

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 ►

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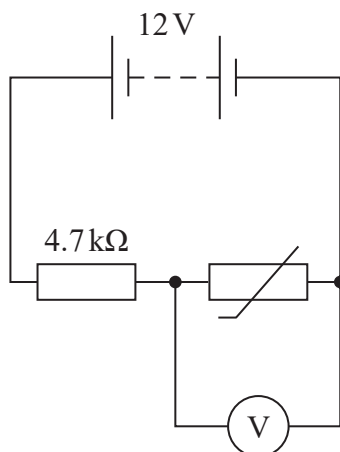
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Answer ALL questions.

- 1 A student investigated the behaviour of a thermistor using the circuit shown in the diagram.



She heated the thermistor to 100°C and measured the potential difference V across it. She decreased the temperature θ and recorded further measurements of V and θ until the temperature reached 10°C .

- (a) Describe how the student was able to vary the temperature θ of the thermistor for this investigation.

(2)

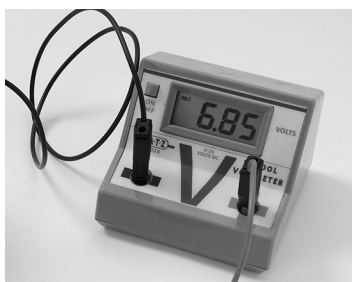
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- (b) The photograph shows the steady reading of V on the voltmeter when the thermistor was at room temperature.



(Source: PAL)

Calculate the percentage uncertainty in the value of V shown.

(2)

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Percentage uncertainty =

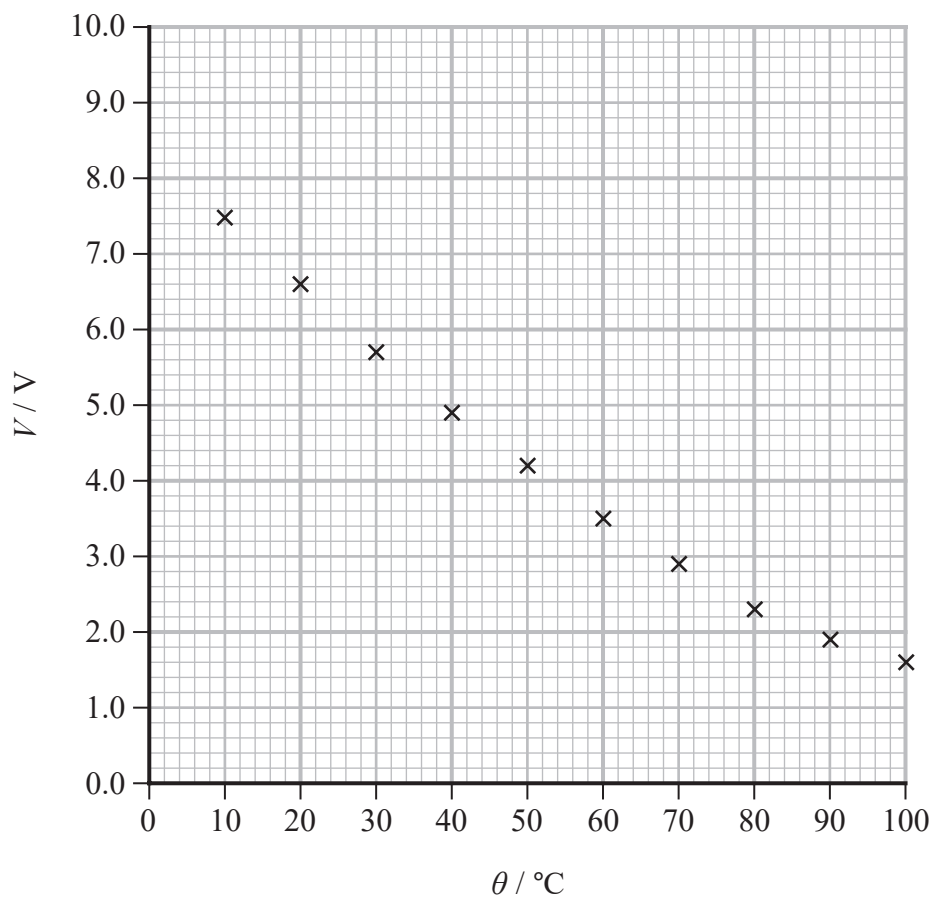


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(c) The student plotted a graph of her measurements of V and θ .



(i) Estimate the value of V for a temperature of 0°C .

(2)

(ii) Calculate the resistance of the thermistor at a temperature of 0°C .

(3)

Resistance =



- (d) The student suggested that V is inversely proportional to temperature measured in kelvin.

Determine whether she is correct.

(2)

(Total for Question 1 = 11 marks)

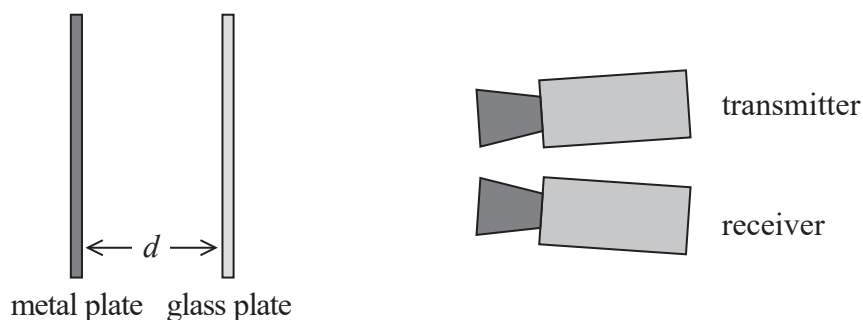
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- 2 A student investigated the reflection of microwaves from a metal plate and a glass plate. The metal plate reflects microwaves and the glass plate partially reflects microwaves. A plan view of the apparatus is shown.



The metal plate, the transmitter and the receiver were kept in fixed positions.

The value of d was varied by moving the glass plate.

- (a) As d varied, the intensity of the microwaves detected by the receiver varied.

Explain why.

(3)

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- (b) The student recorded values of d when the receiver showed a maximum value of intensity.

He recorded d for a sequence of five maxima.

Maxima	1	2	3	4	5
d / cm	9.9	11.1	12.7	13.9	15.4

- (i) Determine the wavelength of the microwaves being transmitted.

(3)

Wavelength =

- (ii) Calculate the frequency of the microwaves being transmitted.

(2)

Frequency =

(Total for Question 2 = 8 marks)

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3 A student was asked to investigate the ultimate tensile stress of a sample of thin nylon fishing line.

(a) Describe a method to determine the maximum force the nylon fishing line can withstand before breaking.

(4)

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(b) Identify one safety issue with this investigation and how it may be dealt with.

(2)



- (c) Before testing, the student measured the diameter at five points along the sample of nylon fishing line.

0.55 mm

0.57 mm

0.54 mm

0.55 mm

0.53 mm

- (i) Calculate the percentage uncertainty in the mean diameter of the nylon fishing line.

(3)

Percentage uncertainty =



- (ii) The student read an article that suggested nylon fishing line can absorb water.

The article suggested that the ultimate tensile stress of nylon decreases by 10% after absorbing water.

She repeated her experiment, using new samples of fishing line before and after they absorbed water.

Sample	Maximum force / N	Diameter / mm
Before	65.8	0.45
After	57.8	0.46

Evaluate whether her results support the suggestion in the article.

(5)

(Total for Question 3 = 14 marks)

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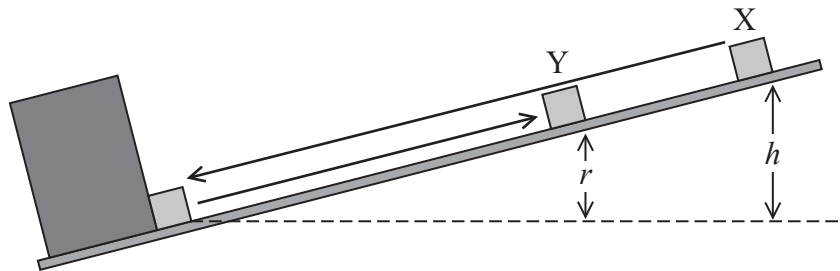
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- 4 A student slid a small metal cube down a frictionless ramp. The cube collided with a fixed metal block at the bottom of the ramp.

The student released the cube from position X as shown in the diagram. After the collision, the cube rebounded to position Y.



The student measured heights h and r . He then repeated the experiment using several different starting positions.

- (a) The student recorded his results in the table below.

h / m	r / m
0.20	0.11
0.25	0.137
0.30	0.16
0.35	0.19
0.40	0.217
0.45	0.24

- (i) Criticise these results.

(2)

- (ii) Plot a graph of r on the y -axis and h on the x -axis.

(5)

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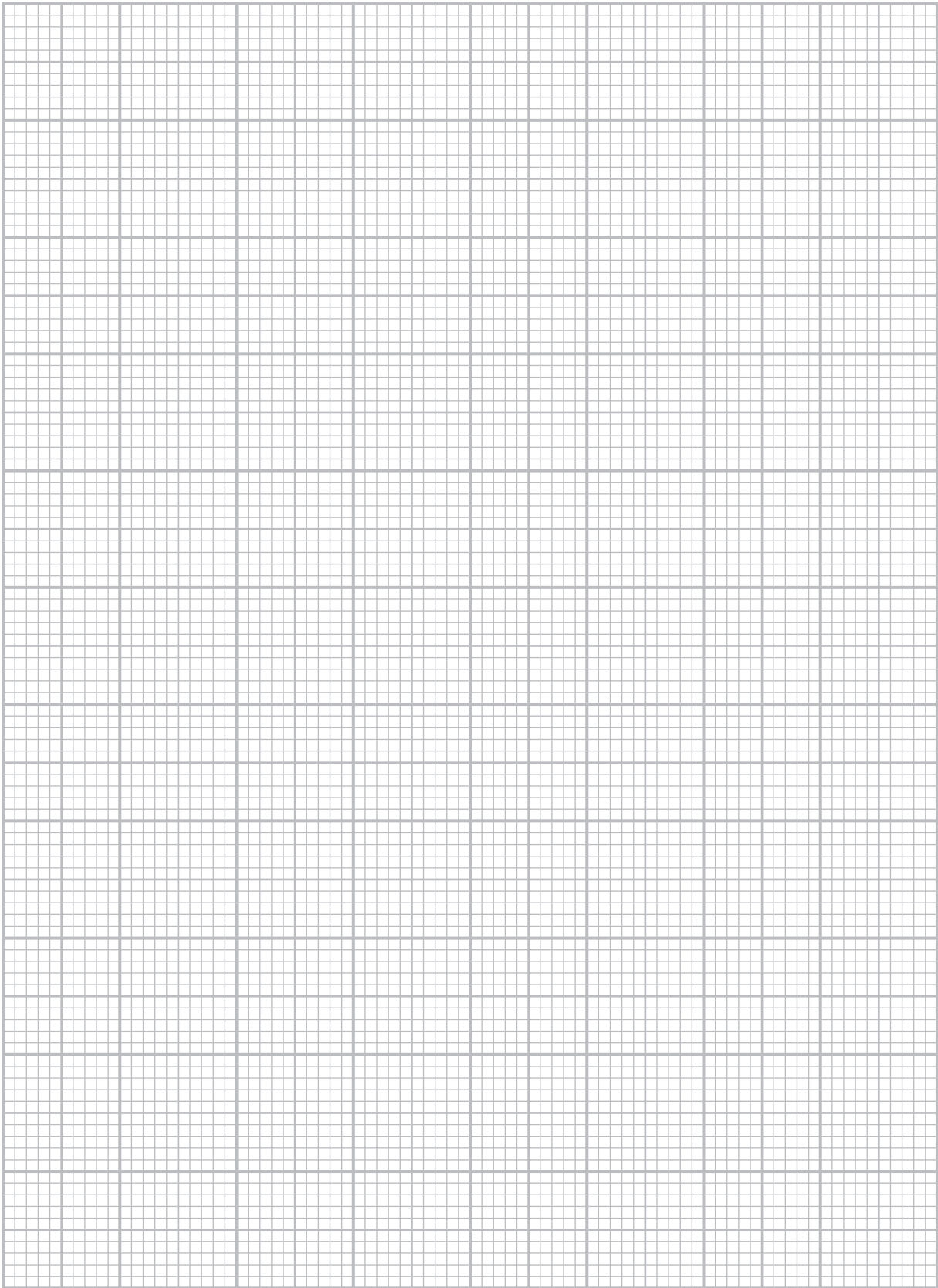
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- (b) (i) Show that the velocity u of the cube immediately before the collision is given by

$$u = \sqrt{2gh} \quad (2)$$

- (ii) The coefficient of restitution e is given by the equation

$$e = \frac{v}{u}$$

where v is the velocity of the cube immediately after the collision.

Explain why the gradient of the graph is e^2 .

(3)

- (c) The student researched the range of values for the coefficients of restitution e of different metals.

stainless steel	$0.63 < e < 0.93$
cast iron	$0.3 < e < 0.6$

Determine which of these metals the cube could be made from.

(3)



- (d) Explain how friction between the cube and the surface of the ramp would affect the value obtained for e .

(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)
Boltzmann constant	$k = 1.38 \times 10^{-23} \text{ J K}^{-1}$	
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 constant	$G = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$	
Gravitational field strength	$g = 9.81 \text{ N kg}^{-1}$	(close to Earth's surface)
Permittivity of free space	$\epsilon_0 = 8.85 \times 10^{-12} \text{ F m}^{-1}$	
Coulomb's law constant	$k = 1/4\pi\epsilon_0$ $= 8.99 \times 10^9 \text{ N m}^2 \text{ C}^{-2}$	
Planck constant	$h = 6.63 \times 10^{-34} \text{ J s}$	
Proton mass	$m_p = 1.67 \times 10^{-27} \text{ kg}$	
Speed of light in a vacuum	$c = 3.00 \times 10^8 \text{ m s}^{-1}$	
Stefan-Boltzmann constant	$\sigma = 5.67 \times 10^{-8} \text{ W m}^{-2} \text{ K}^{-4}$	
Unified atomic mass unit	$u = 1.66 \times 10^{-27} \text{ kg}$	

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

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

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

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

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

$$F = 6\pi\eta rv$$

Hooke's law

$$\Delta F = k\Delta x$$

Elastic strain energy

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

Young modulus

$$E = \frac{\sigma}{\varepsilon} \text{ where}$$

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

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



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

$$P = VI$$

$$P = I^2 R$$

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

$$W = VIt$$

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

$$hf = \phi + \frac{1}{2}mv_{\max}^2$$

de Broglie wavelength

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

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