

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**

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  $\lambda = 471 \text{ nm}$ .  
Which of the following is the correct value of  $\lambda^{-1}$ ?

- A 2.12 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 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





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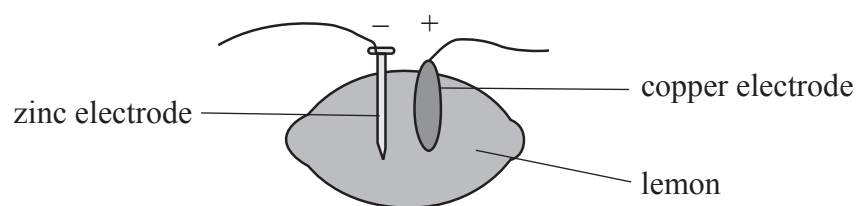
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- 8 When zinc and copper electrodes are put into a lemon, the lemon can be used as an electric cell.



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 $I / \mu\text{A}$	Potential difference $V / \text{V}$
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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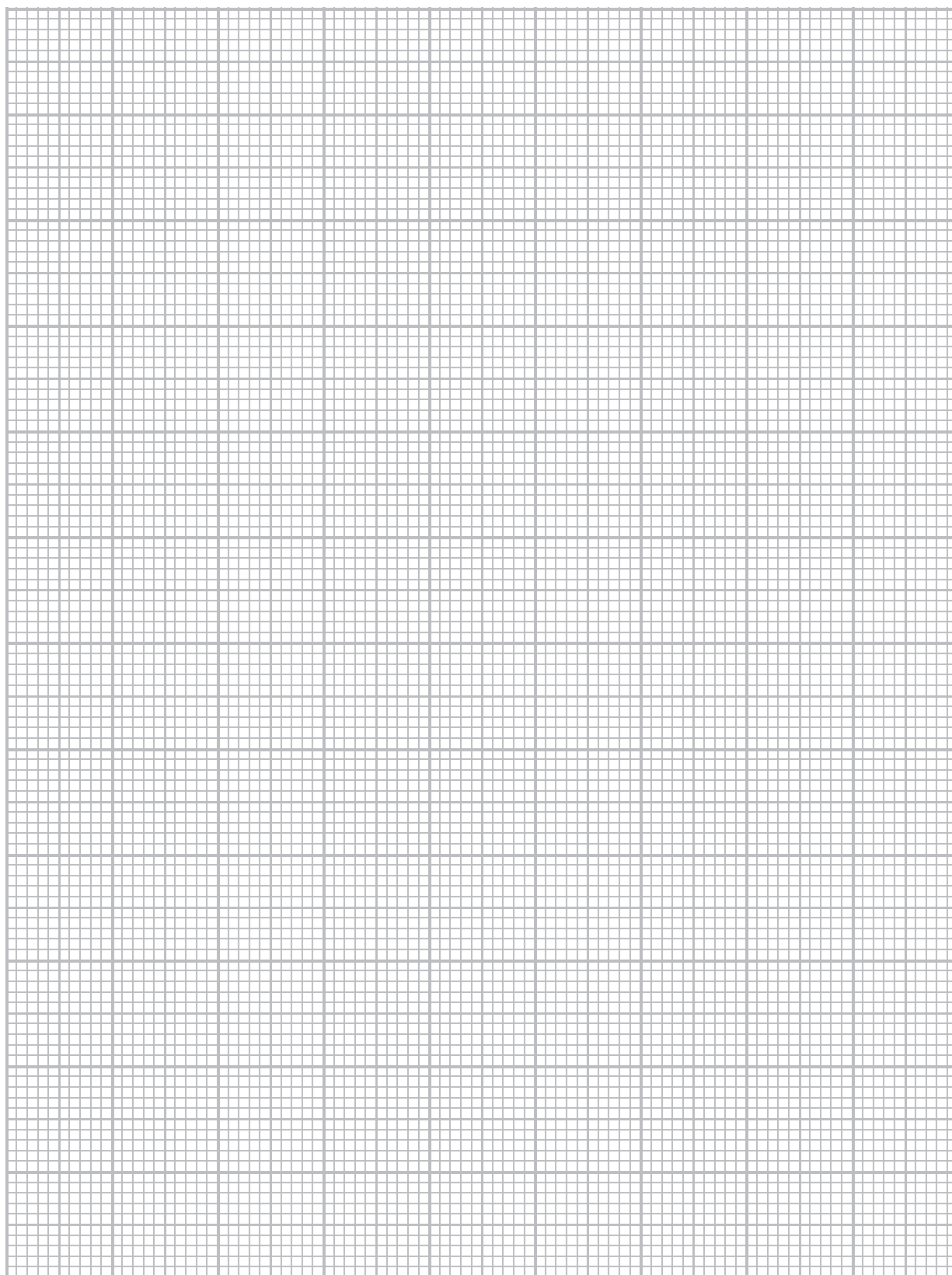
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(c) Use these results to plot the graph on the grid provided and draw a line of best fit.

(5)



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(d) (i) Use your graph to determine the e.m.f. and internal resistance of the battery. (2)

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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	$g = 9.81 \text{ m s}^{-2}$	(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	$v = u + at$ $s = ut + \frac{1}{2}at^2$ $v^2 = u^2 + 2as$
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Forces	$\Sigma F = ma$ $g = F/m$ $W = mg$
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Work and energy	$\Delta W = F\Delta s$ $E_k = \frac{1}{2}mv^2$ $\Delta E_{\text{grav}} = mg\Delta h$
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##### Materials

Stokes' law	$F = 6\pi\eta r v$
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Hooke's law	$F = k\Delta x$
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Density	$\rho = m/V$
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Pressure	$p = F/A$
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Young modulus	$E = \sigma/\epsilon$ where Stress $\sigma = F/A$ Strain $\epsilon = \Delta x/x$
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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  $hf = \phi + \frac{1}{2}mv_{\max}^2$

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