Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel
International
Advanced Level

Centre Number | | | | | |

Candidate Number | | | | |

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

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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P 5 6 0 0 6 A 0 1 1 2

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 Which of the following is an SI base unit?

☒ **A** coulomb

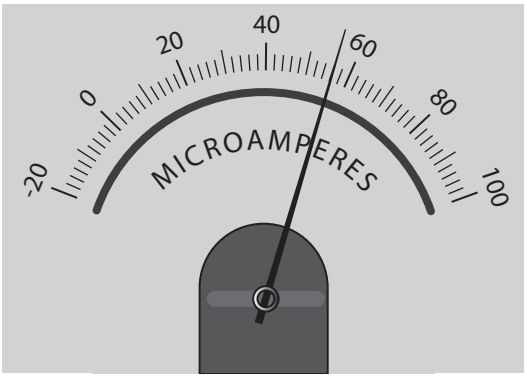
☒ **B** charge

☒ **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** 48×10^{-6}A

☒ **B** 48×10^{-3}A

☒ **C** 56×10^{-6}A

☒ **D** 56×10^{-3}A

(Total for Question 2 = 1 mark)

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}

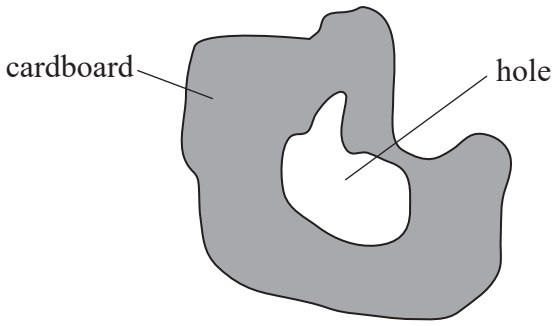
(Total for Question 5 = 1 mark)

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)

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

(2)

(Total for Question 6 = 6 marks)

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)

(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} 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,

$$eV = hf - b$$

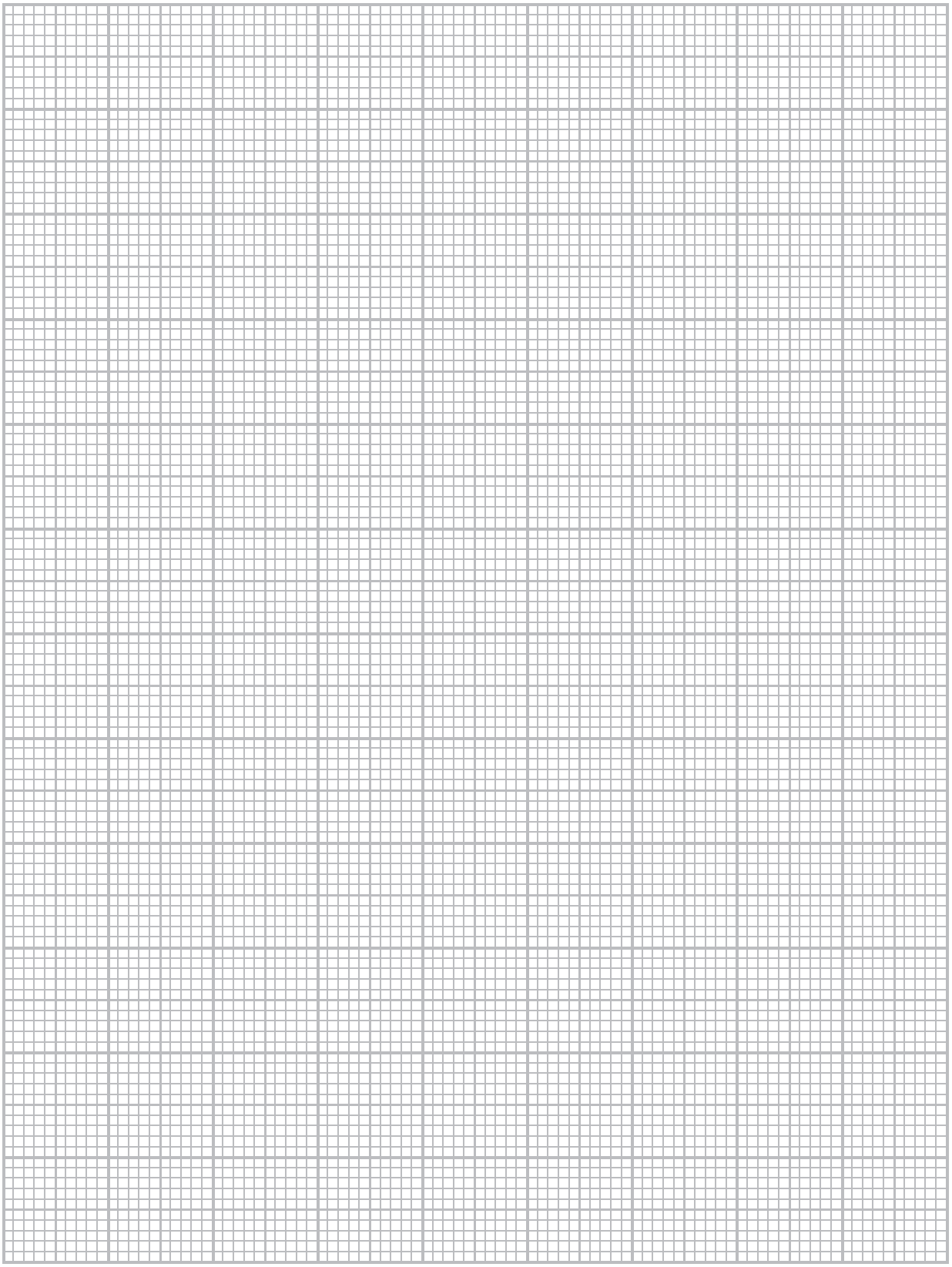
where e is the electron charge and b is a constant.

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)



(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

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

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