

# Pearson Edexcel International Advanced Level

**Tuesday 20 January 2026**

Afternoon (Time: 1 hour 20 minutes)

Paper  
reference

**WPH16/01A**

## **Physics**

**International Advanced Level**

**UNIT 6: Practical Skills in Physics II**

**Question Paper**

### **You must have:**

Scientific calculator, ruler, answer book (sent separately).

Do not return this question paper with the answer book.

### **Information**

- The list of data, formulae and relationships is printed at the end of this booklet.

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**Pearson**

**Answer ALL questions.**

- 1** In an electrical circuit, as the frequency  $f$  of a signal generator is varied, the potential difference  $V$  across a component also varies. This causes an electrical resonance effect which is similar to mechanical resonance.

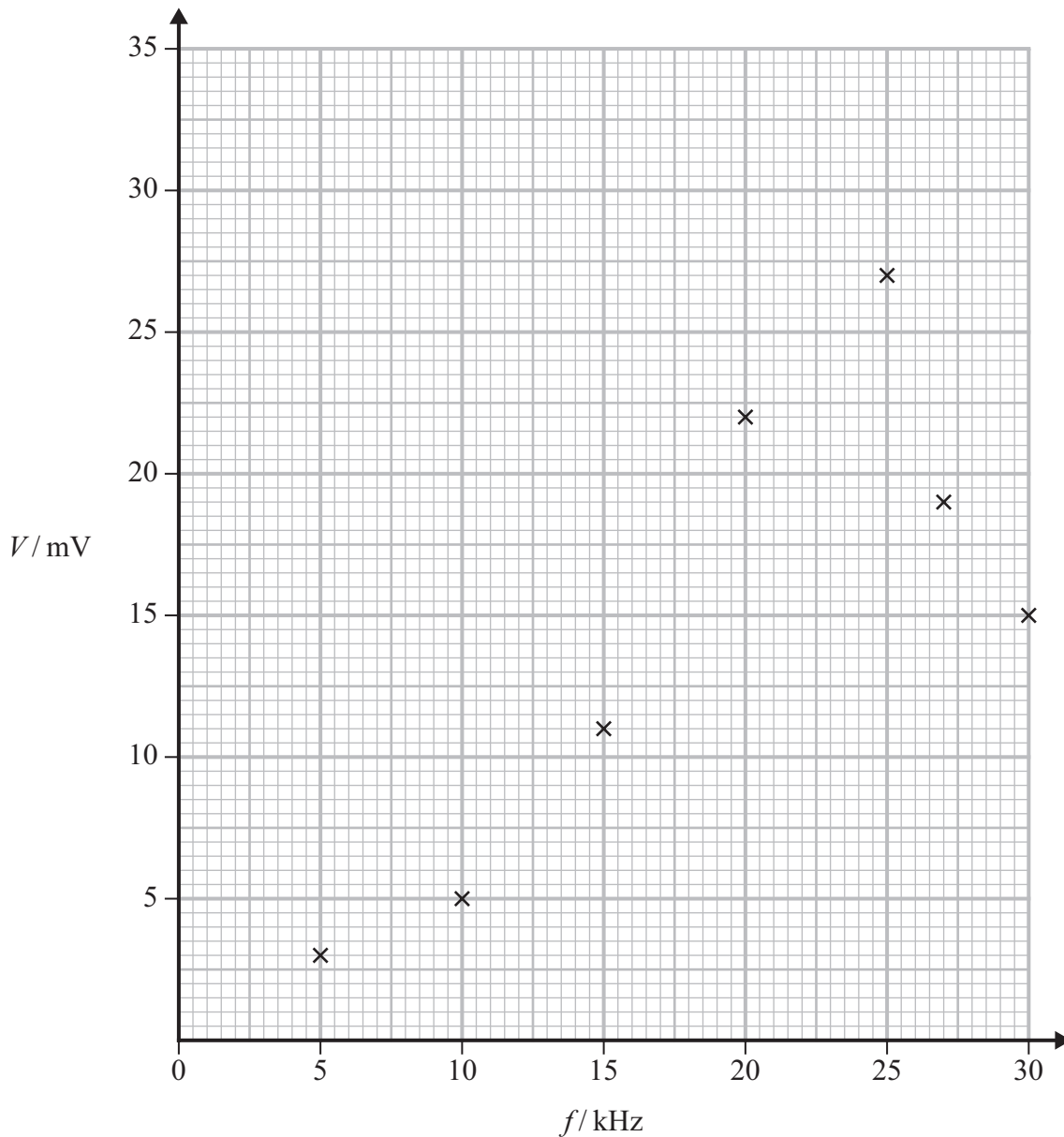
The magnitude of  $V$  is a maximum at the resonant frequency.

In an experiment using a particular circuit the following measurements were recorded.

$f / \text{kHz}$	$V / \text{mV}$
5	3
10	5
15	11
20	22
25	27
27	19
30	15



(a) A graph of  $V$  against  $f$  was plotted.



(i) In the answer book draw a line of best fit on the graph.

(2)

(ii) Estimate the maximum value of  $V$ .

(1)

(iii) State the value of the resonant frequency.

(1)

(b) Suggest one way in which the experiment could be improved to obtain a more accurate value of the resonant frequency.

(1)

(Total for Question 1 = 5 marks)



2 Two identical capacitors were connected in series and charged. They were then discharged through a resistor and ammeter.

A student investigated how the current in the resistor varied as the capacitors discharged.

(a) Draw in the answer book an appropriate circuit diagram for this investigation. (3)

(b) State one safety precaution the student should take. (1)

(c) The student had a stopwatch.  
Describe how the student should determine an accurate value for the total capacitance of the capacitors. (6)

(d) The student repeated the investigation but used a data logger instead of a stopwatch and an ammeter.  
Suggest why using a data logger would improve this investigation. (2)

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**(Total for Question 2 = 12 marks)**



3 Atoms of an element emit characteristic spectral lines when they are bombarded with a beam of high energy electrons. The spectral lines can be used to identify the element.

(a) The relationship between the atomic number  $Z$  and the frequency  $f$  of the most intense spectral line is given by

$$Z = kf^n$$

Where  $k$  and  $n$  are constants.

Explain why a graph of  $\log Z$  against  $\log f$  would give a straight line.

(2)

(b) The table shows the frequency of the most intense spectral line for a range of elements.

Element	$Z$	$f / 10^{15} \text{ Hz}$
Li	3	0.16
C	6	0.69
Si	14	4.19
Mn	25	13.82
Sr	38	33.98
Hg	80	154.64

(i) Plot a graph of  $\log Z$  against  $\log f$  on the grid in the answer book. Use the blank space in the answer book for your processed data.

You should **not** convert the values of  $f$  from  $10^{15} \text{ Hz}$  to Hz.

(6)

(ii) Determine the value of  $n$ .

(3)

(iii) Determine the value of  $k$  using your graph.

(3)

(c) A scientist named Henry Moseley suggested that  $Z \propto f^{0.5}$

Explain whether the graph supports this suggestion.

(2)

(Total for Question 3 = 16 marks)



4 A student measured a metal ring of the type shown below.



(a) The student measured the diameter  $d$  of the hole in the centre of the metal ring with a set of digital calipers.

(i) Explain one technique she should use to reduce the uncertainty in the measurement of  $d$ .

(2)

(ii) She recorded the following measurements.

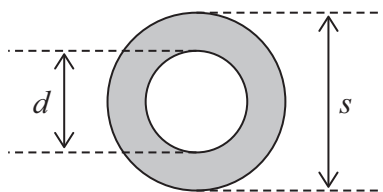
$d / \text{mm}$	8.53	8.56	8.55	8.53
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Determine the mean value of  $d$  and its uncertainty.

(3)



- (b) The student was given a metal ring of a different size. She measured the distances shown.



She calculated the shaded area of the metal ring using the formula

$$A = \frac{\pi}{4} (s^2 - d^2)$$

- (i) Show that the uncertainty in  $d^2$  is about  $1 \text{ mm}^2$

$$d = 10.70 \text{ mm} \pm 0.06 \text{ mm}$$

(3)

- (ii) Show that the percentage uncertainty in  $A$  is about 0.4%

$$s^2 = 881 \text{ mm}^2 \pm 2 \text{ mm}^2$$

(4)

- (c) The student placed 10 identical steel rings on top of one another in a stack. She measured the total thickness  $x_{10}$  and the total mass  $m_{10}$  of the stack of 10 metal rings.

- (i) Determine the mean density  $\rho$ , in  $\text{g cm}^{-3}$ , of the metal the ring is made from.

$$m_{10} = 63.0 \text{ g} \pm 0.5 \text{ g}$$

$$x_{10} = 14.03 \text{ mm} \pm 0.04 \text{ mm}$$

$$A = 602 \text{ mm}^2 \pm 0.4\%$$

(2)

- (ii) The density of stainless steel ranges from  $7.48 \text{ g cm}^{-3}$  to  $7.95 \text{ g cm}^{-3}$ . Deduce whether the metal rings could be made from stainless steel.

(3)

(Total for Question 4 = 17 marks)

**TOTAL FOR PAPER = 50 MARKS**

### List of data, formulae and relationships

Acceleration of free fall	$g = 9.81 \text{ m s}^{-2}$	(close to Earth's surface)
Boltzmann constant	$k = 1.38 \times 10^{-23} \text{ J K}^{-1}$	
Coulomb's law constant	$k = 1/4\pi\epsilon_0$ $= 8.99 \times 10^9 \text{ N m}^2 \text{ C}^{-2}$	
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	$\epsilon_0 = 8.85 \times 10^{-12} \text{ F m}^{-1}$	
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	$p = mv$
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Moment of force	moment = $Fx$
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Work and energy	$\Delta W = F\Delta s$
	$E_k = \frac{1}{2}mv^2$

Power	$\Delta E_{\text{grav}} = mg\Delta h$
	$P = \frac{E}{t}$
	$P = \frac{W}{t}$



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

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

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	$P = VI$ $P = I^2R$ $P = \frac{V^2}{R}$ $W = VI t$
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	$\lambda = \frac{h}{p}$



## Unit 4

### Further mechanics

Impulse

$$F\Delta t = \Delta p$$

Kinetic energy of a non-relativistic particle

$$E_k = \frac{p^2}{2m}$$

Motion in a circle

$$v = \omega r$$

$$T = \frac{2\pi}{\omega}$$

$$a = \frac{v^2}{r}$$

$$a = r\omega^2$$

Centripetal force

$$F = ma = \frac{mv^2}{r}$$

$$F = mr\omega^2$$

### Electric and magnetic fields

Electric field

$$E = \frac{F}{Q}$$

Coulomb's law

$$F = \frac{Q_1 Q_2}{4\pi\epsilon_0 r^2}$$

$$E = \frac{Q}{4\pi\epsilon_0 r^2}$$

$$E = \frac{V}{d}$$

Electrical potential

$$V = \frac{Q}{4\pi\epsilon_0 r}$$

Capacitance

$$C = \frac{Q}{V}$$

Energy stored in capacitor

$$W = \frac{1}{2} QV$$

$$W = \frac{1}{2} CV^2$$

$$W = \frac{1}{2} \frac{Q^2}{C}$$

Capacitor discharge

$$Q = Q_0 e^{-t/RC}$$



Resistor-capacitor discharge

$$I = I_0 e^{-t/RC}$$

$$V = V_0 e^{-t/RC}$$

$$\ln Q = \ln Q_0 - \frac{t}{RC}$$

$$\ln I = \ln I_0 - \frac{t}{RC}$$

$$\ln V = \ln V_0 - \frac{t}{RC}$$

In a magnetic field

$$F = Bqv \sin \theta$$

$$F = BIl \sin \theta$$

Faraday's and Lenz's laws

$$\mathcal{E} = \frac{-d(N\phi)}{dt}$$

*Nuclear and particle physics*

In a magnetic field

$$r = \frac{p}{BQ}$$

Mass-energy

$$\Delta E = c^2 \Delta m$$



## Unit 5

### Thermodynamics

Heating  $\Delta E = mc\Delta\theta$

$$\Delta E = L\Delta m$$

Ideal gas equation  $pV = NkT$

Molecular kinetic theory  $\frac{1}{2}m\langle c^2 \rangle = \frac{3}{2}kT$

### Nuclear decay

Mass-energy  $\Delta E = c^2\Delta m$

Radioactive decay  $A = \lambda N$

$$\frac{dN}{dt} = -\lambda N$$

$$\lambda = \frac{\ln 2}{t_{1/2}}$$

$$N = N_0 e^{-\lambda t}$$

$$A = A_0 e^{-\lambda t}$$

### Oscillations

Simple harmonic motion  $F = -kx$

$$a = -\omega^2 x$$

$$x = A \cos \omega t$$

$$v = -A\omega \sin \omega t$$

$$a = -A\omega^2 \cos \omega t$$

$$T = \frac{1}{f} = \frac{2\pi}{\omega}$$

$$\omega = 2\pi f$$

Simple harmonic oscillator  $T = 2\pi\sqrt{\frac{m}{k}}$

$$T = 2\pi\sqrt{\frac{l}{g}}$$



*Astrophysics and cosmology*

Gravitational field strength  $g = \frac{F}{m}$

Gravitational force  $F = \frac{Gm_1m_2}{r^2}$

Gravitational field  $g = \frac{Gm}{r^2}$

Gravitational potential  $V_{\text{grav}} = \frac{-Gm}{r}$

Stefan-Boltzmann law  $L = \sigma AT^4$

Wien's law  $\lambda_{\text{max}}T = 2.898 \times 10^{-3} \text{ mK}$

Intensity of radiation  $I = \frac{L}{4\pi d^2}$

Redshift of electromagnetic radiation  $z = \frac{\Delta\lambda}{\lambda} \approx \frac{\Delta f}{f} \approx \frac{v}{c}$

Cosmological expansion  $v = H_0 d$



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Please check the examination details below before entering your candidate information

Candidate surname

Other names

Centre Number

Candidate Number

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**Physics**

**International Advanced Level**

**UNIT 6: Practical Skills in Physics II**

**Answer Book**

**You must have:**

Scientific calculator, ruler and question paper (sent separately).

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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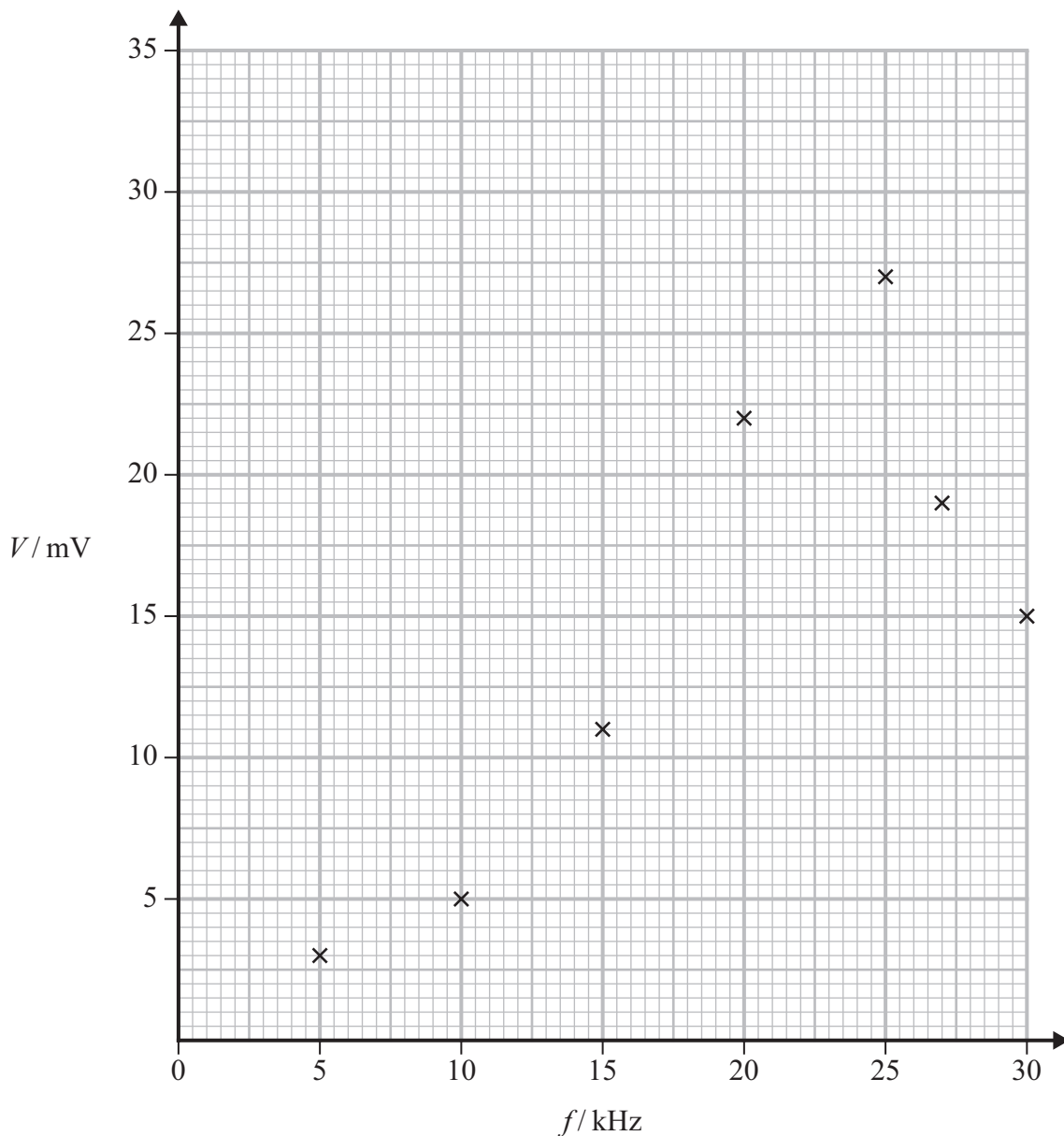
Answer ALL questions.

1

(a)

(i)

(2)



(ii)

(1)

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2



(iii)

(1)

(b)

(1)

(Total for Question 1 = 5 marks)

2

(a)

(3)

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DO NOT WRITE IN THIS AREA



(b)

(1)

(c)

(6)

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DO NOT WRITE IN THIS AREA

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(d)

(2)

(Total for Question 2 = 12 marks)



3

(a)

(2)

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(b)

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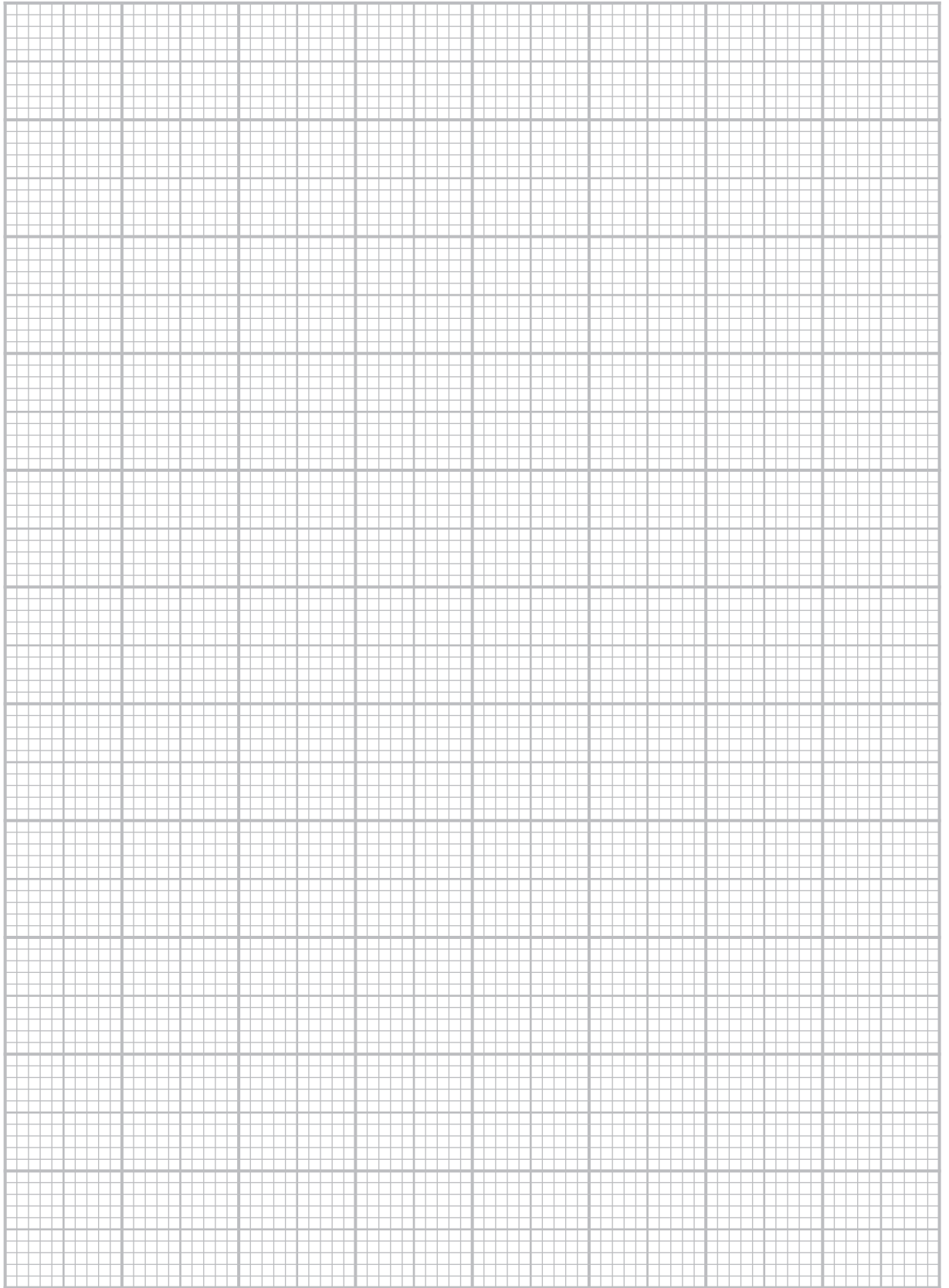
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6



(i)

(6)



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(ii)

(3)

$n =$  .....

(iii)

(3)

$k =$  .....

(c)

(2)

**(Total for Question 3 = 16 marks)**

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4

(a)

(i)

(2)

(ii)

(3)

Mean value of  $d = \dots\dots\dots$  mm  $\pm \dots\dots\dots$  mm

(b)

(i)

(3)



(ii)

(4)

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.....

(c)

(i)

(2)

.....

.....

.....

$$\rho = \dots\dots\dots \text{g cm}^{-3}$$

(ii)

(3)

.....

.....

.....

.....

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**(Total for Question 4 = 17 marks)**

**TOTAL FOR PAPER = 50 MARKS**

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