Write your name here

Surname	Other names

Pearson Edexcel
International
Advanced Level

Centre Number | | | | | |

Candidate Number | | | | |

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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6/6/6/6/3/

P 4 5 0 3 7 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 a correct unit for stress?

☒ **A** m^{-2}

☒ **B** N

☒ **C** $N\ m^{-1}$

☒ **D** Pa

(Total for Question 1 = 1 mark)

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)

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** $s = ½ (u + v) t$

☒ **B** $s = ut + ½ at^2$

☒ **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^3. What is the density of the liquid in kg m^{-3}?

☒ **A** 1.25×10^{-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)

(Total for Question 7 = 13 marks)

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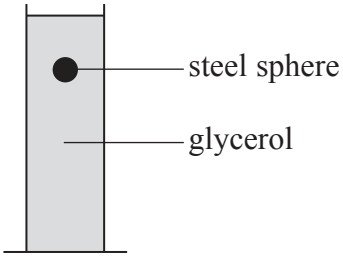
8 In an experiment to measure the viscosity η of glycerol, steel spheres are timed falling through a column of glycerol.



The relationship to be used is

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

where v is the terminal velocity of the sphere, r is the radius of the sphere, ρ_s is the density of steel, ρ_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 / mm	r^2 /	v / m s^{-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.

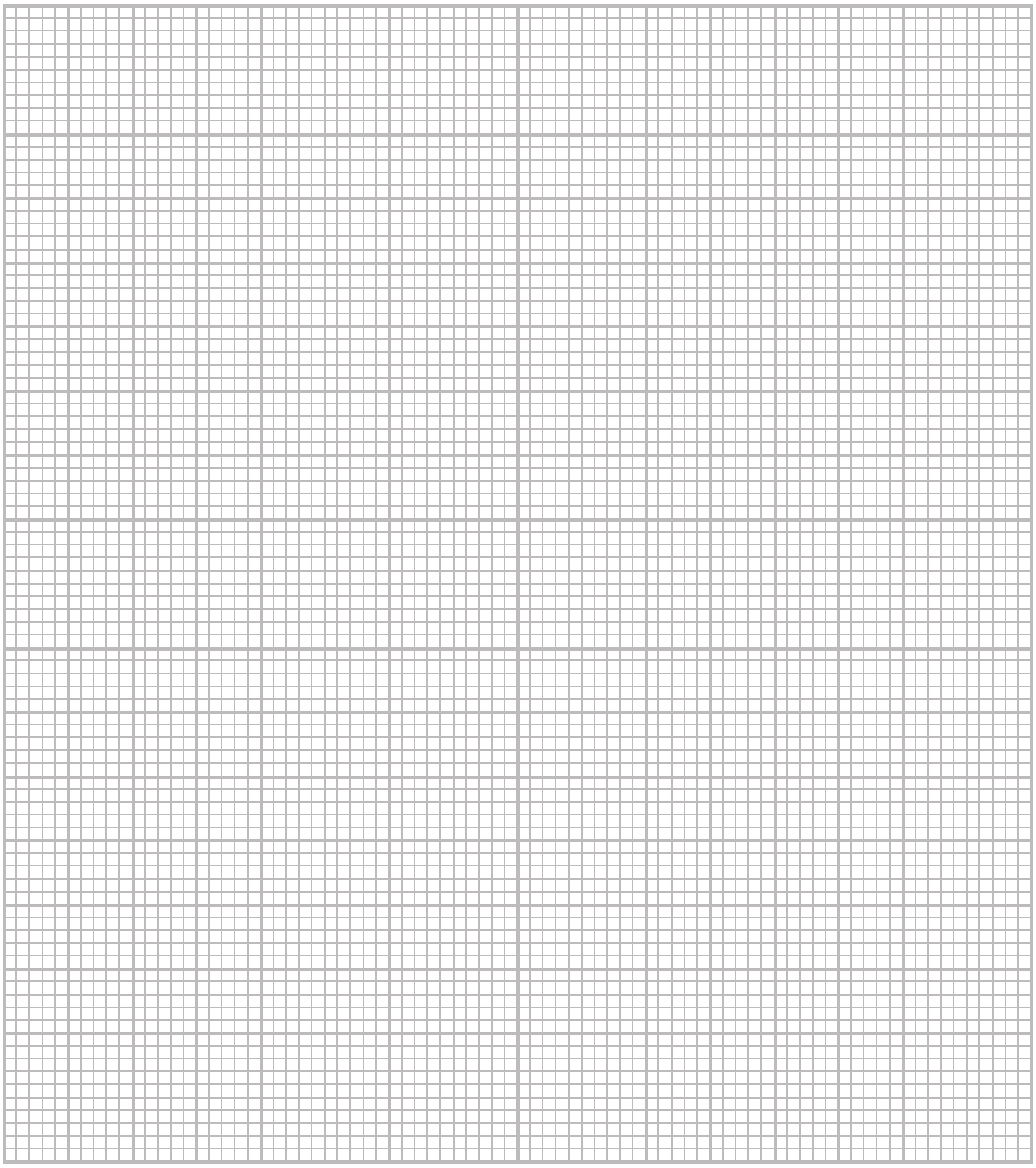
(2)

(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)

(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)

Gradient = ...

(f) Use your value for the gradient to calculate a value for η.

(3)

$\rho_s = 7800 \text{ kg m}^{-3}$ ρ_g (at room temperature) $= 1200 \text{ kg m}^{-3}$

η = ...

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

(2)

.....

.....

.....

.....

(Total for Question 8 = 18 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

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

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

Mechanics

Kinematic equations of motion	$v = u + at$ $s = ut + \frac{1}{2}at^2$ $v^2 = u^2 + 2as$
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	$P = VI$ $P = I^2R$ $P = V^2/R$ $W = VIt$
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	$hf = \phi + \frac{1}{2}mv^2_{max}$