

Please check the examination details below before entering your candidate information

Candidate surname		Other names	
Pearson Edexcel International Advanced Level		Centre Number <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	Candidate Number <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
Wednesday 8 May 2019			
Afternoon (Time: 1 hour 20 minutes)		Paper Reference WPH03/01	
Physics Advanced Subsidiary Unit 3: Exploring Physics			
You must have: Ruler			Total Marks <input type="text"/>

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.
- 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.

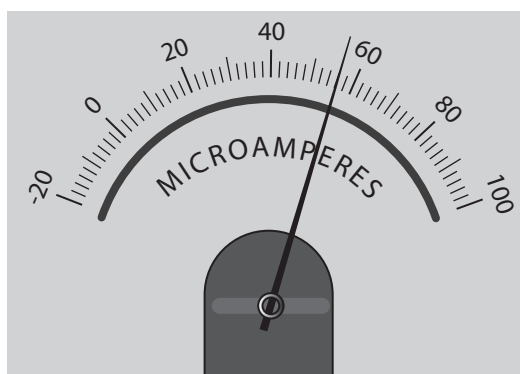
For questions 1–5, in Section A, select one answer from A to D and put a cross in the box ☐. If you change your mind put a line through the box ☒ and then mark your new answer with a cross ☐.

1 Which of the following is an SI base unit?

- ☐ A coulomb
- ☐ B charge
- ☐ C second
- ☐ D time

(Total for Question 1 = 1 mark)

2 The diagram shows the scale on a microammeter.



Which of the following is the correct reading?

- ☐ A $48 \times 10^{-6} \text{ A}$
- ☐ B $48 \times 10^{-3} \text{ A}$
- ☐ C $56 \times 10^{-6} \text{ A}$
- ☐ D $56 \times 10^{-3} \text{ A}$

(Total for Question 2 = 1 mark)

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Questions 3, 4, and 5 refer to an experiment to determine the Young modulus of the material of a wire using a graph.

The wire is suspended from a rigid support. Loads are added to the wire and the corresponding extensions are determined.

3 Which of the following measurements would **not** be needed?

- ☐ A diameter of the wire
- ☐ B mass of the wire
- ☐ C original length of the wire
- ☐ D weight of the load on the wire

(Total for Question 3 = 1 mark)

4 Which of the following gives the Young modulus?

- ☐ A area under a graph of force against extension
- ☐ B gradient of a graph of force against extension
- ☐ C area under a graph of stress against strain
- ☐ D gradient of a graph of stress against strain

(Total for Question 4 = 1 mark)

5 Which of the following is a correct unit for the Young modulus?

- ☐ A N
- ☐ B Nm
- ☐ C Nm^{-1}
- ☐ D Nm^{-2}

(Total for Question 5 = 1 mark)

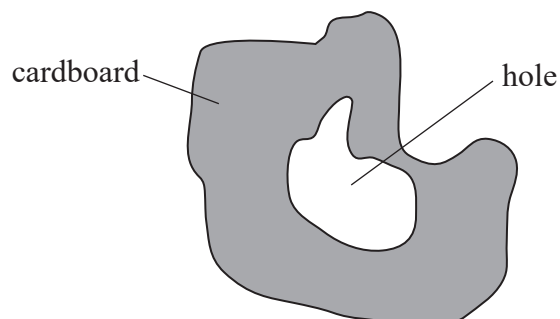
TOTAL FOR SECTION A = 5 MARKS



SECTION B

Answer ALL questions in the spaces provided.

- 6 A student has been asked to determine the centre of gravity of a piece of thick cardboard shaped like the one shown below.



- (a) Describe a simple experiment to determine the position of the centre of gravity of the cardboard.

(4)

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- (b) Explain how your method allows the position of the centre of gravity to be determined.

(2)

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(Total for Question 6 = 6 marks)

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- 7 A student is asked to investigate how the resistance of a negative temperature coefficient thermistor varies with temperature, using a graphical method. The student is to use temperatures between 0°C and 100°C .

Write a plan for this investigation.

You should:

- (a) explain how the temperature will be varied, (2)
- (b) state the quantities to be measured, suggesting a suitable measuring instrument for each quantity, (4)
- (c) identify the dependent and independent variables, (1)
- (d) explain why repeat readings are not appropriate in this case, (2)
- (e) sketch the graph expected, (2)
- (f) identify the main source of uncertainty and state how this could be minimised, (2)
- (g) comment on safety. (1)



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(Total for Question 7 = 14 marks)



- 8 A student determined the Planck constant h , using light emitting diodes (LEDs) of different colours. He measured the minimum potential difference V needed for each LED to light. The frequency f of the light emitted by the LEDs was given by the manufacturer. He recorded the results shown in the table.

$f / 10^{14} \text{ Hz}$	V/V
7.41	1.43
6.88	1.25
5.40	0.67
5.20	0.55

- (a) Criticise these results.

(2)

- (b) The relationship between V and f is, to a good approximation,

$$eV = hf - b$$

where e is the electron charge and b is a constant.

Explain why a graph of V on the y -axis against f on the x -axis should be a straight line.

(2)

- (c) Plot the graph on the grid provided and draw a line of best fit.

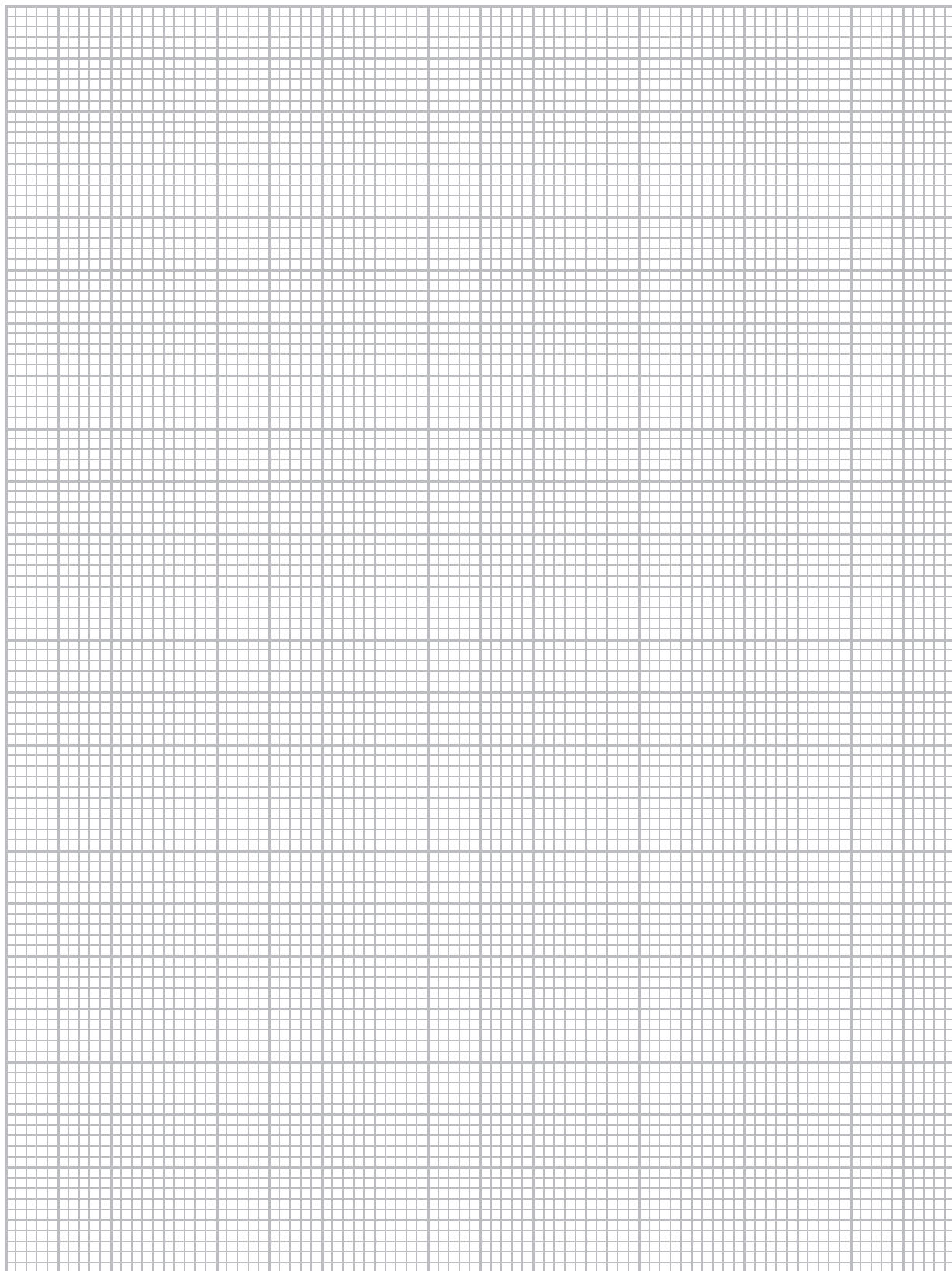
(4)



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P 5 6 0 0 6 A 0 9 1 2

(d) (i) Use your graph to determine a value for the gradient.

(3)

Gradient =

(ii) Use your value for the gradient to determine a value for h .

(2)

$h =$

(e) The student found that the calculated value differed from the accepted value for h .

Explain one improvement to the experimental method which might reduce the difference.

(2)

(Total for Question 8 = 15 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	$E = \sigma/\epsilon$ 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

$$hf = \phi + \frac{1}{2}mv_{\max}^2$$

