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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6/6/6/6/5/

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.

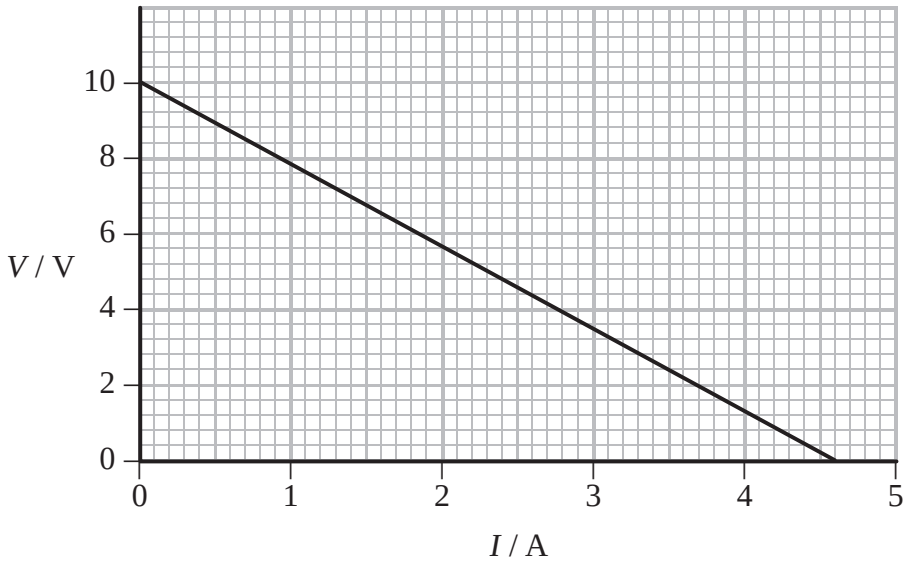
☒ **C** diameter of the wire.

☒ **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)

.....

.....

.....

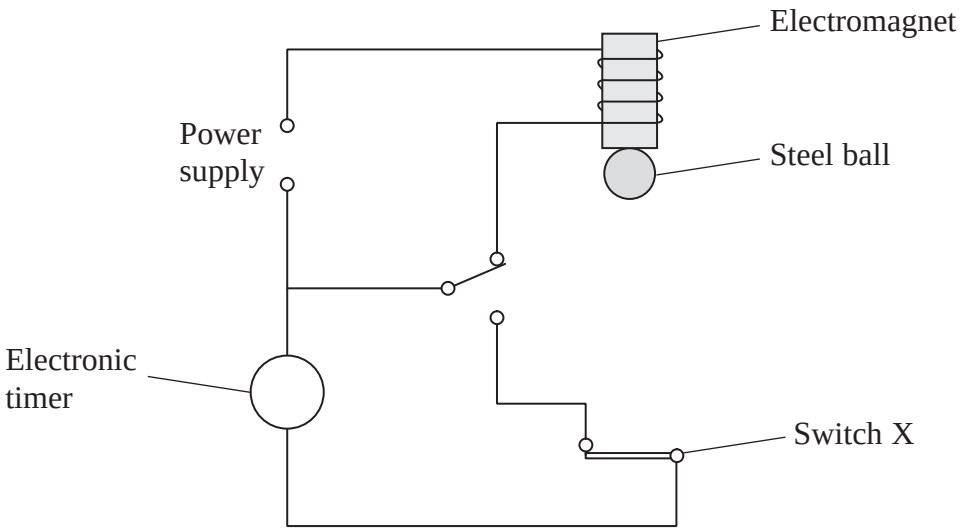
.....

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,

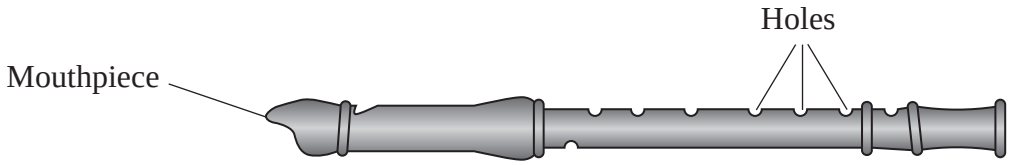
(2)

(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)

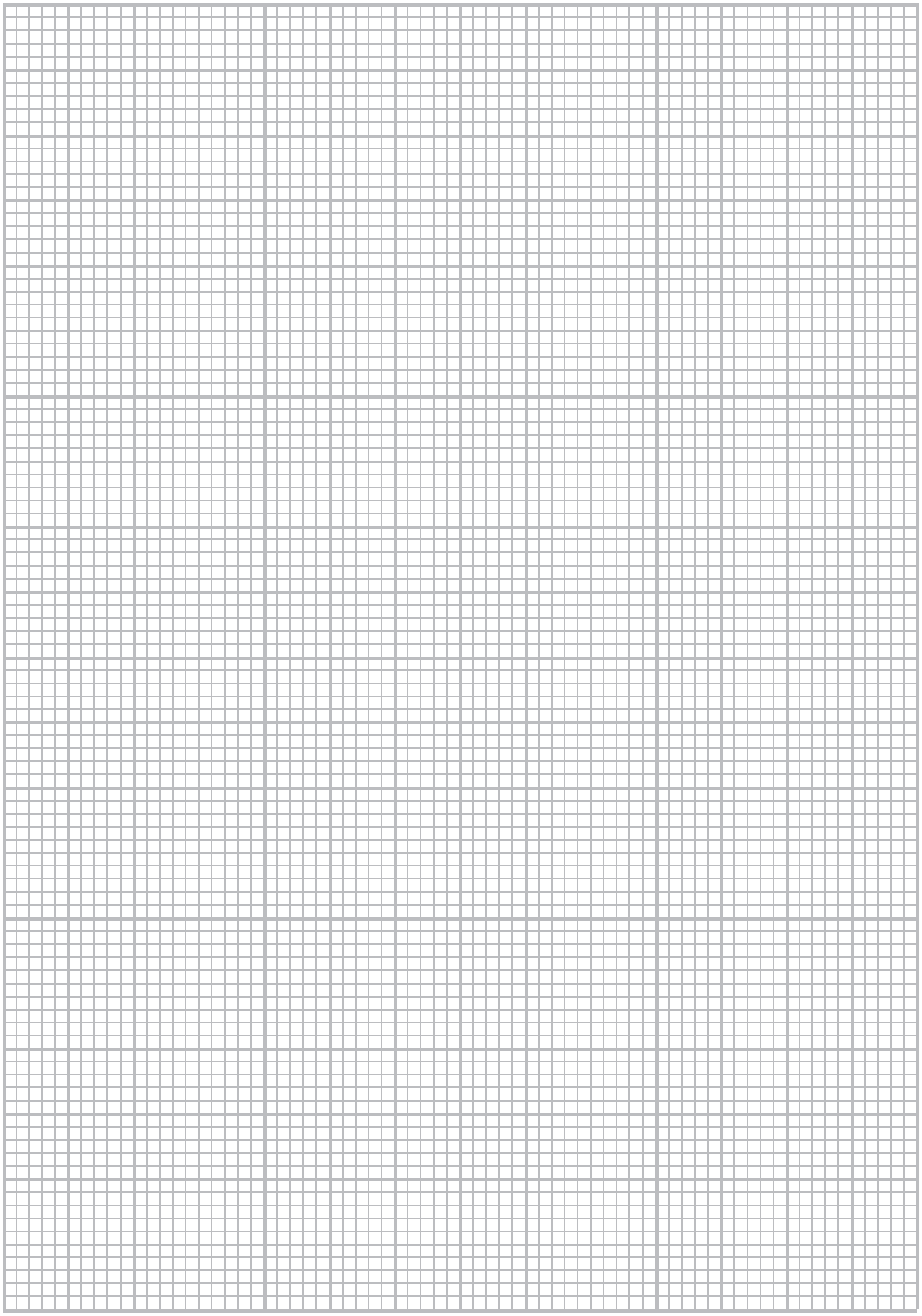
(b) Complete the last column of the table below.

(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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