student plans to determine the resistance of an unknown resistor using a graphical method.

(a) Draw a suitable circuit diagram for the experiment, including a voltmeter, an ammeter and any other necessary apparatus.

**(3)**

(b) The student uses a digital ammeter.

State one advantage of using a digital ammeter rather than an analogue ammeter.

**(1)**

.....

.....

(c) The student takes appropriate readings, with repeats, to determine mean values. Explain an experimental technique she should use to ensure an accurate result.

**(2)**

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

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**7** A student is asked to investigate the relationship between stress and strain for copper. He is given a 2 m length of copper wire and some 100 g masses. He intends to draw a stress-strain graph for the copper wire.

Write a plan for the investigation.

You should:

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

**(1)**

(b) list any measuring instruments and apparatus needed that are not shown in the 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 two quantities stated in (c) explain your choice of measuring instrument,

**(4)**

(f) for one quantity stated in (c) comment on whether repeat readings are appropriate in this case,

**(1)**

(g) explain how the measurements will be used to determine stress and strain and include a sketch of the expected graph,

**(3)**

(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 = 16 marks)**

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**8** A student carried out an experiment to determine the refractive index of glass. She measured the angles of incidence and refraction for light entering a rectangular glass block. She recorded the results below.

| **Angle of incidence $i$ / °** | **Angle of refraction $r$ / °** | **sin $i$** | **sin $r$** |
|---|---|---|---|
| 10 | 7 | | |
| 20 | 14 | | |
| 30 | 20 | | |
| 40 | 26 | | |

(a) Criticise these results.

**(2)**

.....

.....

.....

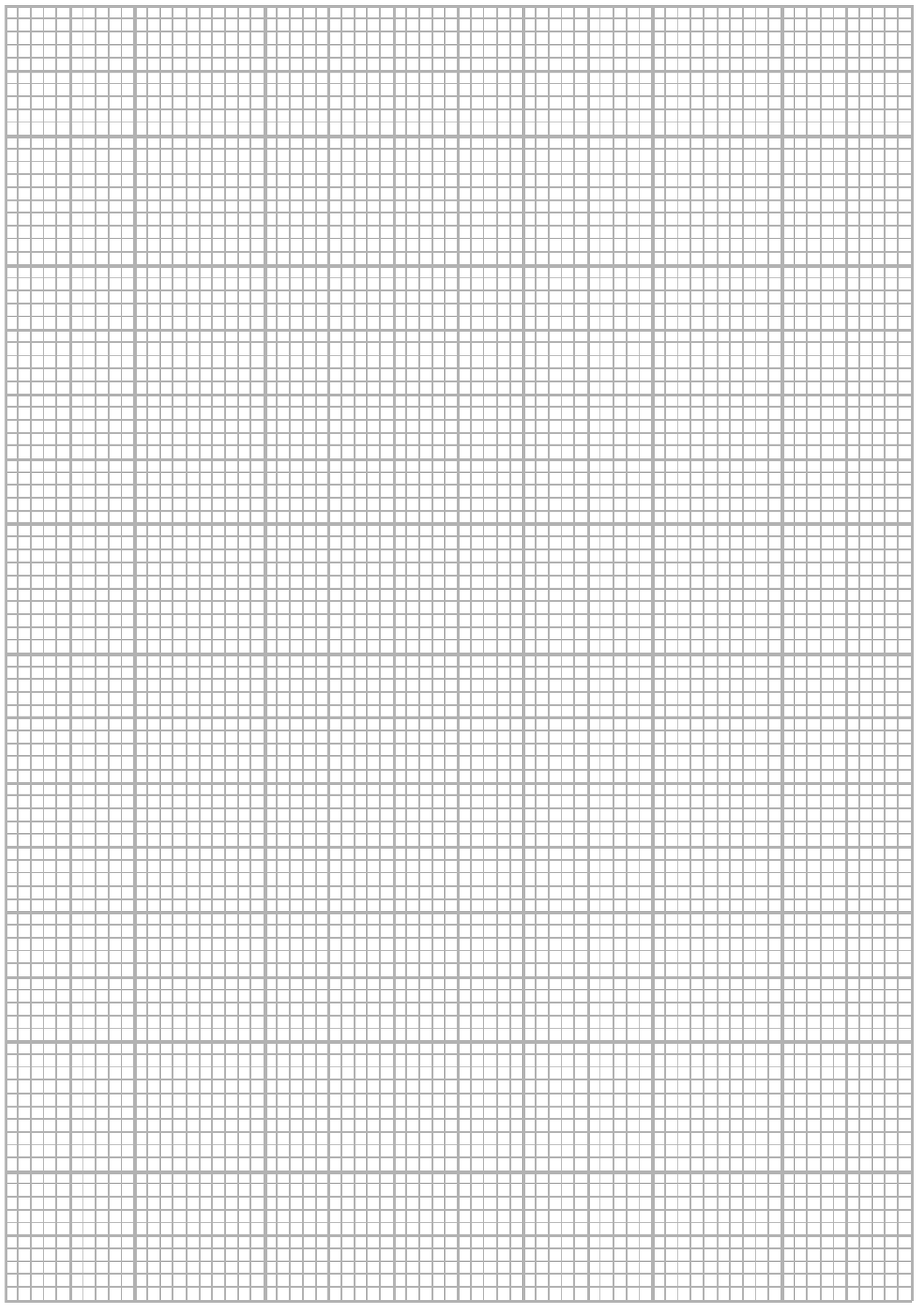
.....

(b) Complete the table.

**(3)**

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

**(4)**



(d) Use your graph to determine the refractive index of the glass.

**(2)**

Refractive index = .....

(e) Explain an experimental technique, other than repeating readings, that the student should use to ensure an accurate result.

**(2)**

**(Total for Question 8 = 13 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 | $v = u + at$<br>$s = ut + \frac{1}{2}at^2$<br>$v^2 = u^2 + 2as$ |
| Forces | $\Sigma F = ma$<br>$g = F/m$<br>$W = mg$ |
| Work and energy | $\Delta W = F\Delta s$<br>$E_k = \frac{1}{2}mv^2$<br>$\Delta E_{grav} = mg\Delta h$ |

*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<br>Stress $\sigma = F/A$<br>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 | $P = VI$<br>$P = I^2R$<br>$P = V^2/R$<br>$W = VIt$ |

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

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

| | |
|---|---|
| Resistivity | $R = \rho l/A$ |
| Current | $I = \Delta Q/\Delta t$<br>$I = nqvA$ |
| 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 | $hf = \phi + \frac{1}{2}mv^2_{max}$ |

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