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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P 5 0 7 0 9 A 0 1 1 6

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)

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2 In an experiment to determine the Planck constant, a student uses light of wavelength $\lambda = 471$ 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)

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)

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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)

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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

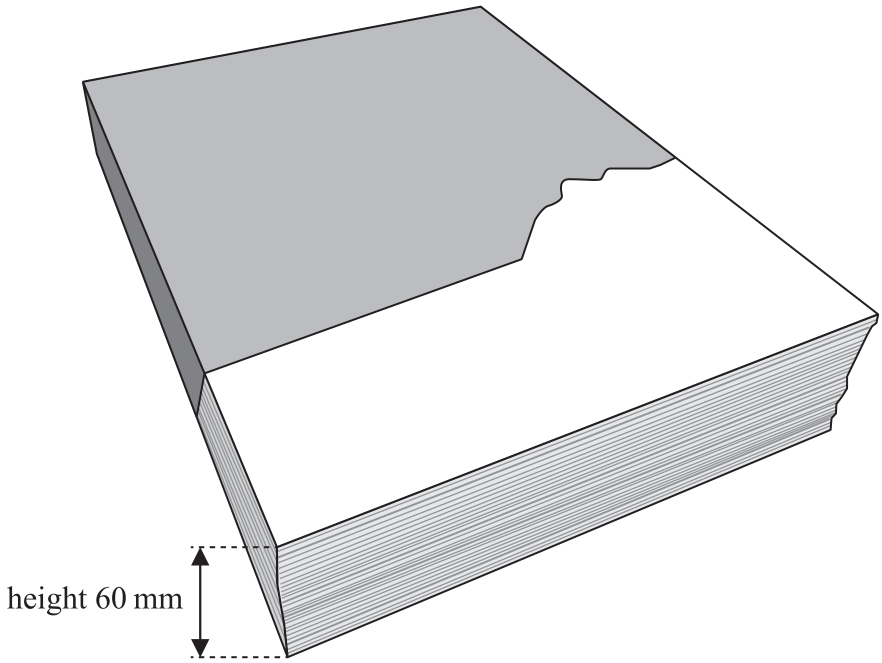
(Total for Question 5 = 1 mark)

TOTAL FOR SECTION A = 5 MARKS

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)

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)**

(Total for Question 7 = 17 marks)

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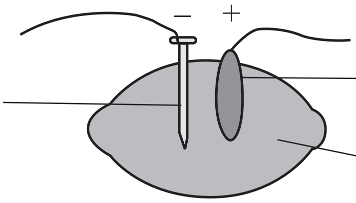
8 When zinc and copper electrodes are put into a lemon, the lemon can be used as an electric cell.



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)

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(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)

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

(2)

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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)

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(Total for Question 8 = 12 marks)

TOTAL FOR SECTION B = 35 MARKS

TOTAL FOR PAPER = 40 MARKS

List of data, formulae and relationships

Acceleration of free fall	$g = 9.81\ \mathrm{m\ s^{-2}}$	(close to Earth's surface)
Electron charge	$e = -1.60 \times 10^{-19}\ \mathrm{C}$	
Electron mass	$m_e = 9.11 \times 10^{-31}\ \mathrm{kg}$	
Electronvolt	$1\ \mathrm{eV} = 1.60 \times 10^{-19}\ \mathrm{J}$	
Gravitational field strength	$g = 9.81\ \mathrm{N\ kg^{-1}}$	(close to Earth's surface)
Planck constant	$h = 6.63 \times 10^{-34}\ \mathrm{J\ s}$	
Speed of light in a vacuum	$c = 3.00 \times 10^{8}\ \mathrm{m\ s^{-1}}$	

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 $F = 6\pi\eta rv$

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 $E_{el} = \frac{1}{2}F\Delta x$

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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