Write your name here

Surname	Other names

Pearson Edexcel
International
Advanced Level

Centre Number | | | | | |

Candidate Number | | | | |

Physics

Advanced Subsidiary
Unit 3: Exploring Physics

Tuesday 8 November 2016 – 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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PEARSON

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 unit?

☒ **A** ampère

☒ **B** coulomb

☒ **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 λ = 471 nm.

Which of the following is the correct value of λ^{-1}?

☒ **A** 2.12 nm

☒ **B** 2.12×10^{-6} nm^{-1}

☒ **C** 2.12×10^{6} nm^{-1}

☒ **D** 2.12×10^{6} m^{-1}

(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 acceleration of free fall g, a student drops a golf ball from rest. She measures the height from which the ball falls and the time taken to reach the ground.

3 Which of the following equations, by itself, should she use?

☒ **A** $s = \frac{1}{2}(u + v)t$

☒ **B** $s = ut + \frac{1}{2}at^2$

☒ **C** $v = u + at$

☒ **D** $v^2 = u^2 + 2as$

(Total for Question 3 = 1 mark)

4 The times she records are

0.61 s 0.63 s 0.49 s 0.58 s

Which of the following should she state as the average time?

☒ **A** 0.578 s

☒ **B** 0.58 s

☒ **C** 0.607 s

☒ **D** 0.61 s

(Total for Question 4 = 1 mark)

5 Which of the following pieces of apparatus would she **not** need to use in this experiment?

☒ **A** balance

☒ **B** metre rule

☒ **C** set square

☒ **D** stopwatch

(Total for Question 5 = 1 mark)

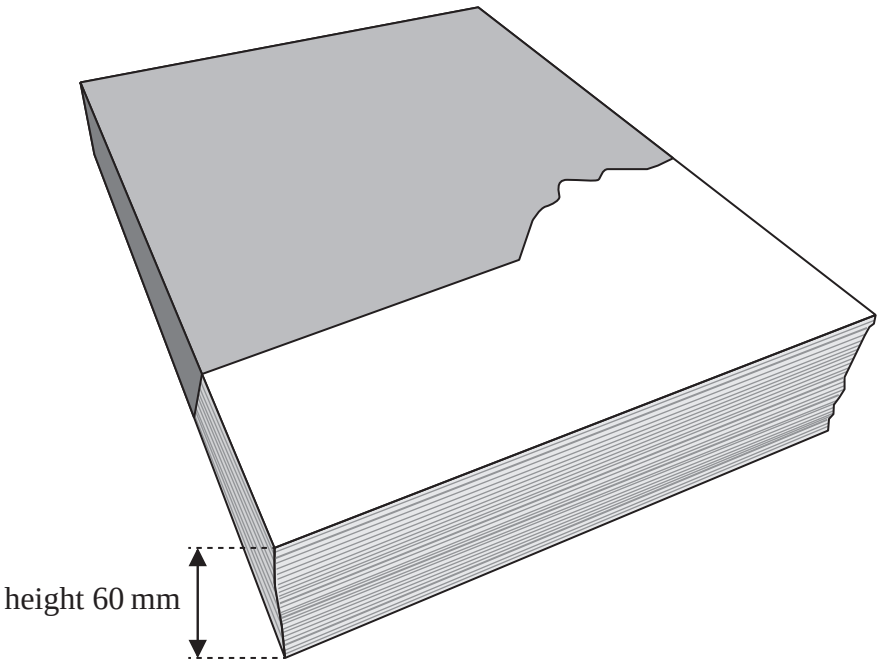
TOTAL FOR SECTION A = 5 MARKS

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SECTION B

Answer ALL questions in the spaces provided.

6 A group of students is given a packet of 500 sheets of paper and asked to determine the thickness of one sheet of paper. The packet shown is approximately 60 mm in height.



(a) Outline a method to determine the thickness of one sheet of paper. You should justify the choice of instrument by reference to uncertainties.

(4)

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(b) Describe how you would make the measurement as accurate as possible.

(2)

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(Total for Question 6 = 6 marks)

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7 A student is asked to determine the Young modulus of nylon in the form of a fishing line. He arranges the fishing line horizontally with one end over a pulley so that masses can be hung vertically from the end of the line.

Describe an experiment that uses this arrangement to determine the Young modulus by a graphical method.

You should:

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

(1)

(b) list any additional measuring instruments required that are not shown in the diagram,

(1)

(c) list the quantities to be measured,

(1)

(d) for two quantities explain your choice of measuring instrument,

(4)

(e) for one quantity comment on whether repeat readings are appropriate,

(1)

(f) state which is the independent variable and which is the dependent variable,

(2)

(g) explain how the data collected will be used to determine the Young modulus, include a sketch of the expected graph,

(4)

(h) comment on a main source of uncertainty and/or systematic error,

(2)

(i) comment on safety.

(1)

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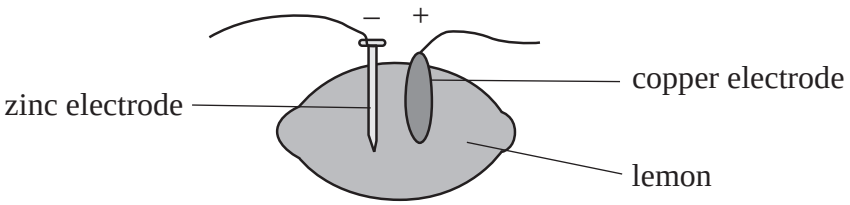
(Total for Question 7 = 17 marks)

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8 When zinc and copper electrodes are put into a lemon, the lemon can be used as an electric cell.



In an experiment to determine the e.m.f. and internal resistance of a battery made from three lemon cells, a student measures the current I for different potential differences V. Her results are shown below.

Current I /μA	Potential difference V/V
117	0.6
98	0.89
66.7	1.31
48.3	1.60
41	1.71

(a) Criticise these results.

(2)

(b) The equation used for the experiment is $\mathcal{E} = V + Ir$.

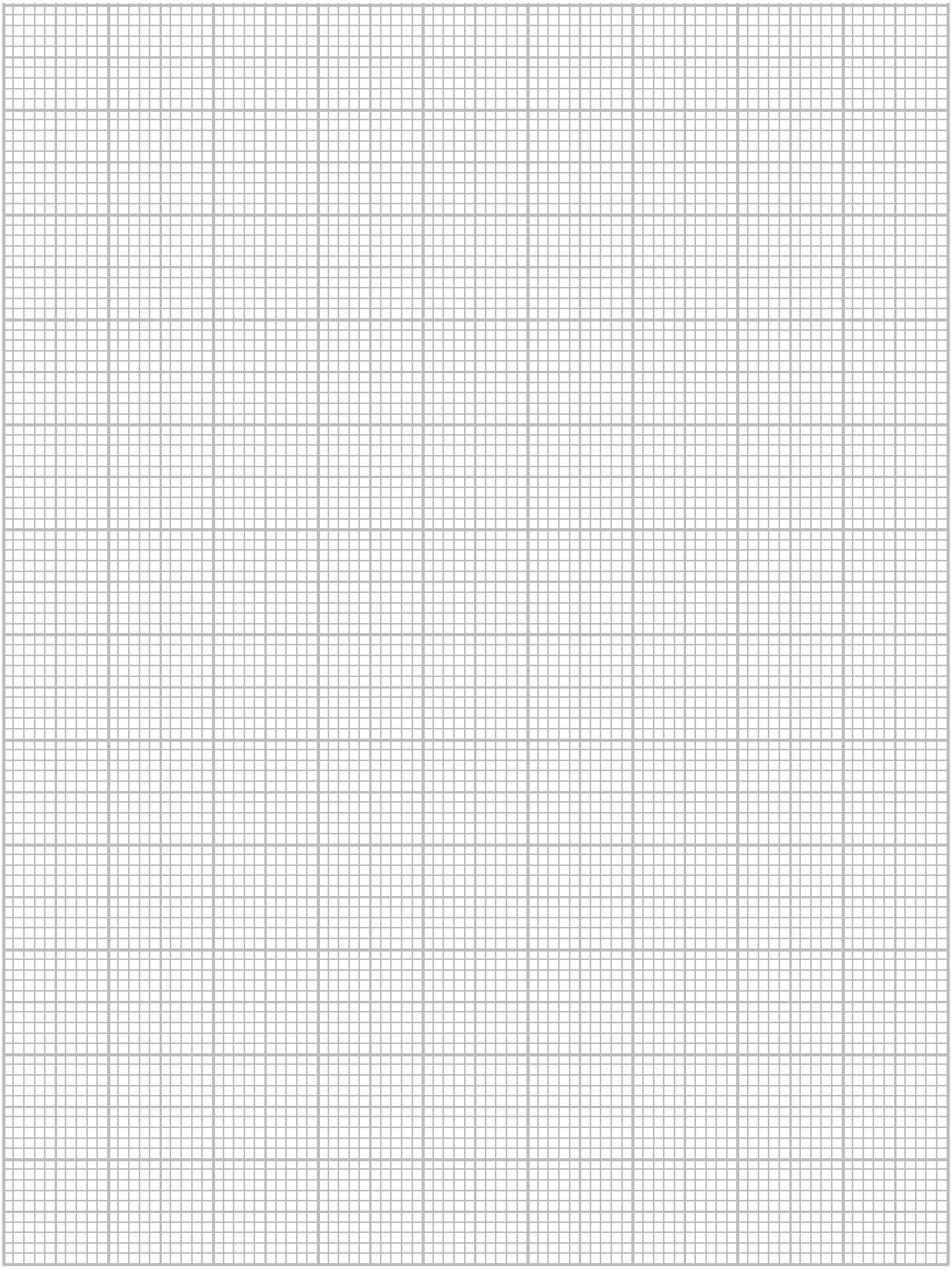
Explain why a graph of V on the y-axis against I on the x-axis is a straight line with a gradient of $-r$ and an intercept on the y-axis of $\mathcal{E}$.

(2)

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(c) Use these results to plot the graph on the grid provided and draw a line of best fit.

(5)



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(d) (i) Use your graph to determine the e.m.f. and internal resistance of the battery.

(2)

E.m.f. = ...

Internal resistance = ...

(ii) The battery is made from 3 lemon cells connected in series.

State how you would use your answers to (d)(i) to determine the e.m.f. and internal resistance of one lemon cell.

(1)

(Total for Question 8 = 12 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	$\Delta W = F\Delta s$ $E_k = \frac{1}{2}mv^2$ $\Delta E_{grav} = mg\Delta h$

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	$E = \sigma/\varepsilon$ where Stress $\sigma = F/A$ Strain $\varepsilon = \Delta x/x$
Elastic strain energy	$E_{el} = \frac{1}{2}F\Delta x$

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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	$P = VI$ $P = I^2R$ $P = V^2/R$ $W = VIt$
	$\%\ \text{efficiency} = \dfrac{\text{useful energy output}}{\text{total energy input}} \times 100$
	$\%\ \text{efficiency} = \dfrac{\text{useful power output}}{\text{total power input}} \times 100$
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	$\dfrac{1}{R} = \dfrac{1}{R_1} + \dfrac{1}{R_2} + \dfrac{1}{R_3}$

Quantum physics

Photon model	$E = hf$
Einstein's photoelectric equation	$hf = \phi + \frac{1}{2}mv^2_{\max}$

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