Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Time 1 hour 20 minutes

Paper reference **WPH13/01**

Physics

International Advanced Subsidiary/Advanced Level
UNIT 3: Practical Skills in Physics I

You must have:
Scientific calculator, 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.*
- **Show all your working out** in calculations and **include units** where appropriate.

Information

- The total mark for this paper is 50.
- 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.

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.

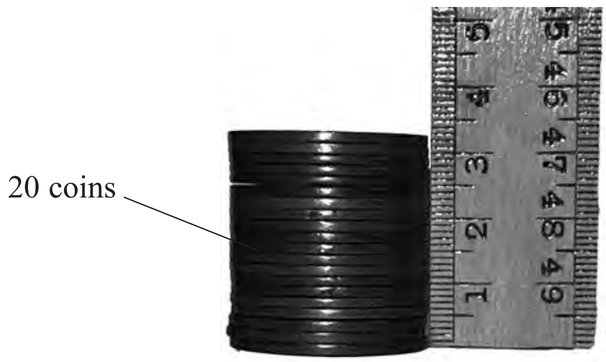
Turn over

Pearson

Answer ALL questions.

1 A student was given a collection of old coins.

She placed the coins alongside a ruler, as shown, to determine the diameter and thickness of the coins.



(a) Determine the average volume of one of the coins.

(4)

Average volume = ...

(b) The mass of the 20 coins shown is 196 g.

Determine the average density of the coins.

(2)

Average density = ...

(c) Determine whether the coins could be made from brass.

density of brass = 8550 $kg\,m^{-3}$ ± 2%

(2)

(d) The surfaces of the coins are uneven, which introduces a systematic error.

Describe an alternative method the student could have used to determine the average volume of one of the coins, which would avoid this error.

Your description should include details of how any measuring equipment is used.

(4)

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(Total for Question 1 = 12 marks)

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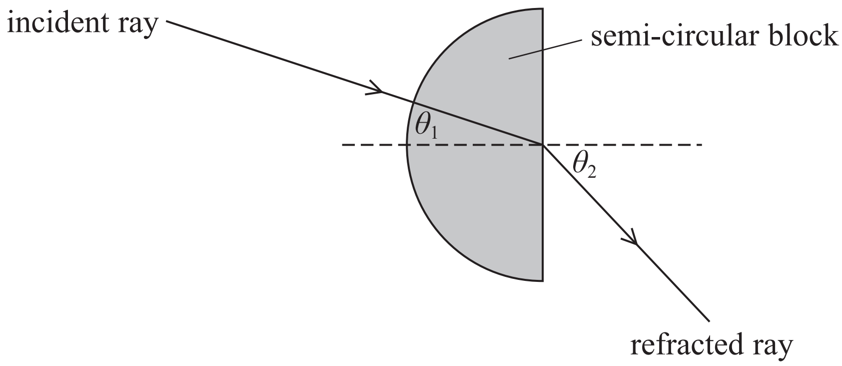
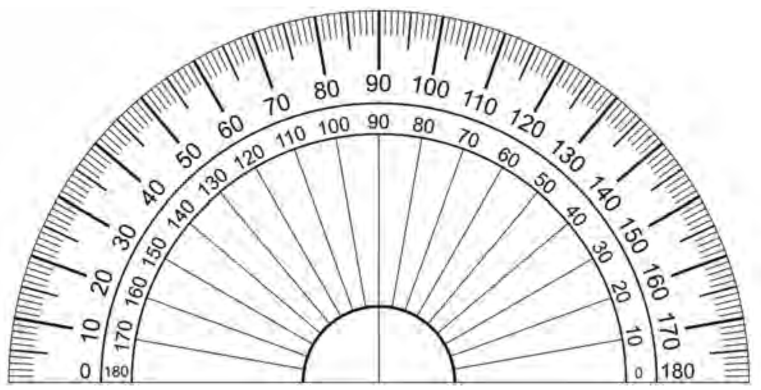
2 A student directed a ray of light from air into a semi-circular block of transparent material as shown.



He varied the angle of incidence θ_1 and measured the corresponding angles of refraction θ_2. He used the protractor shown below.



(Source: PAL)

(a) When the measured value of θ_1 is 35°, the measured value of θ_2 is 62°.

Calculate the percentage uncertainty in each of these values.

(3)

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Percentage uncertainty in θ_1 = ...

Percentage uncertainty in θ_2 = ...

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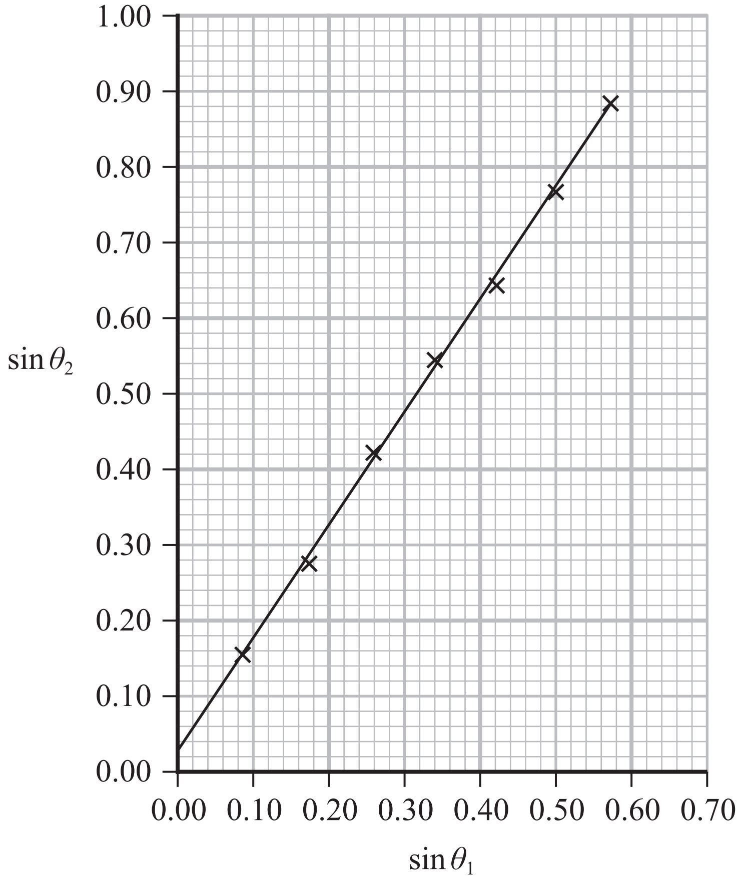
(b) The student plotted a graph of $\sin\theta_2$ against $\sin\theta_1$ as shown.



(i) Explain why the gradient of this graph can be used to determine the refractive index of the transparent material.

(3)

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(ii) Determine the refractive index of the transparent material.

(2)

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Refractive index = ...

(c) The line of best fit on the graph does not pass through the origin.

Describe a possible cause for this error, and how the student could reduce the effect of this error.

(2)

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(Total for Question 2 = 10 marks)

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3 A student investigated the relationship between the resistance R of a light dependent resistor (LDR) and the light intensity I incident upon the LDR.

(a) The student determined R using a circuit that included an ammeter and a voltmeter.

Draw a circuit the student could have used.

(2)

(b) She varied I by varying the distance d between the LDR and a filament bulb.

Describe a method the student could have used to obtain accurate values for R and d.

(3)

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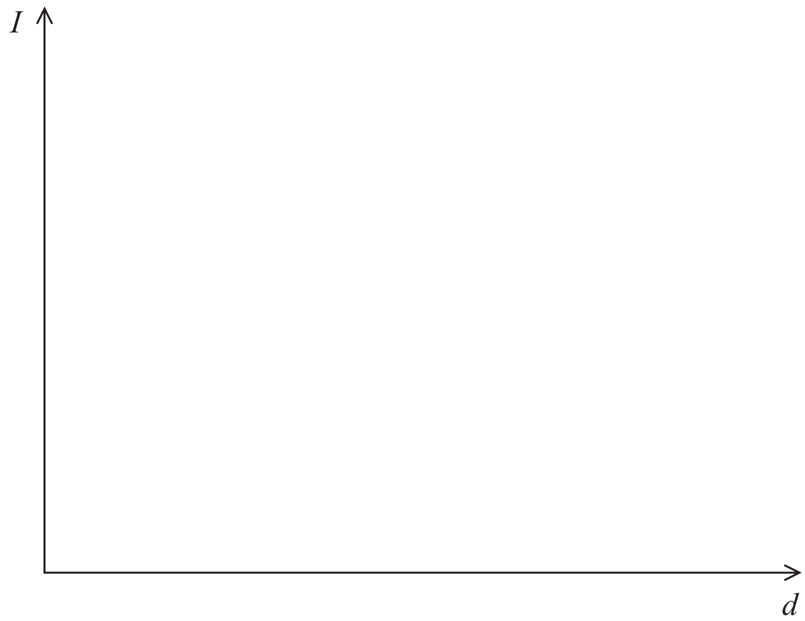
(c) Sketch the relationship between *I* and *d* on the axes below.

(2)



(d) The student calculated the intensity of light incident on the LDR at each value of *d*.

The output power of the filament lamp was 9.0 W.

Calculate the intensity of the light incident on the LDR when *d* is 20 cm.

(3)

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Light intensity = ...

(e) (i) Identify one control variable in this investigation.

(1)

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(ii) State how this variable can be controlled.

(1)

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(Total for Question 3 = 12 marks)

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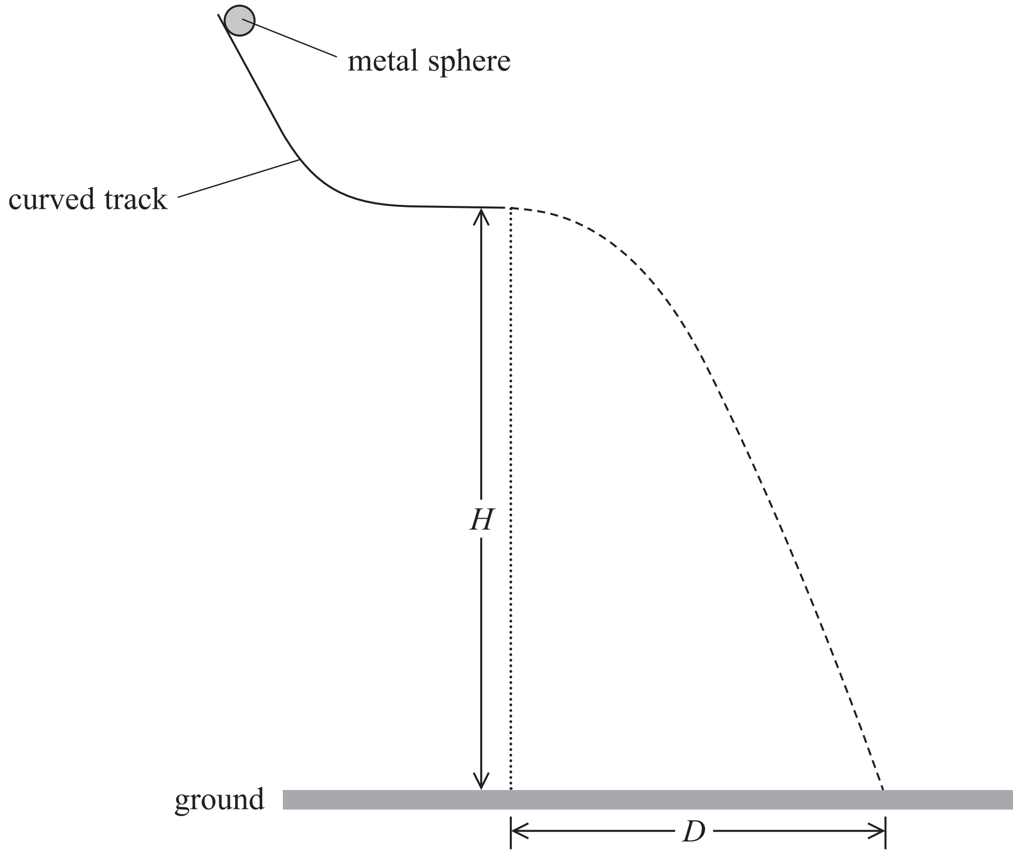
4 A student investigated the motion of a small metal sphere moving horizontally from the lower end of a rigid curved track.

The track was supported by a clamp stand. The student adjusted the position of the track so that the end of the track was a height H above the ground as shown.

She determined the horizontal distance D travelled by the sphere before it reached the ground, for different values of H.



(a) For each value of H, the student released the sphere from the same position on the track.

Explain why this ensured the sphere always reached the end of the track with the same horizontal speed.

(3)

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(b) The student derived the following equation for the relationship between D and H

$$D^2 = \frac{2v^2}{g} H$$

where v is the horizontal velocity of the sphere at the end of the track.

She recorded her results in a table.

***H* / m**	***D* / m**	
0.2	0.38	
0.35	0.53	
0.5	0.63	
0.75	0.76	
1	0.89	
1.2	0.96	

Criticise the recording of these results.

(2)

(c) (i) Plot a graph of D^2 on the y-axis against H on the x-axis. Use the additional column of the table for your processed data.

(6)

(ii) The gradient of the graph is equal to $\frac{2v^2}{g}$

Determine the value of v using your graph.

(3)

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v = ... $m\,s^{-1}$

(iii) The student used a light gate and data logger to measure v. The measured value was $1.98\,m\,s^{-1}$.

Comment on the value of v determined using your graph.

(2)

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(Total for Question 4 = 16 marks)

TOTAL FOR PAPER = 50 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

$$s = \frac{(u+v)t}{2}$$

$$v = u + at$$

$$s = ut + \frac{1}{2}at^2$$

$$v^2 = u^2 + 2as$$

Forces

$$\Sigma F = ma$$

$$g = \frac{F}{m}$$

$$W = mg$$

Momentum

$$p = mv$$

Moment of force

$$\text{moment} = Fx$$

Work and energy

$$\Delta W = F\Delta s$$

$$E_k = \frac{1}{2}mv^2$$

$$\Delta E_{grav} = mg\Delta h$$

Power

$$P = \frac{E}{t}$$

$$P = \frac{W}{t}$$

Efficiency

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

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

Materials

Density $\rho = \frac{m}{V}$

Stokes' law $F = 6\pi\eta rv$

Hooke's law $\Delta F = k\Delta x$

Elastic strain energy $\Delta E_{el} = \frac{1}{2}F\Delta x$

Young modulus $E = \frac{\sigma}{\varepsilon}$ where

Stress $\sigma = \frac{F}{A}$

Strain $\varepsilon = \frac{\Delta x}{x}$

Unit 2

Waves

Wave speed $v = f\lambda$

Speed of a transverse wave on a string $v = \sqrt{\frac{T}{\mu}}$

Intensity of radiation $I = \frac{P}{A}$

Refractive index $n_1 \sin\theta_1 = n_2 \sin\theta_2$

$n = \frac{c}{v}$

Critical angle $\sin C = \frac{1}{n}$

Diffraction grating $n\lambda = d\sin\theta$

Electricity

Potential difference $V = \frac{W}{Q}$

Resistance $R = \frac{V}{I}$

Electrical power, energy $P = VI$

$P = I^2R$

$P = \frac{V^2}{R}$

$W = VIt$

Resistivity $R = \frac{\rho l}{A}$

Current $I = \frac{\Delta Q}{\Delta t}$

$I = nqvA$

Resistors in series $R = R_1 + R_2 + R_3$

Resistors in parallel $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

Particle nature of light

Photon model $E = hf$

Einstein's photoelectric equation $hf = \phi + \frac{1}{2}mv^2_{max}$

de Broglie wavelength $\lambda = \frac{h}{p}$

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