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Pearson Edexcel International Advanced Level	Centre Number <table border="1"><tr><td></td><td></td><td></td><td></td><td></td></tr></table>					
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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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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)

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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



P 5 0 7 9 3 A 0 3 1 6

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)

(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 $i/^{\circ}$	Angle of refraction $r/^{\circ}$	$\sin i$	$\sin r$
10	7		
20	14		
30	20		
40	26		

- (a) Criticise these results.

(2)

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- (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)

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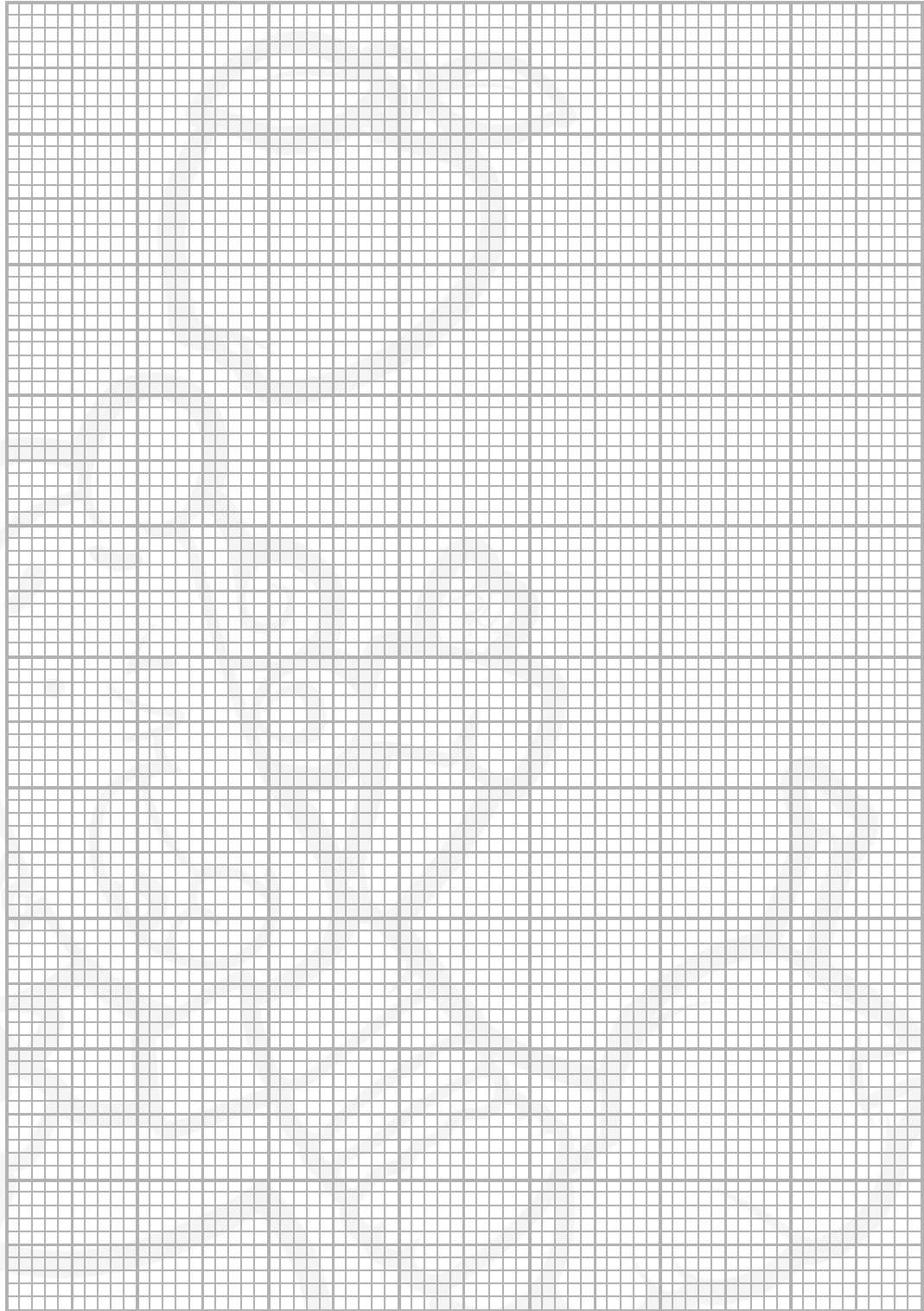
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(d) Use your graph to determine the refractive index of the glass.

(2)

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Refractive index =

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

(2)

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(Total for Question 8 = 13 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	$E_{\text{el}} = \frac{1}{2}F\Delta x$



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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