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Surname	Other names	
Pearson Edexcel International Advanced Level	Centre Number	Candidate Number
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Physics Advanced Subsidiary Unit 3: Exploring Physics		
Tuesday 26 January 2016 – Morning Time: 1 hour 20 minutes	Paper Reference WPH03/01	
You do not need any other materials.	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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SECTION A

Answer ALL questions.

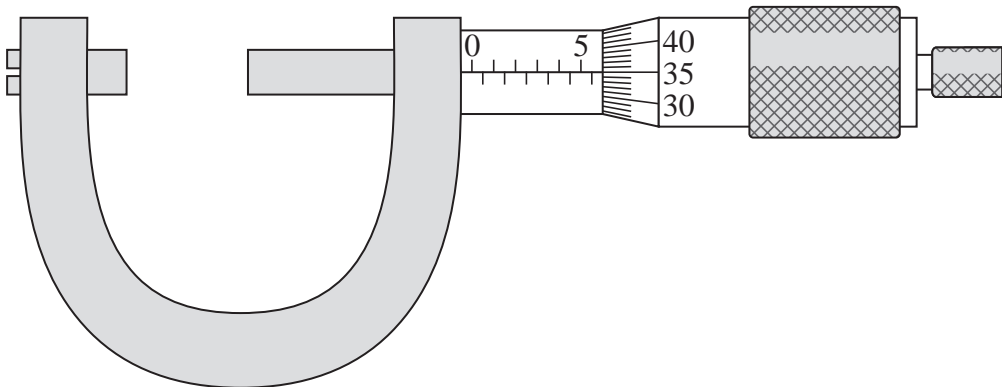
For questions 1–5, in Section A, select one answer from A to D and put a cross in the box ☒. If you change your mind put a line through the box ~~☒~~ and then mark your new answer with a cross ☒.

1 Which of the following is a base SI unit?

- A ampere
- B newton
- C pascal
- D watt

(Total for Question 1 = 1 mark)

2 The diagram below shows a micrometer screw gauge which has been used to measure the width of a piece of metal.



Which is the correct reading of the gauge in millimetres?

- A 5.135
- B 5.235
- C 5.85
- D 6.35

(Total for Question 2 = 1 mark)

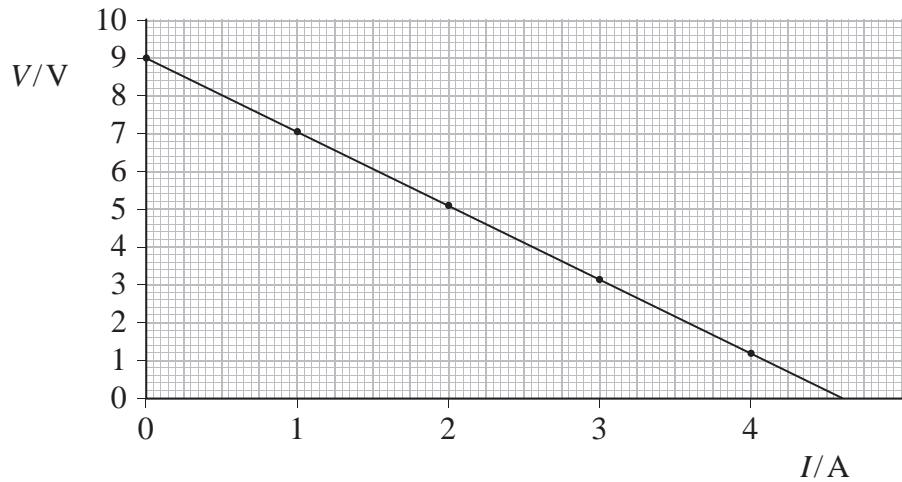
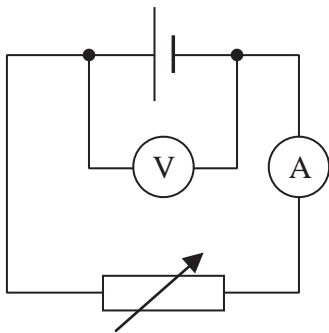
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Questions 3, 4 and 5 refer to the circuit and graph below. The variable resistor is used to vary the current I and the potential difference V is measured.



3 Which 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 non-linear relationship.

(Total for Question 3 = 1 mark)

4 Which of the following would give the e.m.f. of the cell?

- A the area under the graph
- B the magnitude of the gradient
- C the intercept on the I axis
- D the intercept on the V axis

(Total for Question 4 = 1 mark)

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

- A 2.09
- B 1.96
- C 0.511
- D 0.478

(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 In an experiment to determine the density of a metal a student recorded her final value as $8700 \pm 200 \text{ kg m}^{-3}$.

(a) State the range of her measurements.

(1)

.....

.....

(b) Calculate the percentage uncertainty in her measurement.

(2)

.....

.....

.....

Percentage uncertainty =

(c) The student was given the following table of values.

Metal	Density / kg m^{-3}
brass	8440
bronze	8810
copper	8930

State which metal she was using.

(1)

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(Total for Question 6 = 4 marks)

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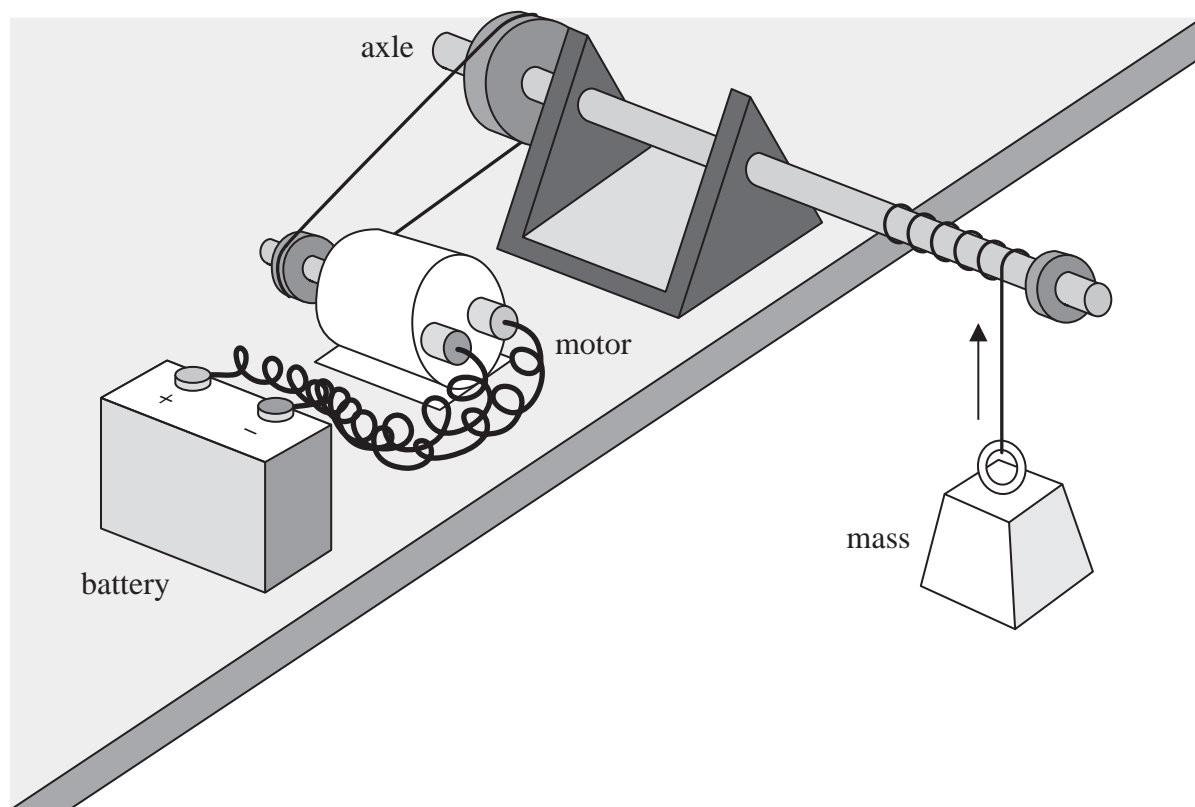
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- 7 A student is asked to determine the efficiency of a 9 V electric motor when it is used to lift a 1 kg mass at a steady speed. The diagram below shows the apparatus to be used.



Write a plan for an experiment to do this.

You should:

- (a) state the quantities to be measured, (2)
- (b) explain your choice of measuring instrument for **two** of these quantities, (4)
- (c) comment on whether repeat readings are appropriate in this case, (1)
- (d) explain how the data collected will be used to calculate the efficiency of the motor, (3)
- (e) identify the main sources of uncertainty and/or systematic error, (2)
- (f) comment on safety. (1)

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(Total for Question 7 = 13 marks)



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8 A student carried out an experiment to investigate the stretching of a length of rubber of rectangular cross-section. His results are shown below.

original length of rubber = 0.15 m

thickness of rubber = 1.05×10^{-3} m

width of rubber = 2.71×10^{-3} m

Extension / m	Force / N
0	0
0.0225	3.9
0.05	7.9
0.13	9.8
0.235	12.4
0.3	14.0
0.35	18.5

(a) Criticise these results.

(2)

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(b) (i) Plot a graph of force on the y-axis and extension on the x-axis and draw a line of best fit.

(4)

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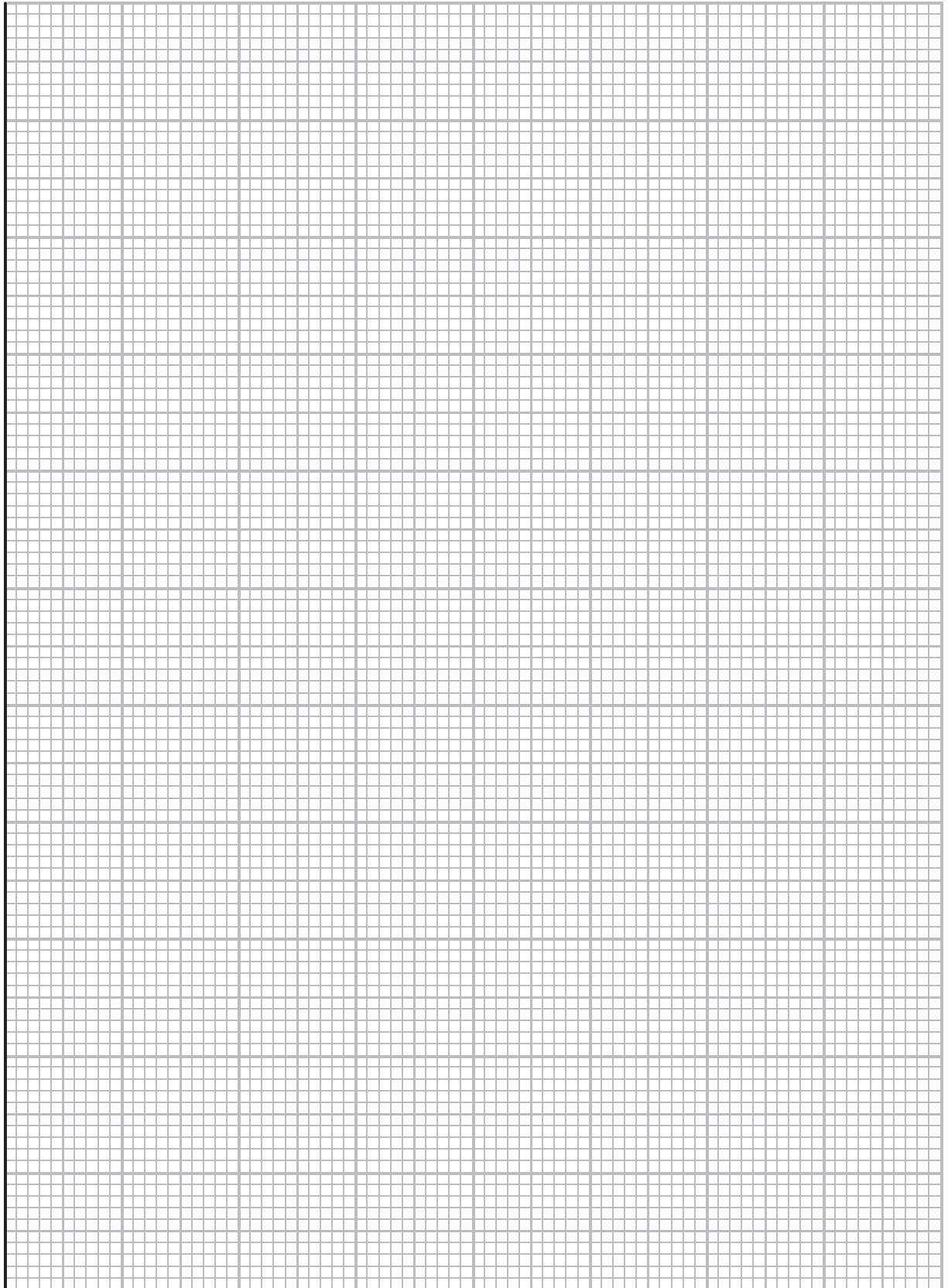


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Force / N



Extension / m

Question 8 continues on the next page



(ii) Comment on the shape of the graph.

(2)

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(iii) The area under the graph represents the work done in stretching the rubber.
Determine the work done in stretching the rubber by 0.2 m.

(4)

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Work done =

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(c) For the last set of results in the table calculate the stress and strain. State an assumption you have made.

(6)

Stress =

Strain =

Assumption.....

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

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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

$$P = VI$$

$$P = I^2R$$

$$P = V^2/R$$

$$W = VI t$$

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

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

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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