

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

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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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)

- 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)

- 3 A wire is stretched by a constant force.

The extension will be directly proportional to the

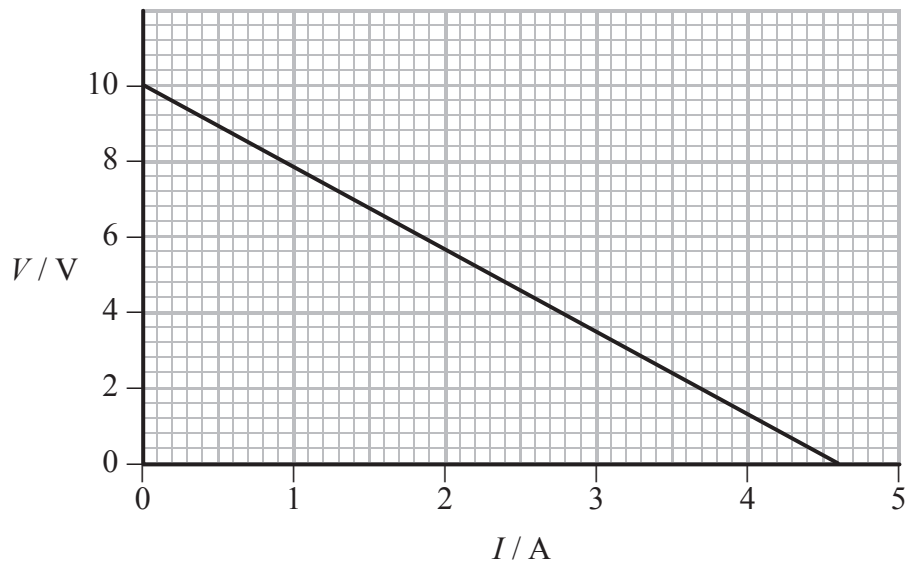
- ☐ A Young modulus of the wire.
- ☐ B length of the wire.
- ☐ C diameter of the wire.
- ☐ D area of cross-section of the wire.

(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 $299\,792.458 \pm 0.001 \text{ km s}^{-1}$.

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

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

(2)

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

Comment on the value determined by Michelson.

(2)

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

(2)

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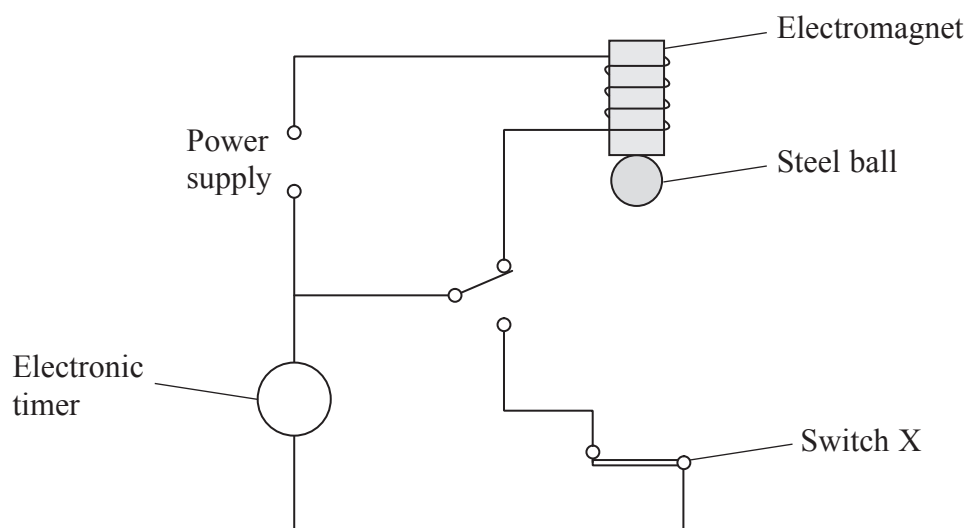
Percentage uncertainty =

(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)



Handwriting practice area with 20 sets of dotted lines on a lined background.

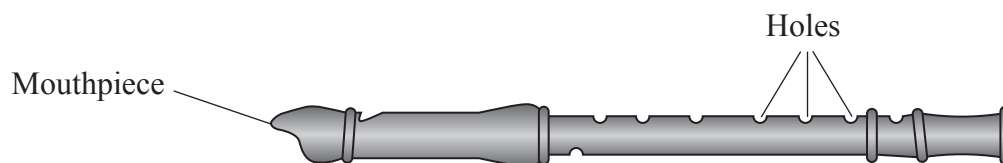


P 4 3 1 2 5 A 0 7 1 6

(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.

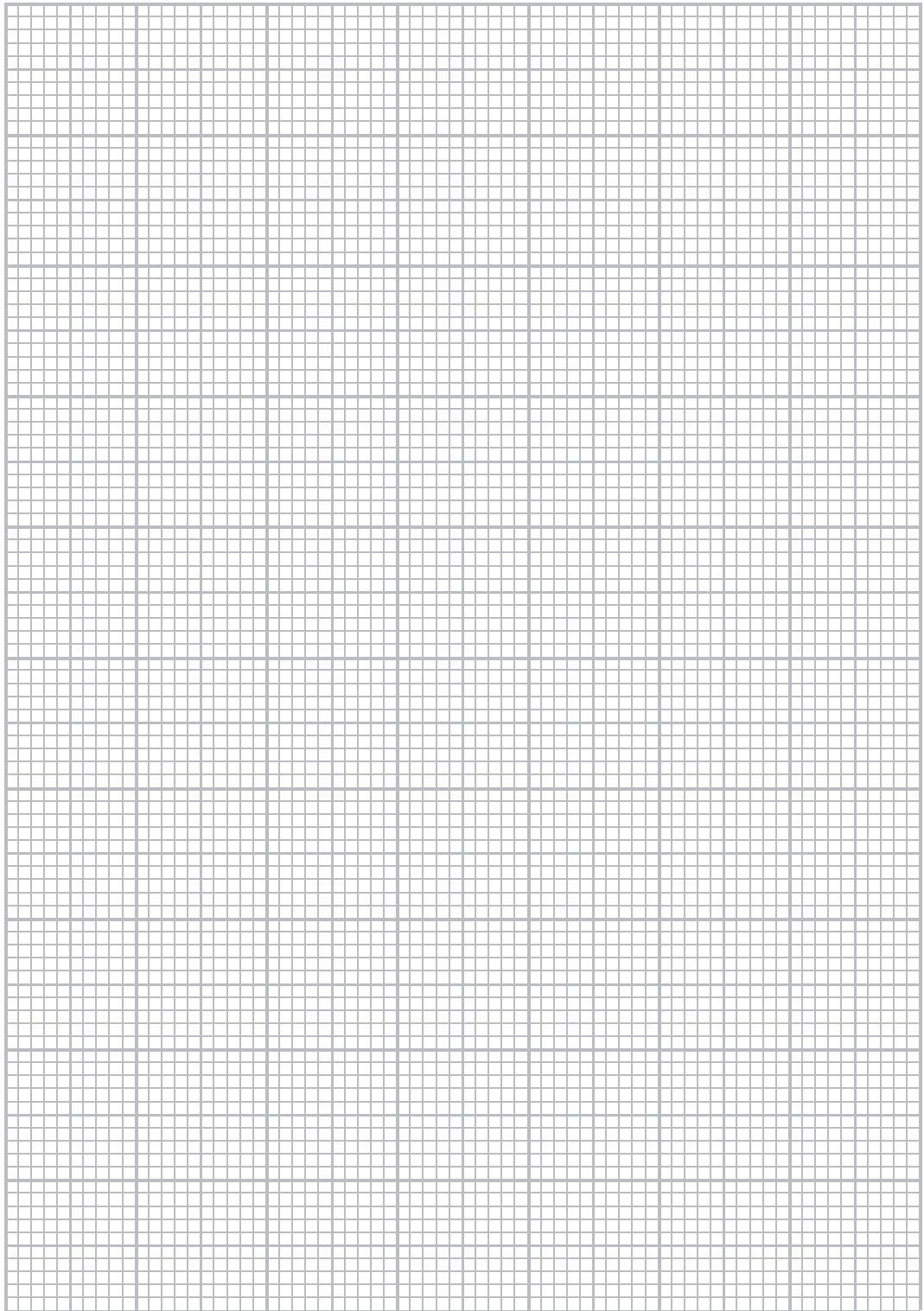
(3)

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)

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Gradient =

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

(3)

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$v =$

(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)

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(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	$\Delta W = F\Delta s$ $E_k = \frac{1}{2}mv^2$ $\Delta E_{\text{grav}} = mg\Delta h$

Materials

Stokes' law	$F = 6\pi\eta r v$
Hooke's law	$F = k\Delta x$
Density	$\rho = m/V$
Pressure	$p = F/A$
Young modulus	$E = \sigma/\epsilon$ where Stress $\sigma = F/A$ Strain $\epsilon = \Delta x/x$
Elastic strain energy	$E_{\text{el}} = \frac{1}{2}F\Delta x$



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

$$P = VI$$

$$P = I^2R$$

$$P = V^2/R$$

$$W = VIt$$

$$\% \text{ efficiency} = \frac{\text{useful energy output}}{\text{total energy input}} \times 100$$

$$\% \text{ efficiency} = \frac{\text{useful power output}}{\text{total power input}} \times 100$$

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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