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

P67156A

E:1/1/1/1/

P 6 7 1 5 6 A 0 1 2 0

Pearson

DO NOT WRITE IN THIS AREA

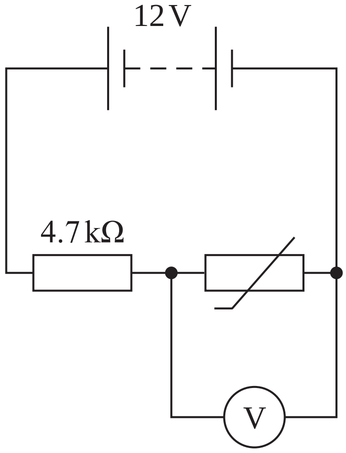
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

BLANK PAGE

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)

....

....

....

....

(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.

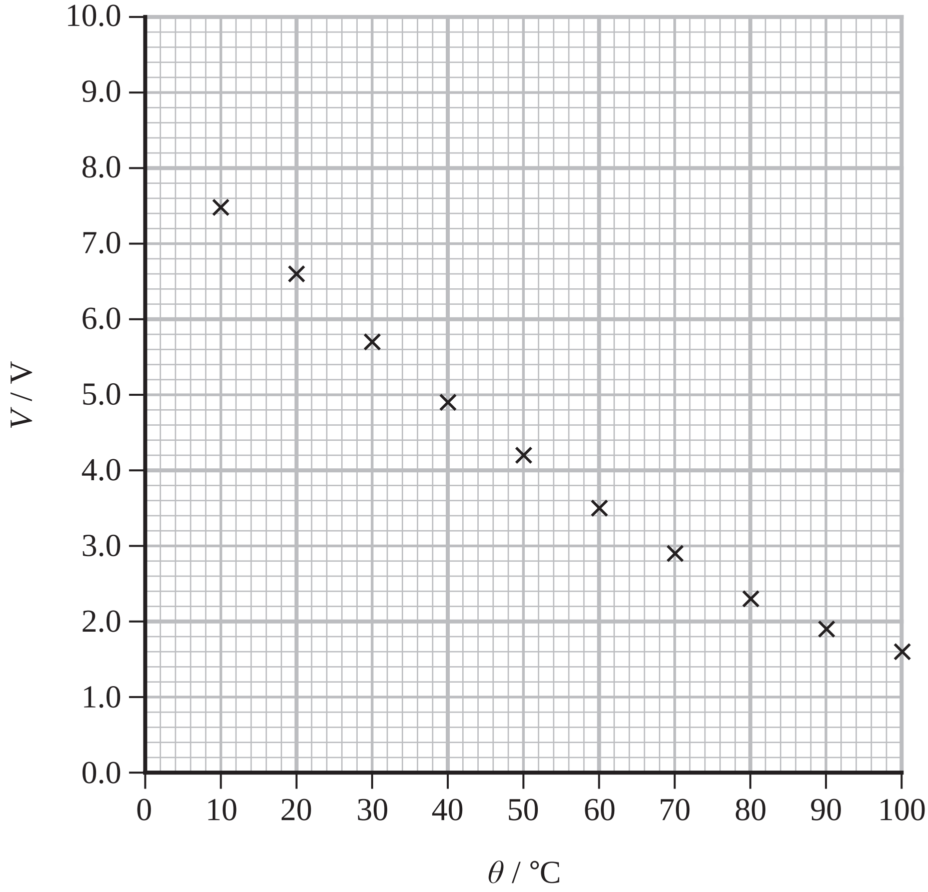
(2)

....

....

Percentage uncertainty = ...

(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)

....

....

....

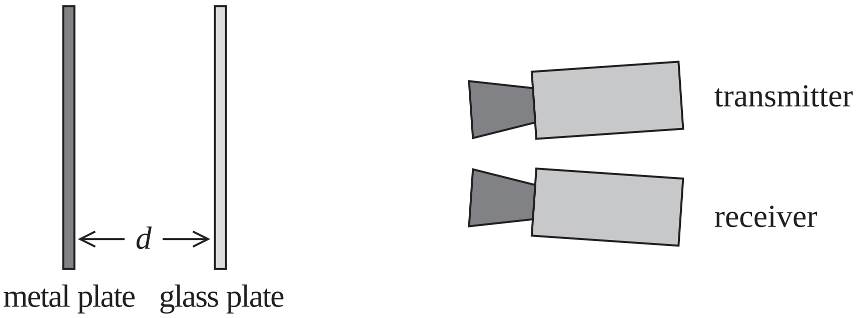
....

(Total for Question 1 = 11 marks)

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)

....

....

....

....

....

....

(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)

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)

....

....

....

....

....

....

....

....

(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)

....

....

....

....

....

....

....

....

....

....

....

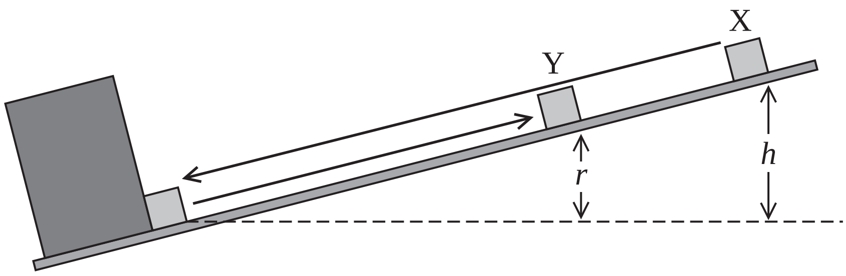
....

(Total for Question 3 = 14 marks)

BLANK PAGE

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)

P 6 7 1 5 6 A 0 1 2 2 0

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

$$u = \sqrt{2gh}$$

(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

P 6 7 1 5 6 A 0 1 5 2 0

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	$\varepsilon_0 = 8.85 \times 10^{-12} \text{ F m}^{-1}$	
Coulomb's law constant	$k = 1/4\pi\varepsilon_0$	
	$= 8.99 \times 10^9 \text{ N m}^2 \text{ C}^{-2}$	
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

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

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

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

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

BLANK PAGE

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

BLANK PAGE