

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 21 January 2015 – 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.
- 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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**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 a correct unit for stress?

- ☐ A  $\text{m}^{-2}$
- ☐ B N
- ☐ C  $\text{N m}^{-1}$
- ☐ D Pa

(Total for Question 1 = 1 mark)

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2 Which of the following quantities does **not** have a unit?

- ☐ A extension
- ☐ B pressure
- ☐ C strain
- ☐ D the Young modulus

(Total for Question 2 = 1 mark)

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Use the information below to answer questions 3 and 4.

In an experiment to measure the acceleration of free fall  $g$ , a tennis ball was dropped from rest, four times, from a measured height. The time it took to reach the ground was measured using a stopwatch.

3 The times recorded were:

0.75 s      0.76 s      0.97 s      0.79 s

Which of the following should be recorded as the mean value?

- ☐ A 0.767 s
- ☐ B 0.77 s
- ☐ C 0.817 s
- ☐ D 0.82 s

(Total for Question 3 = 1 mark)

4 Which of the following equations could be used directly to calculate  $g$ ?

- ☐ A  $s = \frac{1}{2} (u + v) t$
- ☐ B  $s = ut + \frac{1}{2} at^2$
- ☐ C  $v = u + at$
- ☐ D  $v^2 = u^2 + 2as$

(Total for Question 4 = 1 mark)

5 In an experiment to determine the density of a liquid, 100 g of the liquid has a volume of 80 cm<sup>3</sup>. What is the density of the liquid in kg m<sup>-3</sup>?

- ☐ A  $1.25 \times 10^{-5}$
- ☐ B 0.125
- ☐ C 1.25
- ☐ D 1250

(Total for Question 5 = 1 mark)

TOTAL FOR SECTION A = 5 MARKS



## SECTION B

Answer ALL questions in the spaces provided.

- 6 A student is planning an experiment to determine the Young modulus for a material in the form of a wire. He plans to hang weights on the wire which is fastened to a support. He carries out a risk assessment using the table below, which has been partly completed.

Complete the table.

(4)

Apparatus	Hazard	Risk	Precaution
Support	topples over	hits experimenter	secure support to bench with G-clamp
Wire			
Hanging weights			

(Total for Question 6 = 4 marks)



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- 7 A student is asked to investigate how resistance varies with potential difference for a 12 V, 24 W bulb.

Write a plan for an experiment to do this using standard laboratory apparatus and a graphical method.

You should:

- (a) draw a circuit diagram of the circuit to be used, (2)
- (b) state the quantities to be measured, (1)
- (c) explain your choice of measuring instrument for **two** of these quantities, (4)
- (d) comment on whether repeat readings are appropriate in this case, (1)
- (e) explain how the data collected will be used and sketch the expected graph, (3)
- (f) identify the main sources of uncertainty and/or systematic error, (1)
- (g) comment on safety. (1)



Handwriting practice area with 20 sets of dotted lines on a lined background.



(Total for Question 7 = 13 marks)

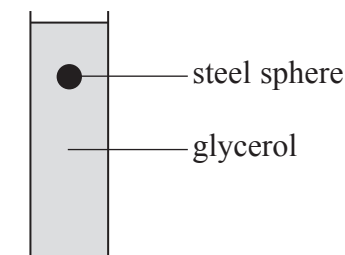




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- 8 In an experiment to measure the viscosity  $\eta$  of glycerol, steel spheres are timed falling through a column of glycerol.



The relationship to be used is

$$v = \frac{2r^2g(\rho_s - \rho_g)}{9\eta}$$

where  $v$  is the terminal velocity of the sphere,  $r$  is the radius of the sphere,  $\rho_s$  is the density of steel,  $\rho_g$  is the density of glycerol and  $g$  is the acceleration of free fall.

The results are shown in the table. The radii of the spheres are taken from data provided by the manufacturer.

$r / \text{mm}$	$r^2 /$	$v / \text{ms}^{-1}$
1	1	0.0098
2	4	0.034
3		0.0781
4	16	0.15

- (a) Complete the table with the missing value and unit.

(1)

- (b) Criticise these results.

(2)

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(c) Explain why a graph of  $v$  on the  $y$ -axis against  $r^2$  on the  $x$ -axis should be a straight line with a gradient of  $\frac{2g(\rho_s - \rho_g)}{9\eta}$

(2)

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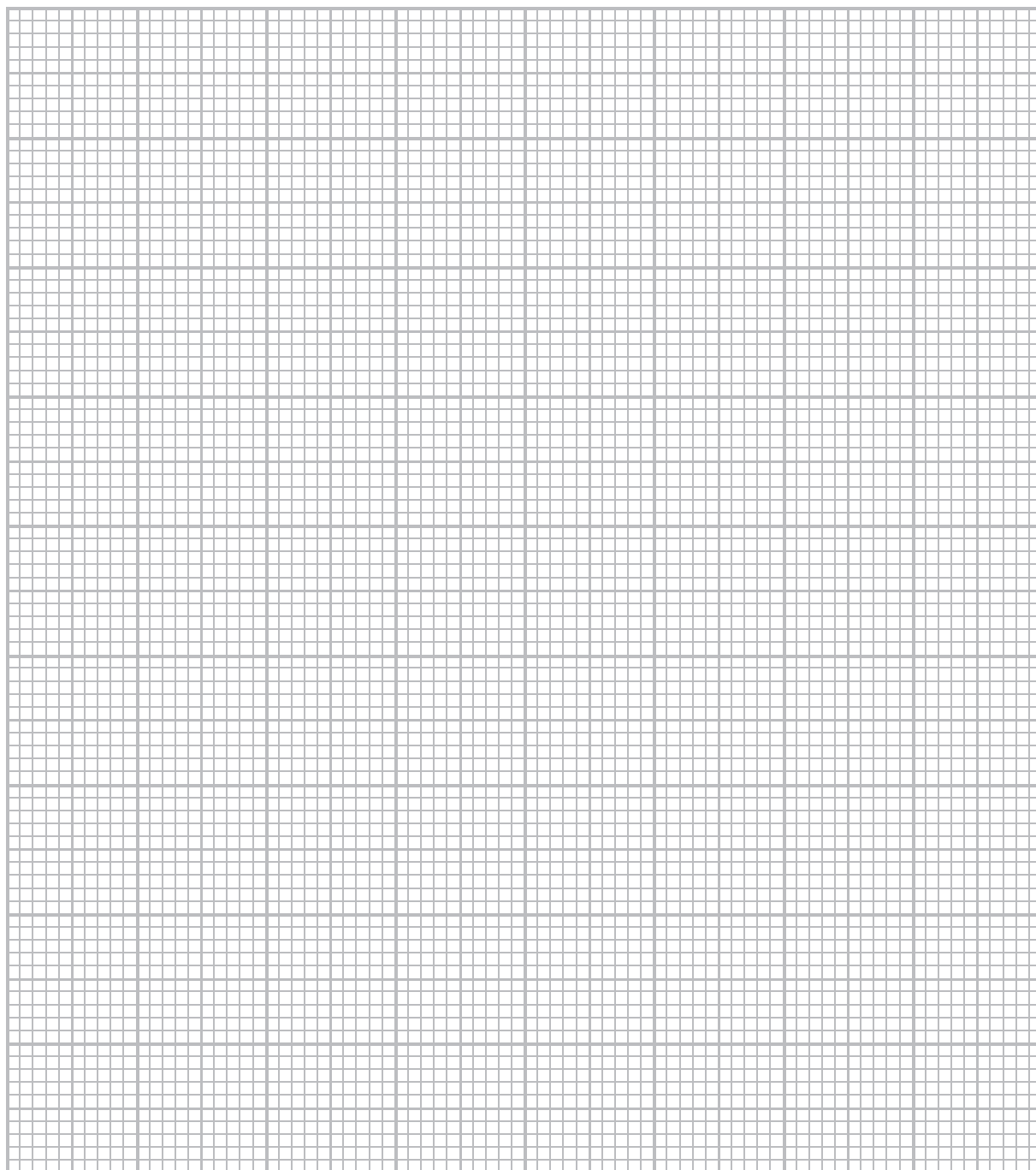
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P 4 5 0 3 7 A 0 1 1 1 6

(d) Plot a graph of  $v$  on the  $y$ -axis against  $r^2$  on the  $x$ -axis on the grid provided and draw a line of best fit.

(5)



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

(3)

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Gradient = .....

(f) Use your value for the gradient to calculate a value for  $\eta$ .

(3)

$$\rho_s = 7800 \text{ kg m}^{-3}$$

$$\rho_g \text{ (at room temperature)} = 1200 \text{ kg m}^{-3}$$

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$\eta =$  .....



(g) Suggest **two** factors in the experiment that would affect the value of  $\eta$ .

(2)

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(Total for Question 8 = 18 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

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

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

### Mechanics

Kinematic equations of motion	$v = u + at$ $s = ut + \frac{1}{2}at^2$ $v^2 = u^2 + 2as$
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Forces	$\Sigma F = ma$ $g = F/m$ $W = mg$
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Work and energy	$\Delta W = F\Delta s$ $E_k = \frac{1}{2}mv^2$ $\Delta E_{\text{grav}} = mg\Delta h$
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### Materials

Stokes' law	$F = 6\pi\eta rv$
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Hooke's law	$F = k\Delta x$
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Density	$\rho = m/V$
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Pressure	$p = F/A$
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Young modulus	$E = \sigma/\epsilon$ where Stress $\sigma = F/A$ Strain $\epsilon = \Delta x/x$
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Elastic strain energy	$E_{\text{el}} = \frac{1}{2}F\Delta x$
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## 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

$$P = VI$$

$$P = I^2R$$

$$P = V^2/R$$

$$W = VIt$$

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

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

