

Write your name here

Surname

Other names

**Pearson Edexcel**  
**International**  
**Advanced Level**

Centre Number

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Candidate Number

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# 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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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  $\text{g cm}^{-3}$
- B  $\text{g m}^{-3}$
- C  $\text{kg m}^{-2}$
- D  $\text{kg m}^{-3}$

(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  $0.20 \pm 0.06 \text{ s}$
- B  $0.20 \pm 0.01 \text{ s}$
- C  $0.17 \pm 0.06 \text{ s}$
- D  $0.17 \pm 0.01 \text{ s}$

(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?

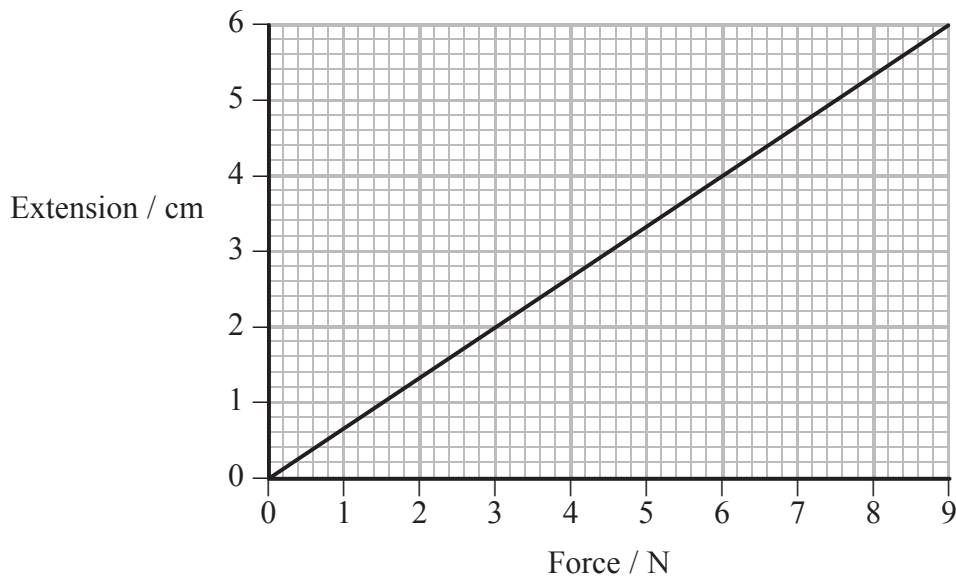
- A diameter of sphere
- B height of fall
- C mass of sphere
- D time of fall

(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)

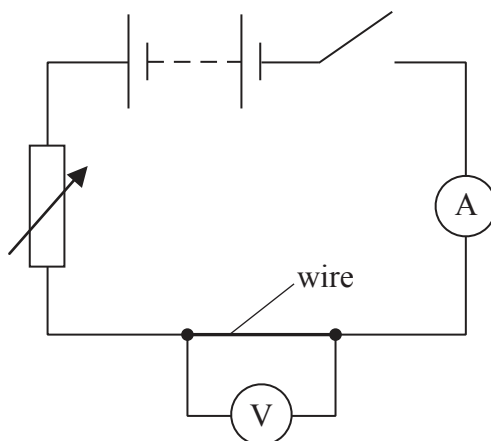
**TOTAL FOR SECTION A = 5 MARKS**



**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)**



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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)

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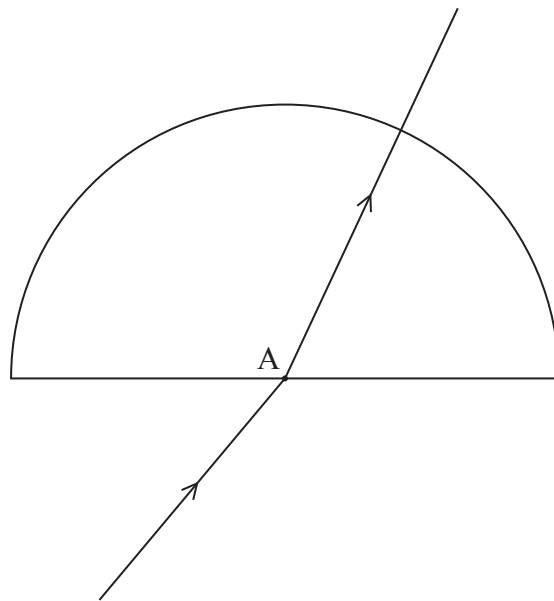
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(Total for Question 7 = 14 marks)



- 8 A student carries out an experiment to determine the refractive index  $\mu$  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.

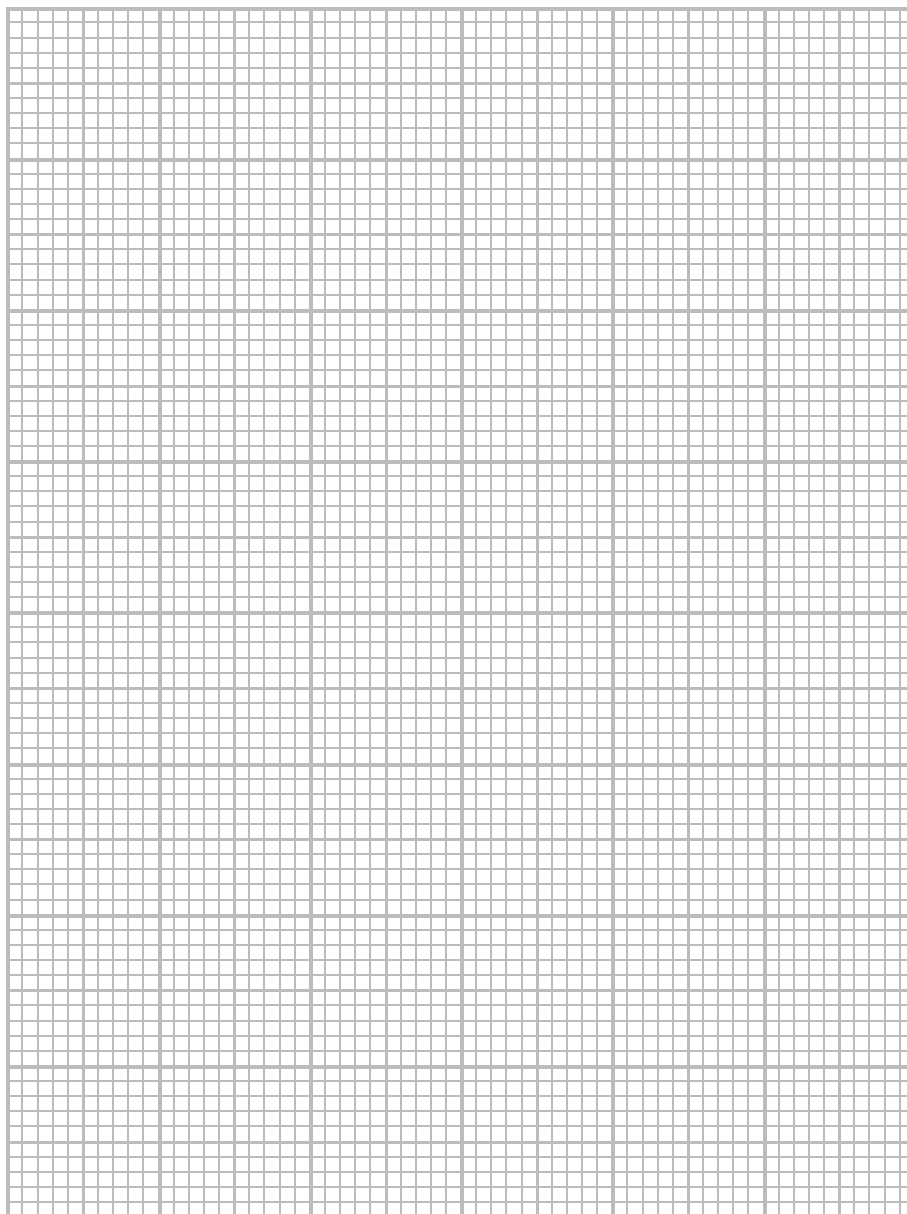
(4)

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  $\mu$ .

(3)

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$\mu =$  .....

**(Total for Question 8 = 16 marks)**

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**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	$F = 6\pi\eta r v$
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

$$P = VI$$
$$P = I^2R$$
$$P = V^2/R$$
$$W = VI t$$

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

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

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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