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Surname	Other names

Pearson Edexcel
International
Advanced Level

Centre Number | | | | | |

Candidate Number | | | | |

Physics

Advanced Subsidiary
Unit 3: Exploring Physics

Wednesday 11 May 2016 – Afternoon
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.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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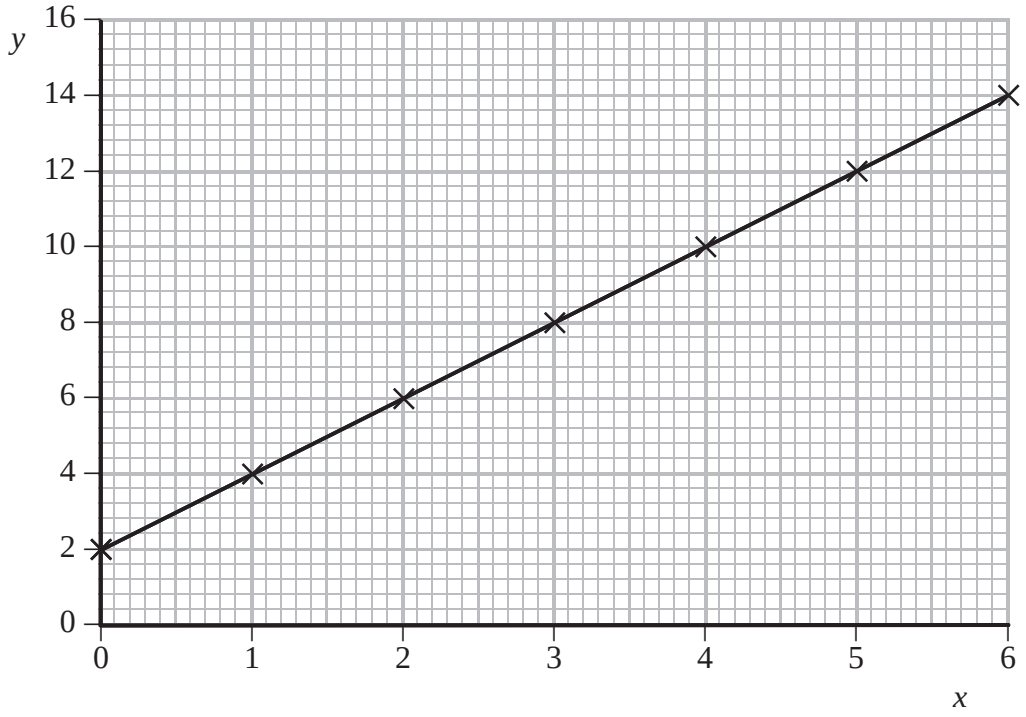
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SECTION A

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 The graph shows the results from an experiment.



Which statement about the two quantities is correct?

☒ **A** They are directly proportional.

☒ **B** They are inversely proportional.

☒ **C** There is a negative relationship.

☒ **D** There is a linear relationship.

(Total for Question 1 = 1 mark)

2 Which of the following is a derived SI quantity?

☒ **A** mass

☒ **B** pascal

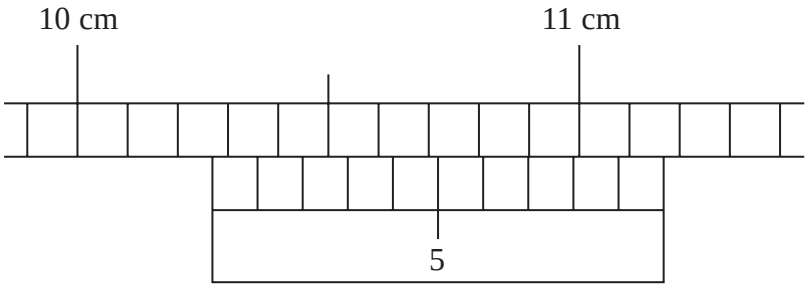
☒ **C** second

☒ **D** velocity

(Total for Question 2 = 1 mark)

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3 A vernier scale is used to make a measurement.



Which is the correct reading of the scale in centimetres?

☒ **A** 10.27

☒ **B** 10.50

☒ **C** 10.70

☒ **D** 12.70

(Total for Question 3 = 1 mark)

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Questions 4 and 5 are about an experiment to measure the acceleration of free fall *g*.

During this experiment a football falls through a known distance *s*. The time of fall *t* is measured.

4 In the following equations the symbols have their usual meanings.
Which equation should be used to calculate *g*?

☒ **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 4 = 1 mark)

5 Three measurements of *s* are:

2.55 m 2.56 m 2.59 m

Which of the following should be stated as the average result?

☒ **A** 2.56 m

☒ **B** 2.566 m

☒ **C** 2.567 m

☒ **D** 2.57 m

(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 student's uncertainty in recording her reaction time was ± 0.03 s.
She recorded a reaction time of 0.38 s.

(a) What was the range of her measurements?

(1)

.....

.....

(b) Calculate the percentage uncertainty in her measurement.

(2)

.....

.....

.....

Percentage uncertainty = ... %

(c) The student plans to use a stopwatch to measure the time taken for a trolley to move down a slope. She estimates this time to be about 3 s.
Comment on her plan.

(2)

.....

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(Total for Question 6 = 5 marks)

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7 A student is asked to determine the refractive index of glass.

Write a plan for this experiment that uses a rectangular glass block, standard laboratory apparatus and a graphical method.

You should:

(a) draw a labelled diagram of the apparatus to be used and list any additional apparatus needed,

(2)

(b) show on your diagram the quantities to be measured,

(2)

(c) explain your choice of measuring instrument for **one** of these quantities,

(2)

(d) comment on whether repeat readings are appropriate in this case,

(1)

(e) explain how to determine the refractive index,

(3)

(f) identify the main source of uncertainty and/or systematic error,

(1)

(g) comment on safety.

(1)

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(Total for Question 7 = 12 marks)

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8 In an experiment to determine the resistivity of the material of a wire, a student measured the diameter of the wire to be 0.56×10^{-3} m.

(a) Describe how the student should measure the diameter of the wire.

(2)

.....

.....

.....

.....

(b) During this experiment, the student kept the current constant at 0.11 A and recorded the following results.

Length / m	Potential difference / V	Resistance / Ω
1.00	0.52	
0.80	0.41	
0.60	0.27	
0.40	0.19	
0.20	0.1	

(i) Criticise his results.

(2)

.....

.....

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.....

(ii) Suggest how the student could keep the current constant.

(1)

.....

.....

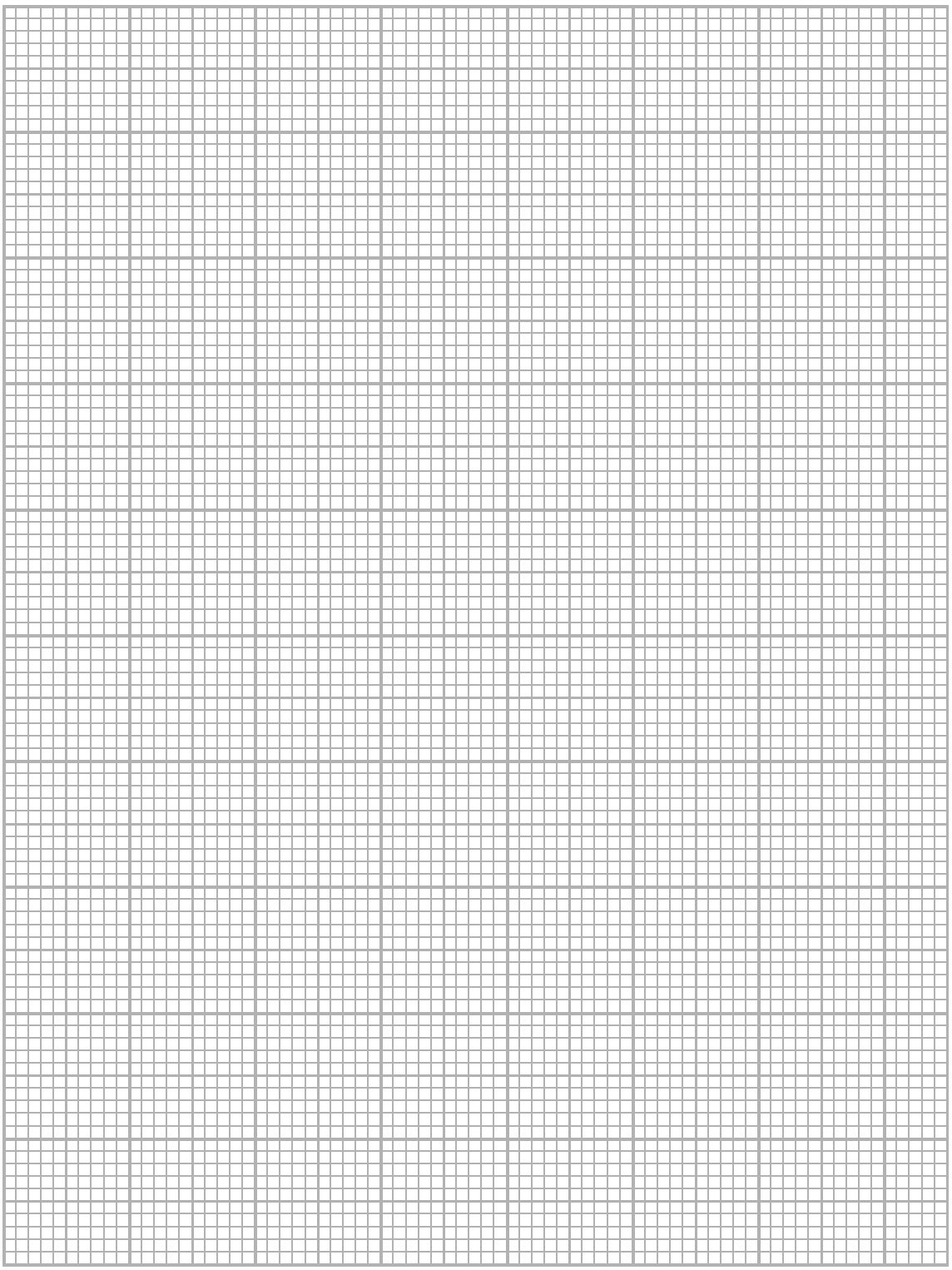
(iii) Complete the last column of the table.

(2)

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(c) (i) Plot a graph of resistance on the *y*-axis and length on the *x*-axis and draw a line of best fit.

(4)



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(ii) Determine the gradient of the graph.

(2)

Gradient = ...

(iii) Use your value for the gradient to calculate a value for the resistivity.

(4)

Resistivity = ...

(iv) There may be a difference between the value in (c)(iii) and the accepted value for the resistivity of the material of the wire.

Suggest why there may be a difference. You may assume that your calculations are correct.

(1)

(Total for Question 8 = 18 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	$F = 6\pi\eta rv$
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	$E_{el} = \frac{1}{2}F\Delta x$

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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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