Write your name here

Surname	Other names

Pearson Edexcel
International
Advanced Level

Centre Number | | | | | |

Candidate Number | | | | |

Physics

Advanced Subsidiary
Unit 3: Exploring Physics

Friday 12 January 2018 – 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.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

P51631A

1/1/1/

P 5 1 6 3 1 A 0 1 1 6

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 **not** an SI base quantity?

☒ **A** amount of substance

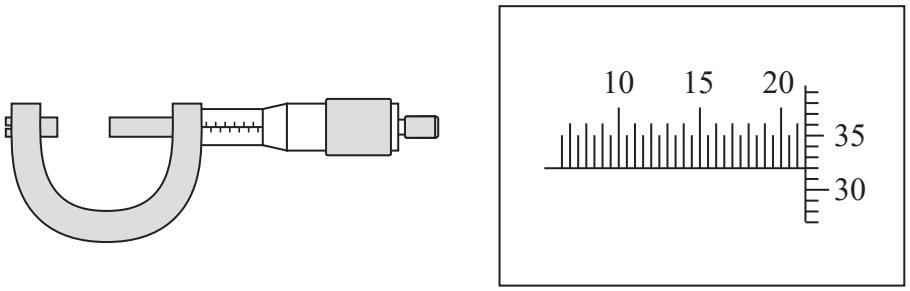
☒ **B** electric charge

☒ **C** electric current

☒ **D** thermodynamic temperature

(Total for Question 1 = 1 mark)

2 The diagram shows a micrometer screw gauge which has been used to measure a length.



Which of the following is the correct reading of the micrometer?

☒ **A** 20.13 mm

☒ **B** 20.32 mm

☒ **C** 21.32 mm

☒ **D** 22.32 mm

(Total for Question 2 = 1 mark)

Questions 3, 4 and 5 refer to an experiment to calculate the efficiency of an electric motor.

The time taken for the motor to raise a mass through a height of 0.45 m is measured.
The times recorded, in seconds, are

3.4 4.5 3.1 3.5

3 Which time should be used in the efficiency calculation?

☒ **A** 3.6

☒ **B** 3.63

☒ **C** 3.3

☒ **D** 3.33

(Total for Question 3 = 1 mark)

4 Which of the following quantities is **not** needed in the efficiency calculation?

☒ **A** power input to the motor

☒ **B** power output from the motor

☒ **C** density of the mass

☒ **D** weight of the mass

(Total for Question 4 = 1 mark)

5 A student repeats the experiment using an increased height of 0.90 m. The mean time is now 7.1 s.

Which of the following statements is correct?

☒ **A** The uncertainty in the height measurement has increased.

☒ **B** The percentage uncertainty in the height measurement has increased.

☒ **C** The uncertainty in the time measurement has decreased.

☒ **D** The percentage uncertainty in the time measurement has decreased.

(Total for Question 5 = 1 mark)

TOTAL FOR SECTION A = 5 MARKS

BLANK PAGE

SECTION B

Answer ALL questions in the spaces provided.

6 A student took measurements to determine the density of a metal in the form of a cube.

(a) The student measured the sides of the cube and stated the mean length as 1.50 cm ± 0.05 cm.

(i) State the instrument the student should have used for this measurement.

(1)

.....

.....

(ii) State the range of these measurements.

(1)

.....

(iii) Calculate the percentage uncertainty in the measurement of length.

(2)

.....

.....

.....

Percentage uncertainty = ...

(b) The student measured the mass of the cube as 38.1 g with negligible uncertainty.

Determine the density of the metal in $kg\,m^{-3}$.

(3)

.....

.....

.....

.....

.....

Density = ... $kg\,m^{-3}$

(Total for Question 6 = 7 marks)

7 You are to plan an experiment to determine the e.m.f. and internal resistance of a cell using a graphical method. The cell is labelled '1.5 V'.

You should:

(a) draw a circuit diagram for the experiment,

(2)

(b) state the quantities to be measured,

(1)

(c) state which is the independent variable and which is the dependent variable,

(1)

(d) for one of the quantities listed in (b) explain your choice of measuring instrument,

(2)

(e) comment on whether repeat readings are appropriate in this case,

(1)

(f) explain how the data collected will be used, include a sketch of the expected graph,

(4)

(g) identify the main sources of uncertainty and/or systematic error,

(2)

(h) comment on safety.

(1)

(Total for Question 7 = 14 marks)

BLANK PAGE

8 A student investigated the properties of a spring. She hung masses from the spring and recorded her results in the table below.

Number of 1.0 kg masses	Load F / N	Length of spring x / mm	Extension of spring Δx / mm
0	0.0	70	0
1	9.8	85	15
2	19.6	104	34
3	29.4	119	49
4		136	

(a) Criticise these results.

(2)

.....

.....

.....

.....

(b) Complete the last row of the table.

(2)

(c) Explain why a graph of F on the y-axis against Δx on the x-axis should be a straight line through the origin.

(2)

.....

.....

.....

.....

.....

.....

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

(4)

(ii) Determine the force constant for the spring.

(2)

.....

.....

.....

.....

Force constant = ...

(iii) Calculate the energy stored in the spring when it is extended by 50 mm.

(2)

.....

.....

.....

.....

Energy stored = ...

(Total for Question 8 = 14 marks)

TOTAL FOR SECTION B = 35 MARKS
TOTAL FOR PAPER = 40 MARKS

BLANK PAGE

BLANK PAGE

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