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 16 January 2026

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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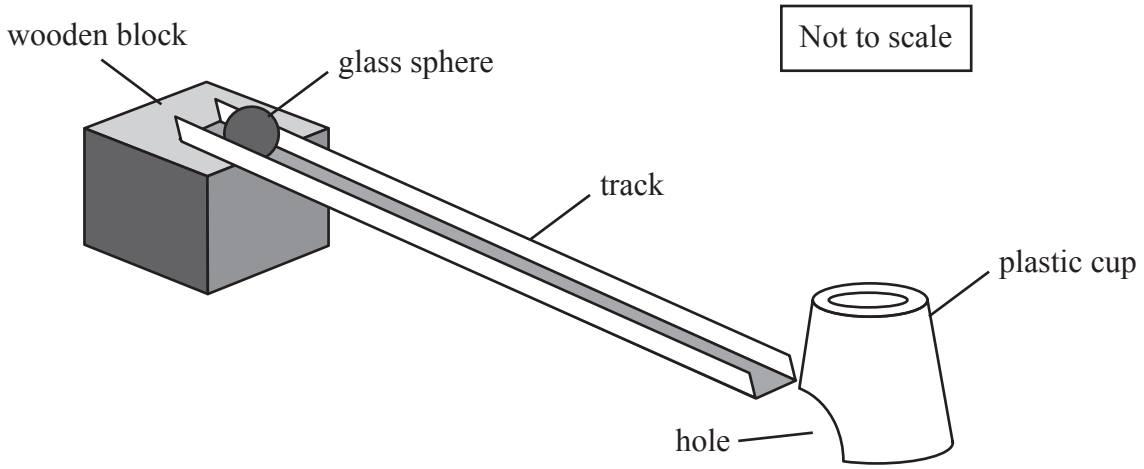
Pearson

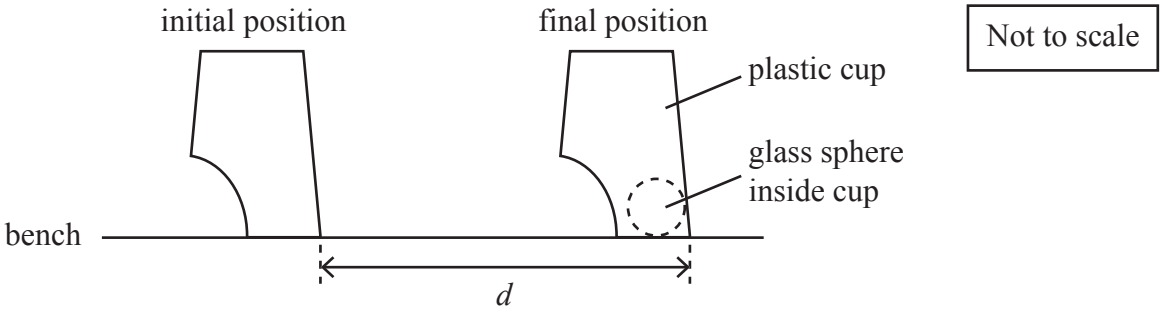
Answer ALL questions.

1 A student investigated energy transfer using the apparatus shown, set up on a bench.



The student released a glass sphere at the top of the track. The glass sphere rolled down the track, through the hole into the plastic cup.

The plastic cup moved a distance *d* across the bench, as shown.



(a) The student used vernier calipers to measure *d*. She repeated the procedure, and the corresponding measurement of *d*, several times.

(i) Describe two variables she should control when repeating the procedure.

(2)

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(ii) Explain what she should do with the vernier calipers before taking the measurement.

(2)

(b) The student investigated how adding different masses of modelling clay to the top of the plastic cup affected *d*.

She used a balance to measure the mass of pieces of modelling clay.

For each mass, she repeated the measurement of *d* to determine a mean value of *d*.

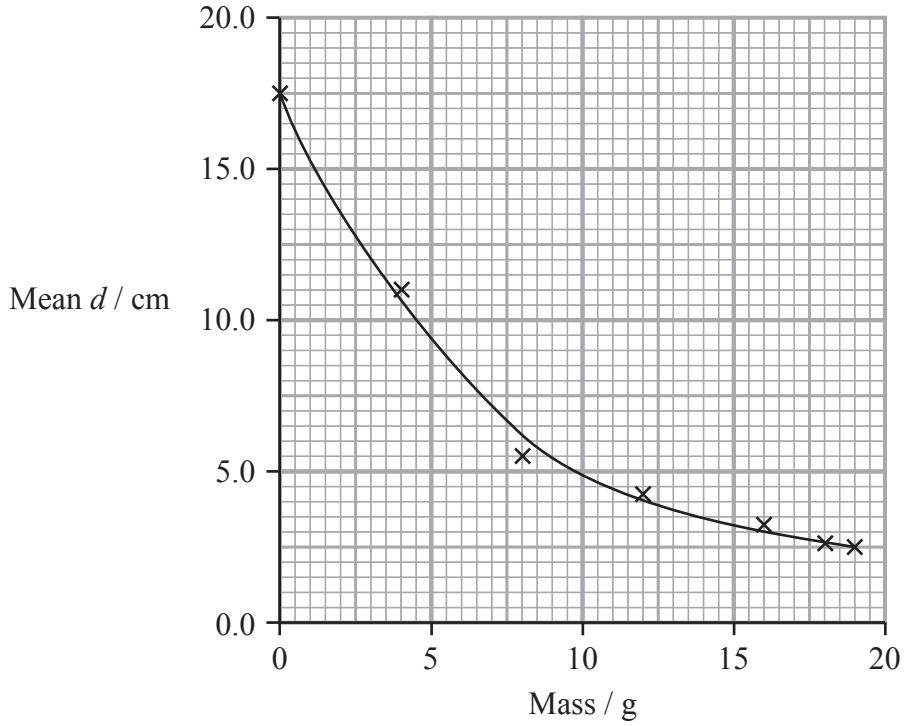
The student recorded the following data to plot a graph of the mean *d* against mass.

Mass of modelling clay / g	**Mean *d* / cm**
16.1	3
18.3	2.67
18.9	2.6

Criticise the recording of the data.

(3)

(c) Another student completed the same investigation and plotted the following graph.



The student suggested that there is an inverse relationship between the mean *d* and the mass added to the plastic cup.

Explain how the student should check if the relationship is inversely proportional.

(2)

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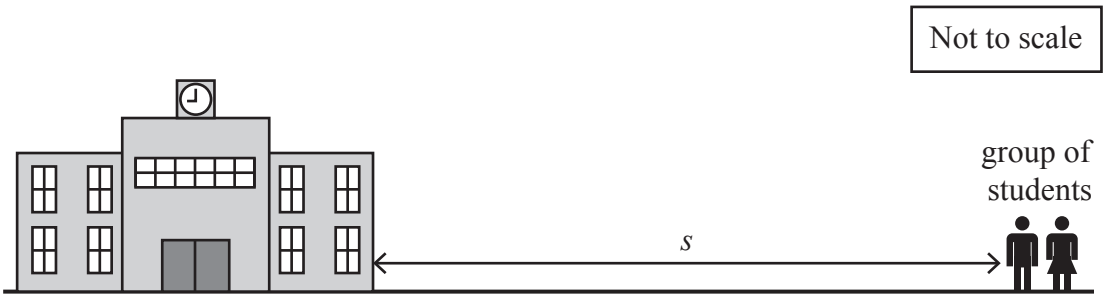
(Total for Question 1 = 9 marks)

2 A group of six students used the pulse-echo technique to determine the distance s to a building, as shown.



(a) One of the students banged two wooden blocks together to make a loud sound. The other five students each started a stopwatch when they heard the loud sound.

A short time later the students heard the echo of the sound and stopped their stopwatches.

The students recorded their measurements in a table, as shown.

Time / s	0.45	0.51	0.41	0.55	0.49

(i) Calculate the mean value of time.

(2)

Mean value of time = ...

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

(2)

Percentage uncertainty = ...

(iii) Explain a source of error in these measurements of time.

(2)

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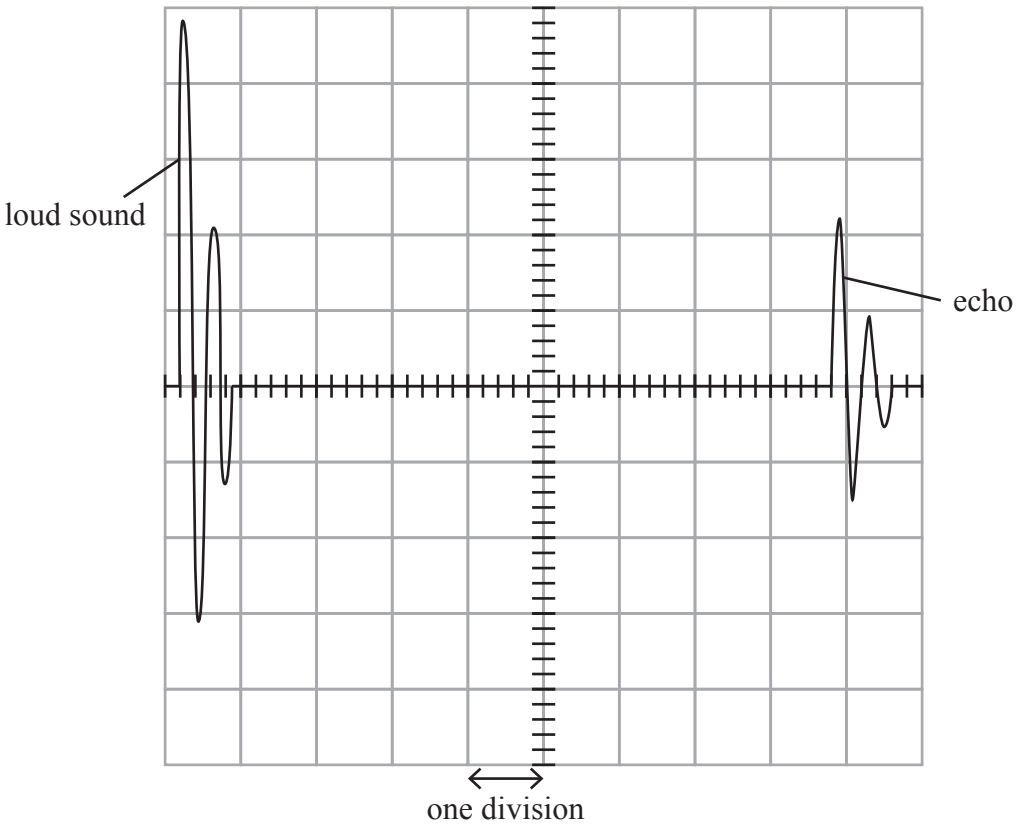
(b) Another student determined the time between the loud sound and the echo using a microphone connected to an oscilloscope.

The screen of the oscilloscope is shown.



The horizontal scale represents time.

The horizontal scale was set to 50 ms per division.

(i) Determine the time between the loud sound and the echo.

(3)

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Time = ...

(ii) State the resolution, in ms, of the horizontal scale on the oscilloscope.

(1)

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.....

(iii) Determine the percentage uncertainty in the time between the loud sound and the echo.

(2)

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Percentage uncertainty = ...

(iv) The speed of sound in air is 330 $m\,s^{-1}$.

Determine the distance s to the building, using the value of time determined from the oscilloscope.

(2)

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.....

.....

s = ...

(c) Large distances, such as the distance *s* to the building, can be measured using a laser distance meter.

A laser distance meter uses the pulse-echo technique with pulses of laser light.

State two advantages of using laser light instead of sound to determine this distance.

(2)

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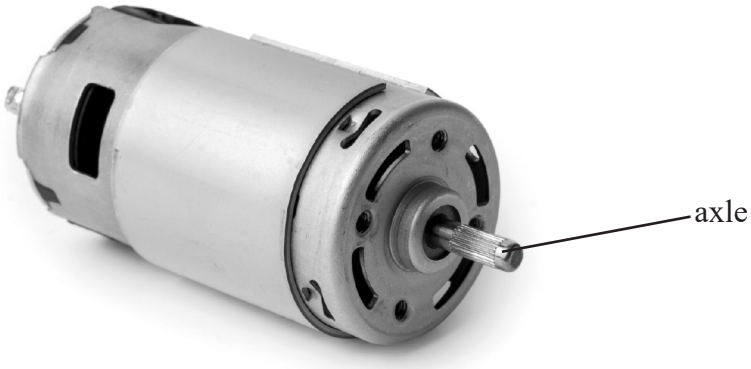
(Total for Question 2 = 16 marks)

3 A student investigated the efficiency of the small 9 V d.c. electric motor shown in the photograph. The axle turns when the motor is connected to a power supply.

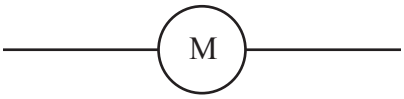


(Source: © Pushy zver/Shutterstock)

(a) The student determined the electrical power input to the electric motor.

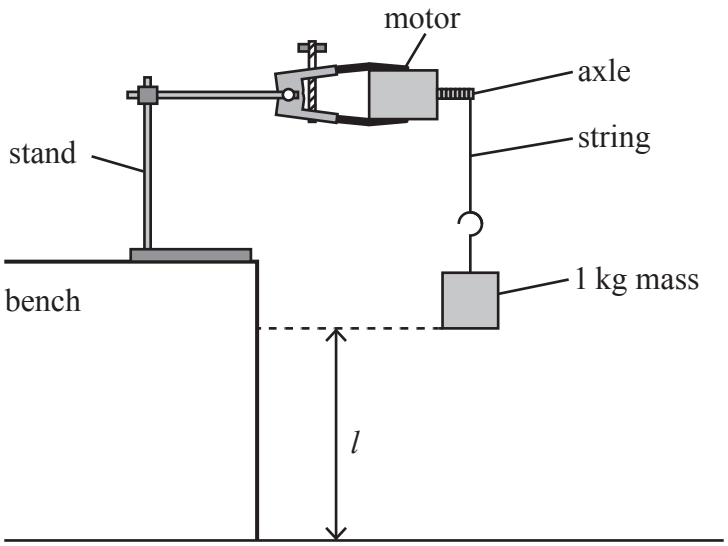
Complete the circuit diagram to show the circuit the student should use.

(2)



(b) The student set up the apparatus shown. A 1kg mass was suspended from the axle using string.

The student connected the motor to the circuit. The student switched on the motor for a short time. During this time the motor raised the 1kg mass through a height *l*.



(i) Identify a health and safety issue and how it may be dealt with.

(2)

(ii) The student used a metre rule to measure *l*.

Describe an accurate method to determine a single value of *l* using a metre rule.

You may include additional apparatus.

(3)

(c) The student switched off the motor and returned the 1 kg mass to the floor.

The student then switched on the motor and immediately started a stopwatch. He stopped the stopwatch when the mass had moved through a height l. He recorded the time t on the stopwatch. He repeated this for different values of l.

The student plotted a graph of l on the y-axis against t on the x-axis.

The student stated that the efficiency of the motor can be determined from the graph using the formula

$$\text{efficiency} = \text{gradient} \times \frac{mg}{IV}$$

where m is the mass, I is the current through the motor and V is the potential difference across the motor.

Explain whether the student's statement is correct.

(4)

(d) The student used a distance sensor connected to a data logger to determine l and t.

Explain why using the sensor and data logger would improve the investigation.

(2)

(Total for Question 3 = 13 marks)

4 The de Broglie wavelength λ of electrons is related to their velocity v by the formula

$$\lambda = \frac{h}{mv}$$

where h is the Planck constant and m is the mass of the electron.

The table shows measured values of λ for corresponding values of $\frac{1}{v}$.

λ / 10^{-11} m	$\frac{1}{v}$ / 10^{-7} m^{-1} s
10.38	1.43
9.12	1.25
8.06	1.11
7.41	1.00
6.65	0.91
6.01	0.83

(a) Plot a graph of λ on the y-axis against $\frac{1}{v}$ on the x-axis on the grid opposite.

(5)

(b) Determine the gradient of the graph.

(3)

Gradient = ...

(c) Determine the value of h from the gradient of the graph.

(2)

$h =$ ..... $\text{kg m}^2\,\text{s}^{-1}$

(d) A student determined the value of h as $6.54 \times 10^{-34}\,\text{kg m}^2\,\text{s}^{-1}$ with an estimated percentage uncertainty of 3%.

Determine whether this value of h is consistent with the quoted value of h.

(2)

(Total for Question 4 = 12 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 $F = 6\pi\eta rv$

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

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

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

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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