Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Friday 17 October 2025

Afternoon (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.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **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 ▶

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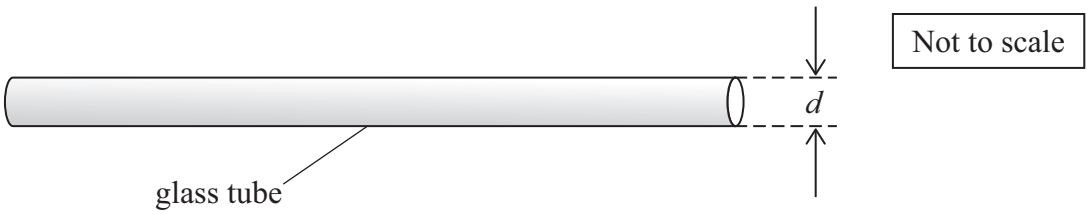
Pearson

Answer ALL questions.

1 A student used a micrometer screw gauge to measure the diameter d of the glass tube shown.



(a) The walls of the glass tube are very thin.

Identify a health and safety issue associated with this measurement and how it may be dealt with.

(2)

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(b) The student made measurements to determine a mean value for d.

He measured d at different orientations along the glass tube.

Explain another technique he should use to reduce error when measuring d with a micrometer screw gauge.

(2)

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(c) The student recorded the following measurements.

d / mm	3.19	3.22	3.19	3.21	3.20

(i) Calculate the mean value of d.

(2)

Mean value of d = ...

(ii) Determine the percentage uncertainty in the mean value of d.

(2)

Percentage uncertainty = ...

(Total for Question 1 = 8 marks)

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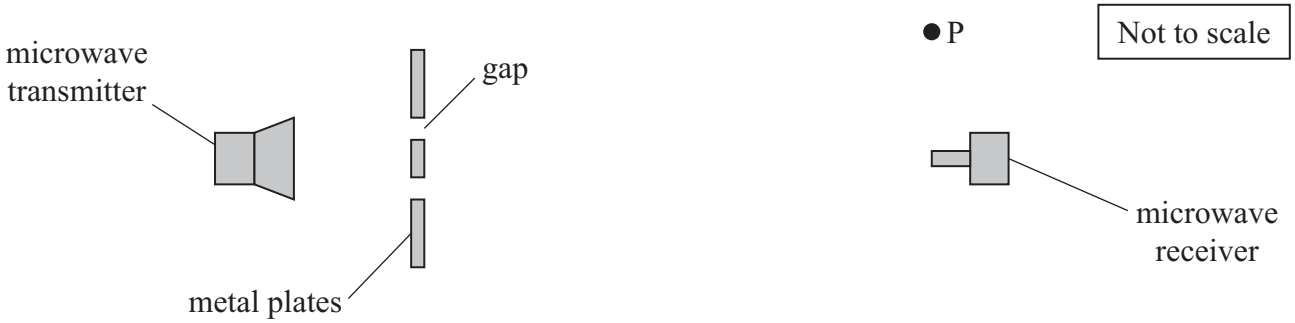
2 A student investigated the diffraction of microwaves using the apparatus shown.



The student placed the microwave receiver opposite the centre of the middle metal plate.

(a) The student moved the microwave receiver towards point P. The microwave receiver detected a series of maximum and minimum values of intensity.

(i) Explain why there are positions of minimum intensity.

(2)

(ii) The student located the first position where the intensity was a minimum.

The student used vernier calipers to measure the distance x from the initial position to the position of this minimum.

Identify two possible sources of uncertainty in the measurement of x.

(2)

(b) The student suggested that the wavelength λ of the microwaves is given by

$$\lambda = \frac{2xd}{D}$$

where
d is the distance between the centres of the gaps in the metal plates
D is the perpendicular distance between the metal plates and the initial position of the receiver.

(i) Calculate the frequency f of the microwaves.

$x = 17.84\,\text{cm}$
$d = 4.09\,\text{cm}$
$D = 0.502\,\text{m}$

(3)

$f =$ .....

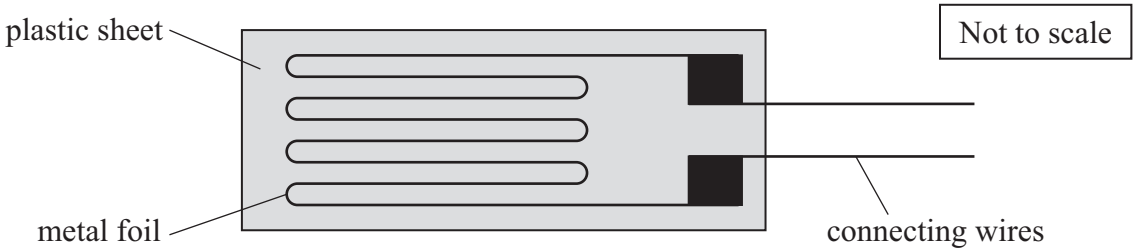
(ii) The student increased the value of D.

Explain how increasing D reduces the percentage uncertainty in x.

(2)

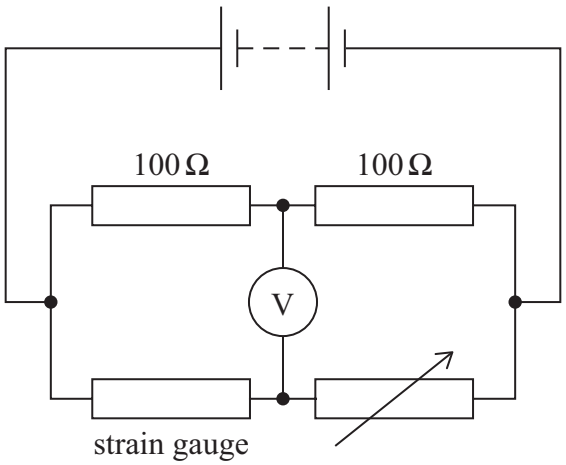
(Total for Question 2 = 9 marks)

3 A strain gauge is a sensor made from metal foil fixed to a plastic sheet, as shown.

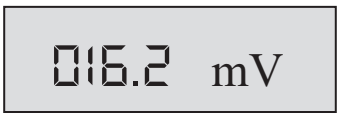


Bending the plastic sheet changes the dimensions of the metal foil.
This changes the resistance of the metal foil.

A student connected the strain gauge into the circuit shown below.



(a) The student switched on the power supply and the voltmeter displayed the following reading.



Determine the percentage uncertainty in this reading.

(2)

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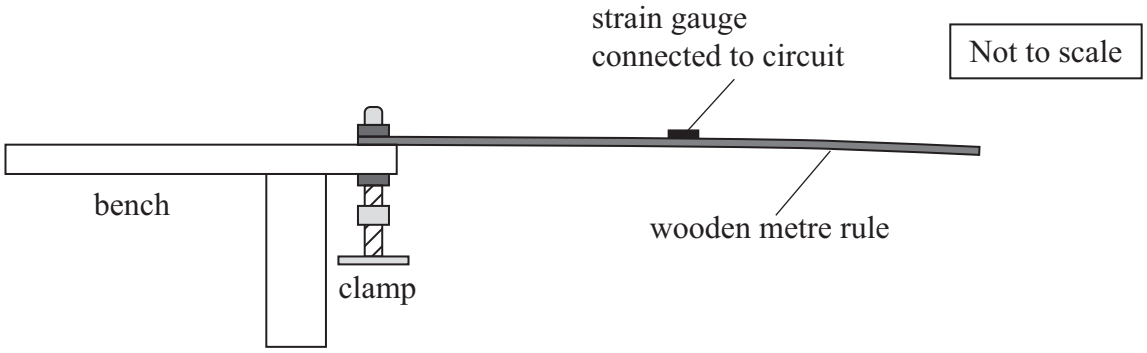
Percentage uncertainty = ...

(b) The student adjusted the variable resistor in the circuit so that the reading on the voltmeter was 0.0 mV.

He attached the strain gauge to a wooden metre rule. He clamped the metre rule to hang over the edge of a bench, as shown.



(i) The reading on the voltmeter increased. The student adjusted the variable resistor again so that the reading on the voltmeter was 0.0 mV.

Explain the reason for this adjustment.

(2)

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(ii) The student attached a 500 g mass to the metre rule at a distance L from the centre of the strain gauge.

The strain ε can be calculated using the formula

$$\varepsilon = \frac{6WL}{Ebt^2}$$

where
W is the weight of the 500 g mass
E is the Young modulus of the wood
b is the width of the metre rule
t is the thickness of the metre rule.

Show that ε is about 1.5×10^{-3}

$E = 11.9\,\text{GPa}$
$L = 0.513\,\text{m}$
$b = 25.3\,\text{mm}$
$t = 5.8\,\text{mm}$

(3)

(iii) The student added more masses to the metre rule.

For each mass he recorded the reading V on the voltmeter and determined the corresponding value of ε.

The student recorded the following data to plot a graph of ε against V.

Mass / g	ε	**V / mV**
500	1.5×10^{-3}	520
750	2.24×10^{-3}	372
1000	3×10^{-3}	494

Criticise the recording of the data.

(3)

(c) Engineers use strain gauges to monitor the forces exerted on aeroplane wings.

Suggest two reasons why engineers need to monitor these forces.

(2)

(Total for Question 3 = 12 marks)

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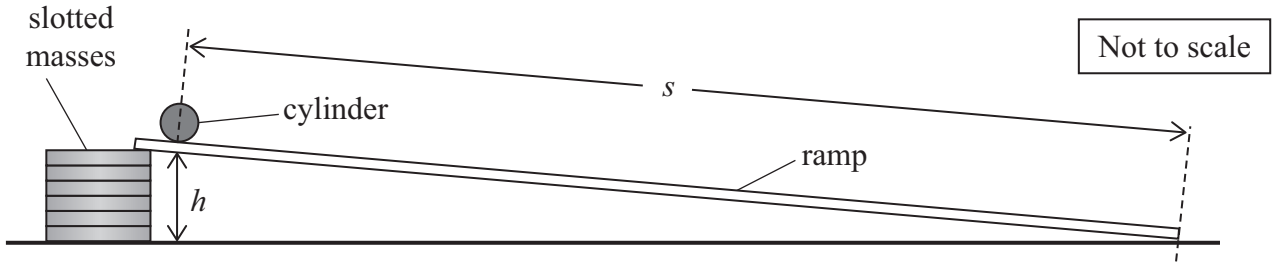
4 A student determined a value for the acceleration of freefall g using the apparatus shown.



(a) The student released the cylinder at a distance s from the bottom edge of the ramp.

She measured the time t for the cylinder to travel the distance s.

(i) Describe an accurate method to determine t using a stopwatch.

(3)

(ii) The student suggested that adding a light gate near the top of the ramp and a light gate near the bottom of the ramp would improve the measurement of t.

Describe advantages and disadvantages of using light gates to measure t.

(3)

(b) In this investigation, the relationship between t and h is given by

$$\frac{1}{t^2} = \left(\frac{g}{3s^2}\right)h - R$$

where R is a constant.

(i) Explain how a graph of $\frac{1}{t^2}$ against h can be used to determine the value of g.

(2)

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(ii) The student varied the number of slotted masses to adjust h.

She determined corresponding values of t and recorded the following results.

h / m	t / s	
0.066	2.15	
0.057	2.25	
0.044	2.66	
0.033	3.36	
0.022	4.71	

Complete the table with corresponding values of $\frac{1}{t^2}$

(2)

(iii) Plot a graph of $\frac{1}{t^2}$ on the y-axis against h on the x-axis on the grid opposite.

(5)

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(iv) Determine a value for g from the graph.

$s = 0.900\,\text{m}$

(4)

$g =$ .....

(v) The student determined the value of g as $9.56\,\text{m s}^{-2}$ with a percentage uncertainty of 4%.

Deduce whether the student's value of g is consistent with the accepted value.

(2)

(Total for Question 4 = 21 marks)

TOTAL FOR PAPER = 50 MARKS

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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 $F = 6\pi\eta r v$

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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