Write your name here

Surname	Other names

Pearson Edexcel
International
Advanced Level

Centre Number | | | | | |

Candidate Number | | | | |

Physics

Advanced Subsidiary
Unit 3: Exploring Physics

Wednesday 8 January 2014 – Afternoon
Time: 1 hour 20 minutes

Paper Reference
WPH03/01

You must have:
Ruler, protractor

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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6/6/6/6/6/5/

P 4 3 1 1 6 R 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 the SI unit for density?

☒ **A** g cm^{-3}

☒ **B** g m^{-3}

☒ **C** kg m^{-2}

☒ **D** kg m^{-3}

(Total for Question 1 = 1 mark)

2 A student is trying to determine his reaction time. He takes the following readings.

0.21 s, 0.19 s, 0.20 s, 0.09 s

Which of the following is the best mean value of his reaction time stated with a suitable uncertainty?

☒ **A** 0.20 ± 0.06 s

☒ **B** 0.20 ± 0.01 s

☒ **C** 0.17 ± 0.06 s

☒ **D** 0.17 ± 0.01 s

(Total for Question 2 = 1 mark)

3 A student carries out an experiment to determine the viscous drag on a sphere falling at constant speed through a liquid of known viscosity.

Which of the following quantities is **not** required?

☒ **A** diameter of sphere

☒ **B** height of fall

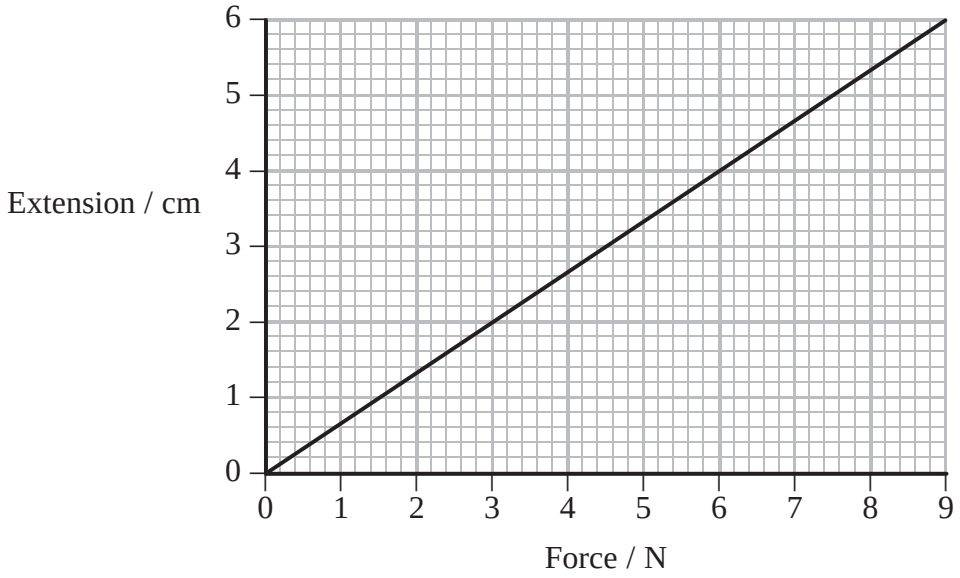
☒ **C** mass of sphere

☒ **D** time of fall

(Total for Question 3 = 1 mark)

Questions 4 and 5 refer to the graph below.

The graph shows how extension varies with applied force for a spring.



4 The force constant k for the spring is given by

- ☒ **A** half the area under the graph.
- ☒ **B** the area under the graph.
- ☒ **C** the gradient.
- ☒ **D** the inverse of the gradient.

(Total for Question 4 = 1 mark)

5 The energy stored in the spring when it is stretched by 6 cm is given by

- ☒ **A** half the area under the graph.
- ☒ **B** the area under the graph.
- ☒ **C** the gradient.
- ☒ **D** the inverse of the gradient.

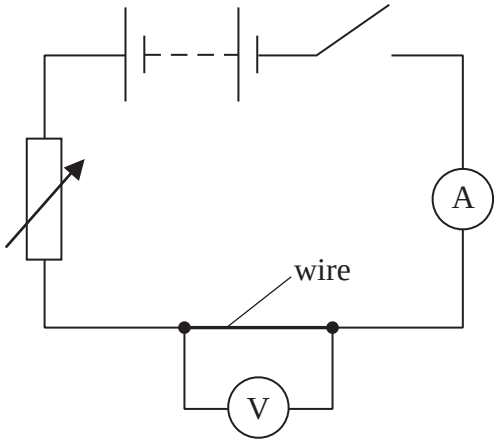
(Total for Question 5 = 1 mark)

TOTAL FOR SECTION A = 5 MARKS

SECTION B

Answer ALL questions in the spaces provided.

6 The circuit below is to be used to determine the resistance of a length of wire.



(a) Explain why the voltmeter should have a very high resistance.

(3)

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(b) Explain why the variable resistor has been included in the circuit.

(2)

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(Total for Question 6 = 5 marks)

7 A student is asked to determine the power of another student who runs up some stairs.

Write a plan for an experiment which could be used to achieve this.

You should:

(a) list any apparatus required,

(1)

(b) state the quantities to be measured,

(1)

(c) for two of these quantities explain your choice of measuring instrument,

(4)

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

(2)

(e) explain how the data collected will be used to determine the power,

(3)

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

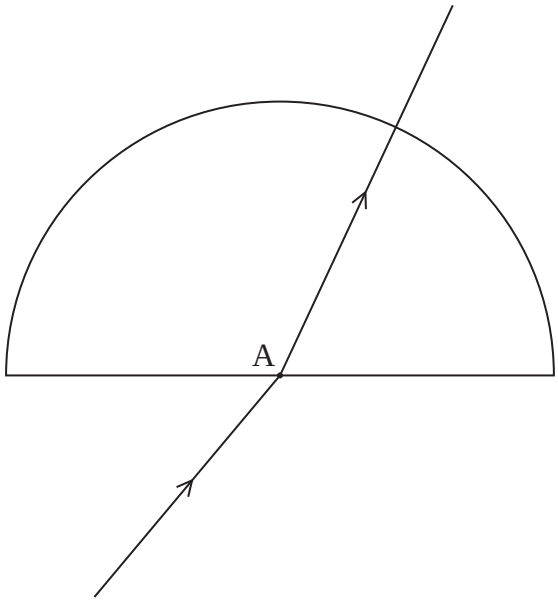
(2)

(g) comment on safety.

(1)

(Total for Question 7 = 14 marks)

8 A student carries out an experiment to determine the refractive index μ for light travelling from air into plastic. She shines a ray of light through a semicircular block of the plastic as shown.



The student measures different angles of incidence i and corresponding angles of refraction r.

(a) Suggest what the student should do to make her measurements as accurate as possible.

(2)

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(b) The student's results are shown in the table.

Angle of incidence *i*	Angle of refraction *r*
6	4
15.5	10
21	14
30	19
34	22.5

Criticise her results.

(3)

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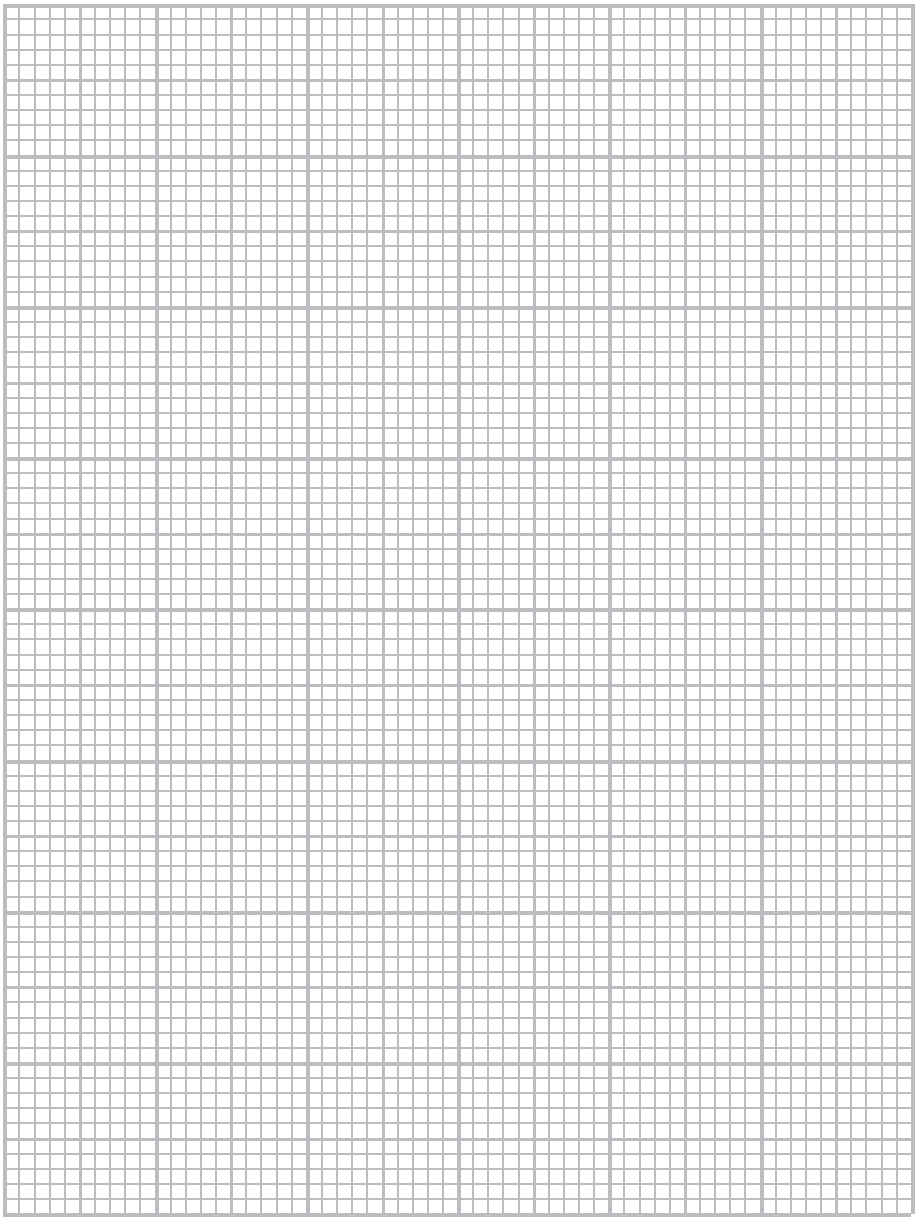
(c) On the diagram, draw a normal at A and take measurements to complete the last row of the table below.

(4)

Angle of incidence *i*	Angle of refraction *r*	sin *i*	sin *r*
6	4	0.105	0.070
15.5	10	0.267	0.174
21	14	0.358	0.242
30	19	0.500	0.326
34	22.5	0.559	0.382

(d) Plot a graph of sin *i* on the *y*-axis against sin *r* on the *x*-axis on the grid provided and draw a line of best fit.

(4)



(e) Use your graph to determine a value for μ.

(3)

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μ = ...

(Total for Question 8 = 16 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	$hf = \phi + \frac{1}{2}mv^2_{max}$