Write your name here

Surname	Other names

Pearson Edexcel
International
Advanced Level

Centre Number | | | | | |

Candidate Number | | | | |

Physics

Advanced Subsidiary
Unit 3: Exploring Physics

Thursday 8 May 2014 – 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.
- 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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P 4 3 1 2 5 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 A student is measuring the length of a wire. He takes the following readings.

1000 mm, 1002 mm, 999 mm, 998 mm

How should he record the mean length in his results table?

☒ **A** 1.0 m

☒ **B** 1.00 m

☒ **C** 1.000 m

☒ **D** 0.999 m

(Total for Question 1 = 1 mark)

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2 Which of the following could **not** be a unit for pressure?

☒ **A** kN m^2

☒ **B** N mm^{-2}

☒ **C** N m^{-2}

☒ **D** Pa

(Total for Question 2 = 1 mark)

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3 A wire is stretched by a constant force.

The extension will be directly proportional to the

☒ **A** Young modulus of the wire.

☒ **B** length of the wire.

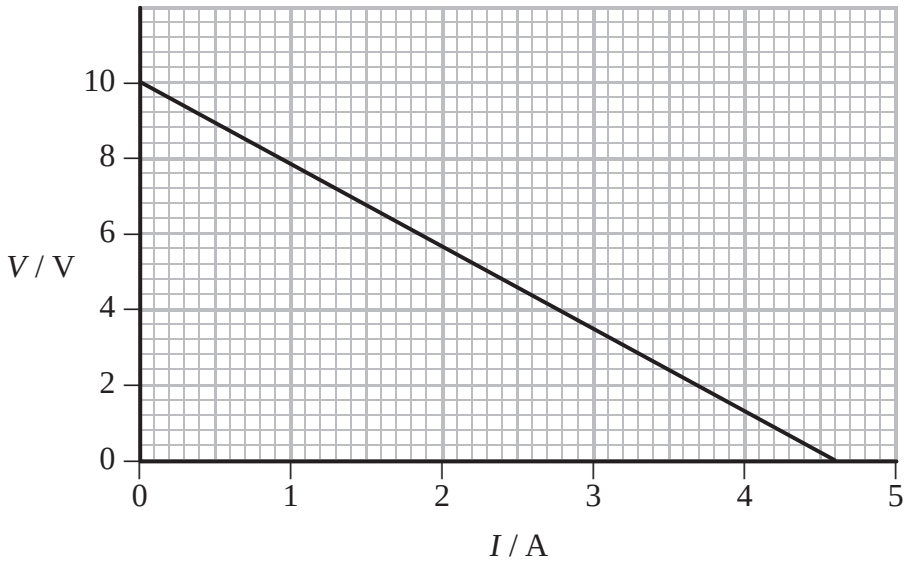
☒ **C** diameter of the wire.

☒ **D** area of cross-section of the wire.

(Total for Question 3 = 1 mark)

Questions 4 and 5 refer to the graph below.

The graph shows how the potential difference *V*, across a power supply, varies with the current *I*, in an electric circuit.



4 Which of the following is the correct description of the relationship between *V* and *I*?

☒ **A** They are directly proportional.

☒ **B** They are inversely proportional.

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

☒ **D** There is a positive correlation.

(Total for Question 4 = 1 mark)

5 Which of the following is the magnitude of the gradient of the graph?

☒ **A** 10

☒ **B** 4.6

☒ **C** 2.2

☒ **D** 0.46

(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 Today's internationally accepted value for the speed c of electromagnetic radiation in a vacuum is 299 792.458 ± 0.001 km s^{-1}.

(a) In 1883 Newcomb determined a value for c which he stated as 299 850 ± 30 km s^{-1}.

Explain how his stated uncertainty shows that Newcomb must have underestimated the uncertainties in his measurements.

(2)

(b) In 1926 Michelson determined a value for c which he stated as 299 796 ± 4 km s^{-1}.

Comment on the value determined by Michelson.

(2)

(c) Calculate the percentage uncertainty claimed for today's internationally accepted value for c.

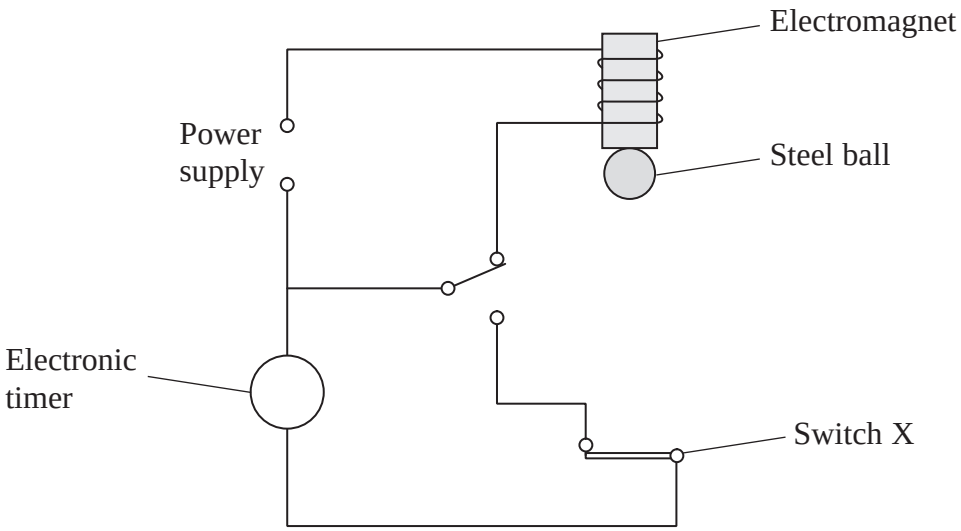
(2)

Percentage uncertainty = ...

(Total for Question 6 = 6 marks)

7 A student is asked to determine a value for the acceleration of free fall *g* by timing a falling steel ball.

The diagram below shows the apparatus to be used. The steel ball falls a distance *s* from the electromagnet to switch X. The electronic timer records the time taken *t*.



The student is told to plot a graph of *s* against t^2.

Write a plan for an experiment to determine *g* using this method.

You should:

(a) draw on the diagram the distance *s* to be measured,

(1)

(b) state the apparatus required to measure *s* and explain your choice,

(2)

(c) explain why an electronic timer is used to measure *t*,

(1)

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

(1)

(e) explain what data will be collected and how it will be used to determine *g*,

(5)

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

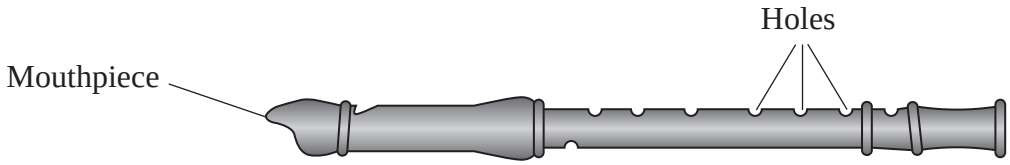
(2)

(g) comment on safety.

(1)

(Total for Question 7 = 13 marks)

8 A student carried out an experiment to determine the speed *v* of sound in air. She used the musical instrument shown, in which standing waves are produced by blowing into the instrument to vibrate the air inside.



The length *l* of the vibrating air column is changed by covering the holes. This changes the frequency *f* of the sound produced.

She measured *f* for different values of *l*. Her results are shown in the table.

***l* /cm**	***f* /Hz**
10	1719
12.5	1375
14.5	1185
16.5	1042
19	904

(a) Criticise her results.

(2)

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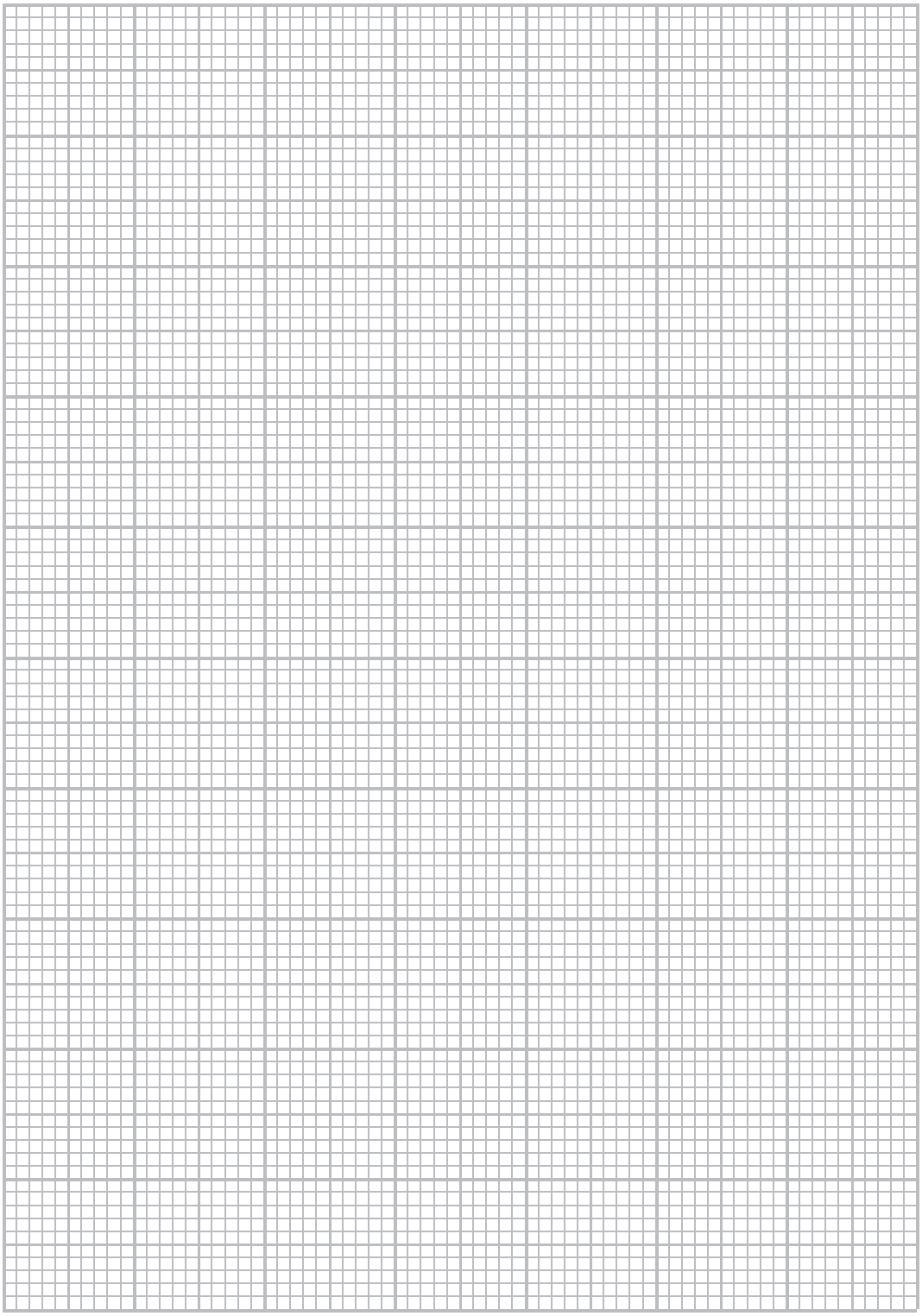
(b) Complete the last column of the table below.

(3)

l /cm	f /Hz	$\frac{1}{l}$ /
10	1719	
12.5	1375	
14.5	1185	
16.5	1042	
19	904	

(c) Plot a graph of f on the y-axis against $\frac{1}{l}$ on the x-axis on the grid provided and draw a line of best fit.

(4)



(d) Determine the gradient of your graph.

(3)

Gradient = ...

(e) The equation for the graph is $f = \frac{v}{2l}$. Calculate a value for v.

(3)

v = ...

(f) The accepted value for v is 330 m s^{-1}.

Assuming your calculations are correct, suggest why there is a difference between your value for v and the accepted value.

(1)

(Total for Question 8 = 16 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	$v = u + at$ $s = ut + \frac{1}{2}at^2$ $v^2 = u^2 + 2as$
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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