

Write your name here

Surname					Other names									
<b>Pearson Edexcel</b>					Centre Number					Candidate Number				
<b>International</b>					[ ] [ ] [ ] [ ] [ ] [ ]					[ ] [ ] [ ] [ ] [ ] [ ]				
<b>Advanced Level</b>														
<b>Physics</b>														
<b>Advanced Subsidiary</b>														
<b>Unit 3: Exploring Physics</b>														
Thursday 8 May 2014 – Morning										Paper Reference				
<b>Time: 1 hour 20 minutes</b>										<b>WPH03/01</b>				
<b>You must have:</b>										Total Marks				
Ruler										[ ]				

### 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  $\text{kN m}^2$   
 B  $\text{N mm}^{-2}$   
 C  $\text{N m}^{-2}$   
 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

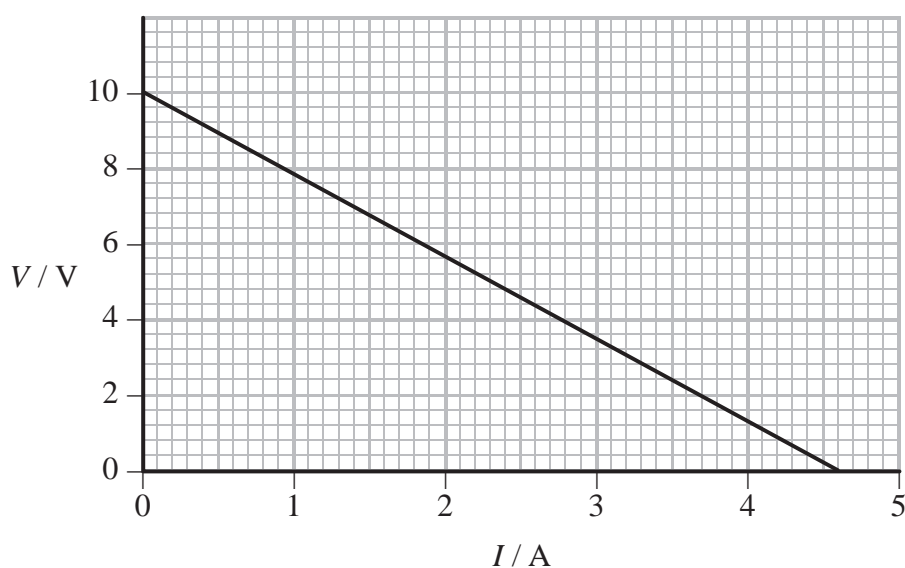
- A Young modulus of the wire.  
 B length of the wire.  
 C diameter of the wire.  
 D area of cross-section of the wire.

(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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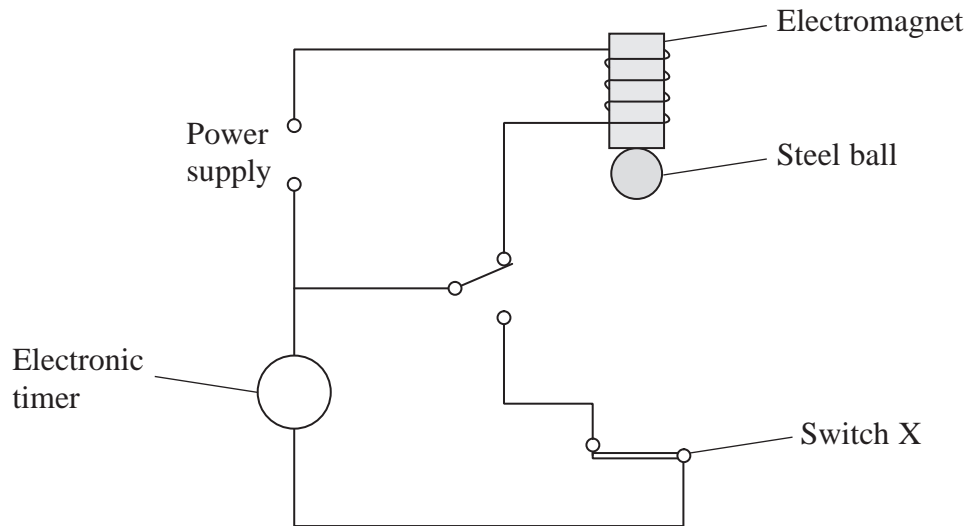
Percentage uncertainty = .....

**(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)



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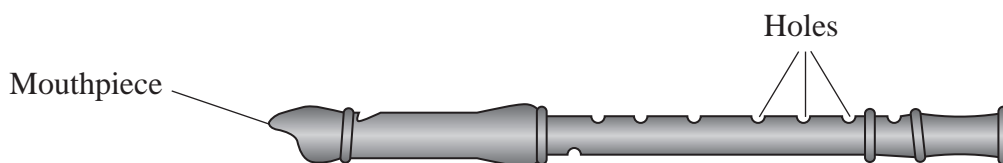
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**(Total for Question 7 = 13 marks)**





- 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.

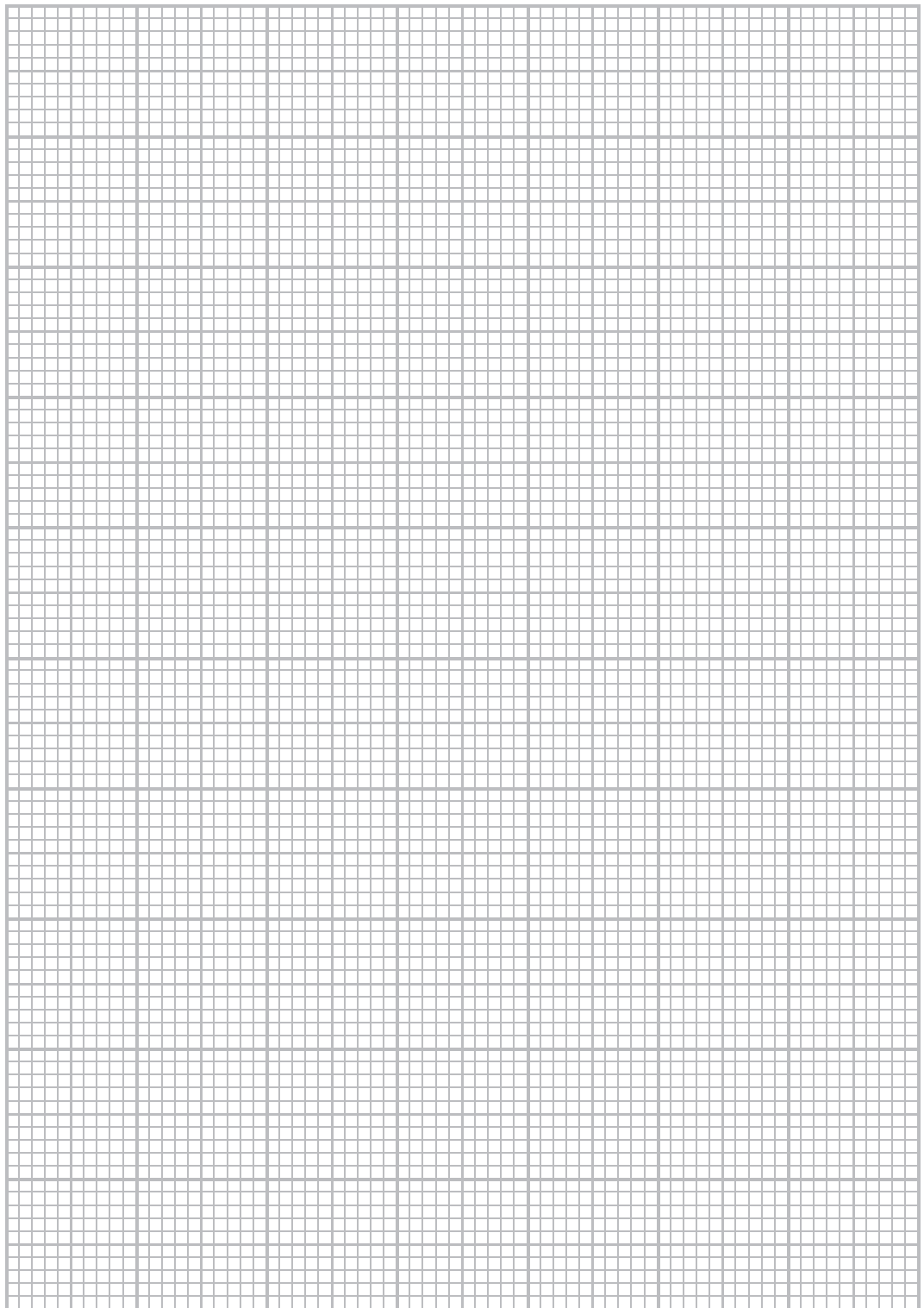
(3)

$l / \text{cm}$	$f / \text{Hz}$	$\frac{1}{l} /$
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  $330 \text{ m s}^{-1}$ .

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)**

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**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	$F = 6\pi\eta rv$
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	$E_{\text{el}} = \frac{1}{2}F\Delta x$



**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  
 $P = VI$   
 $P = I^2R$   
 $P = V^2/R$   
 $W = VI t$

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

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

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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