Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Monday 19 May 2025

Morning (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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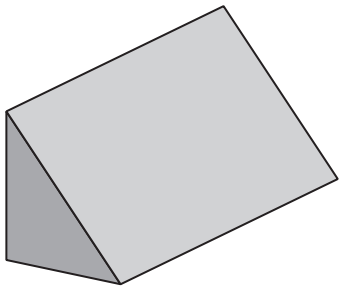
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Answer ALL questions.

1 A student made measurements on the solid metal prism shown.



(a) The student used a balance to determine the mass of the metal prism.

The reading on the balance is shown below.



(i) State the resolution of the balance.

(1)

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(ii) Determine the percentage uncertainty in this reading.

(2)

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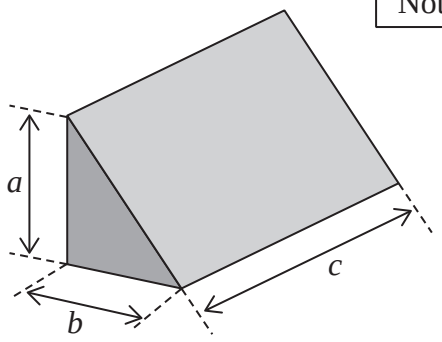
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Percentage uncertainty = ...

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(b) The student used vernier calipers to determine the lengths *a*, *b* and *c*.

Not to scale



(i) Explain one technique he should use to determine accurate values for these lengths.

(2)

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(ii) The student checked that the angle between the side of length *a* and the side of length *b* was a right angle. He did not have a set square or an instrument to measure the angle directly.

Describe how he could use one other measurement and a calculation to check this angle.

(2)

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(iii) Determine the density, in $g\,cm^{-3}$, of the metal.

a = 25.3 mm
b = 24.9 mm
c = 49.6 mm
mass of prism = 135 g

(3)

Density = ... $g\,cm^{-3}$

(iv) The percentage uncertainty in this calculated value of the density of the metal is 0.9%.

The accepted value for the density of copper is $8.94\,g\,cm^{-3}$.

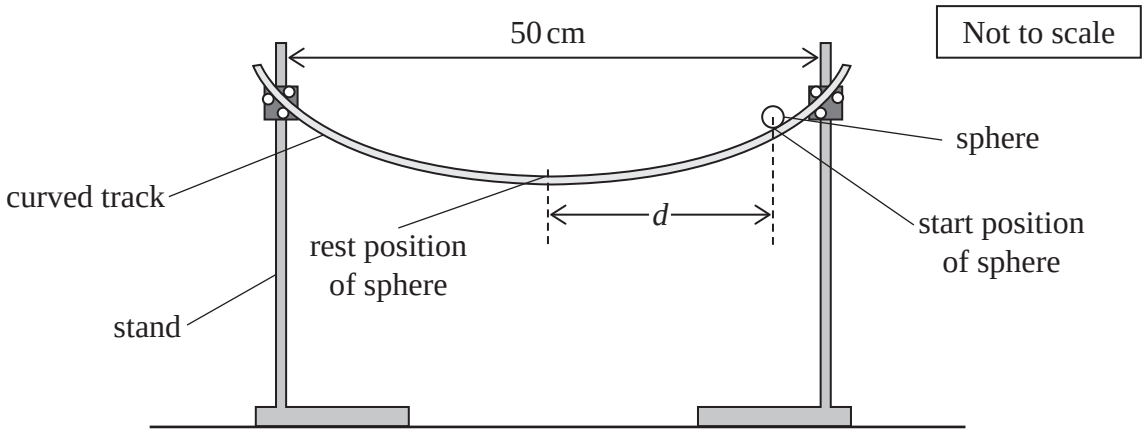
Deduce whether the prism could be made of copper.

(2)

(Total for Question 1 = 12 marks)

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2 A student investigated the motion of a small sphere on a curved track using the apparatus shown.



(a) The student marked the track at the rest position of the sphere.

The student then marked the track at the start position of the sphere.

She used a metre rule to measure the horizontal distance *d* between the two marks on the track.

Describe an accurate method to measure a single value of *d*.

(3)

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(b) The student placed the sphere at the start position on the track.

The student released the sphere. She used a stopwatch to measure the time t for the sphere to come to rest at the rest position.

The student repeated the measurement several times and recorded the following data.

t/s	5.23	5.89	5.66	5.01

(i) Determine the mean value of t.

(2)

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Mean value of t = ...

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

(2)

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Percentage uncertainty = ...

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(c) The student investigated how varying the distance *d* affected the mean time *t*.

She recorded the following data.

***d*/cm**	**Mean *t*/s**
12	3.6
14.5	5.12
17	82
19.5	12.66

The student used the data to plot a graph.

Criticise the data recorded by the student.

(3)

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(d) The student suggested using a video camera to record the motion of the sphere.

Explain how using a video recording could improve the measurement of *t*.

(2)

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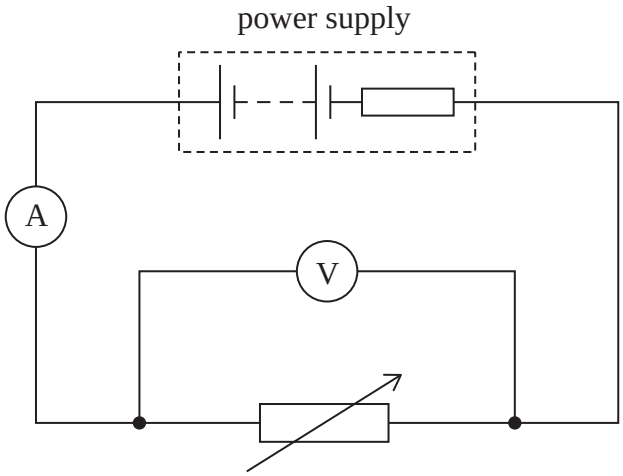
(Total for Question 2 = 12 marks)

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3 A student investigated the power output of a power supply using the circuit shown.



The power supply has an internal resistance.

(a) Before switching on the power supply, the student used an ohmmeter to check that the variable resistor was set to the maximum resistance.

He then measured corresponding values of current and potential difference for a range of resistances.

(i) Explain why starting from the maximum resistance is safer than starting from the minimum resistance.

(2)

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(ii) Explain whether repeat readings are appropriate for this investigation.

(2)

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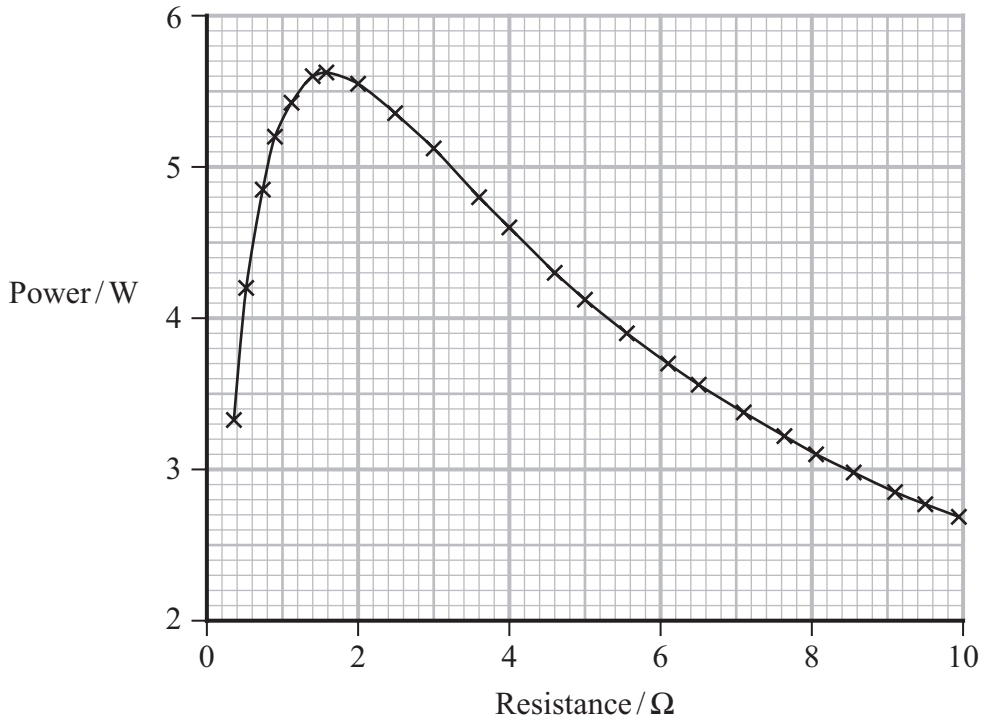
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(b) The student used his results to plot a graph of the power output of the power supply against the resistance of the variable resistor, as shown.



The power output is at its maximum value when the resistance of the variable resistor is equal to the internal resistance of the power supply.

(i) Determine the internal resistance of the power supply.

(1)

Internal resistance = ...

(ii) Determine the output potential difference of the power supply when the power output is a maximum.

(2)

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Output potential difference = ...

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(c) When the power output is at its maximum value, the overall efficiency is 50%.

Radio transmitters are used to transmit radio waves over a large area.

The aerial connected to the radio transmitter has an equivalent resistance equal to the internal resistance of the transmitter.

Suggest one advantage and one disadvantage of making the resistances equal for a radio transmitter.

(2)

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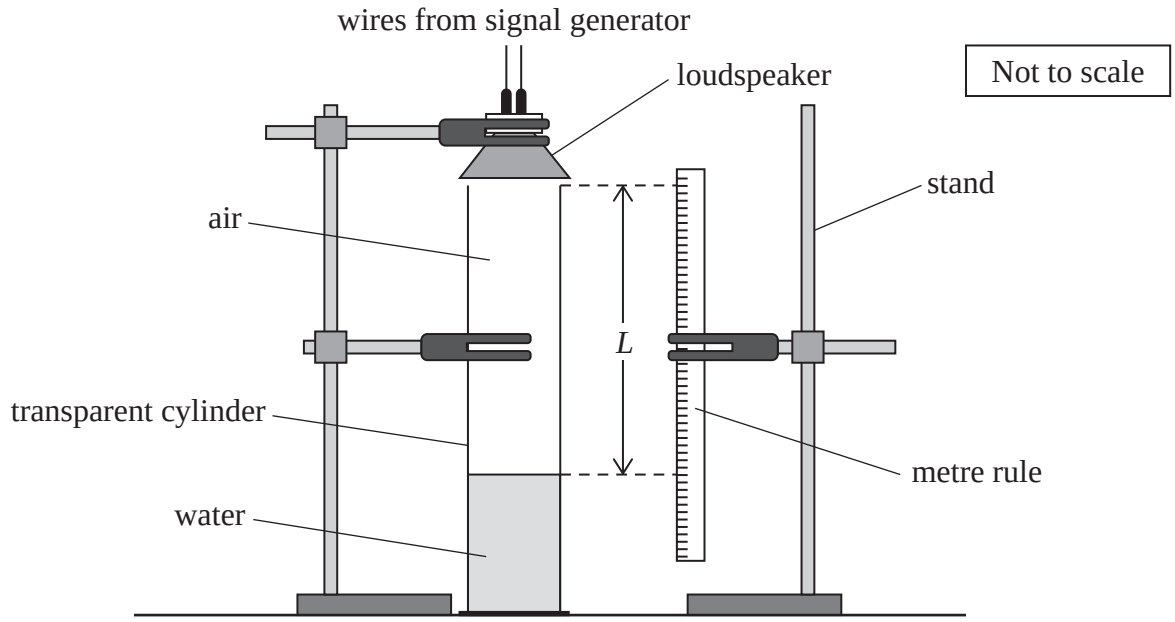
(Total for Question 3 = 9 marks)

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4 A student determined the speed of sound in air using the apparatus shown.



(a) The student used the metre rule to determine the distance L between the level of the water and the top of the transparent cylinder.

Explain how to reduce a source of uncertainty in the measurement of L.

(2)

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(b) The student connected the loudspeaker to a signal generator. She set the frequency f of the signal generator to its lowest value.

The student gradually increased f until a standing wave was produced in the transparent cylinder. The sound from the cylinder was loudest at this value of f.

Explain a technique the student could use to determine, as accurately as possible, when a standing wave is produced in the cylinder.

(2)

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(c) The student recorded the value of f for the first loud sound. She continued to increase f and recorded the next five values of f that also produced a loud sound.

She gave each of these recorded values a number n. For the lowest frequency $n = 1$ and for the highest frequency $n = 6$.

The student suggested that the relationship between f and n is given by the formula

$$f = \left(\frac{v}{2L}\right)n + k$$

where
v is the speed of sound in air
k is a constant.

(i) Explain how a graph of f against n can be used to determine the value of v.

(2)

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(ii) The student recorded the following data.

n	***f* / Hz**
1	128
2	445
3	741
4	1020
5	1312
6	1608

Plot a graph of f on the y-axis against n on the x-axis on the grid opposite.

(5)

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(iii) Determine the value of v from the graph.

$L = 0.595\,\text{m}$

(4)

$v =$ .....

(iv) The student suggested that the magnitude of k is half the magnitude of the gradient.

Determine whether the student's suggestion could be correct.

(2)

(Total for Question 4 = 17 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

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

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

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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 $\Delta E_{\text{el}} = \frac{1}{2} F \Delta x$

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

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

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

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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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