Pearson Edexcel International Advanced Level

Friday 16 January 2026

Morning (Time: 1 hour 20 minutes)

Paper reference **WPH13/01A**

Physics

International Advanced Subsidiary/Advanced Level

UNIT 3: Practical Skills in Physics I

Question Paper

You must have:
Scientific calculator, ruler and 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.

Turn over ▶

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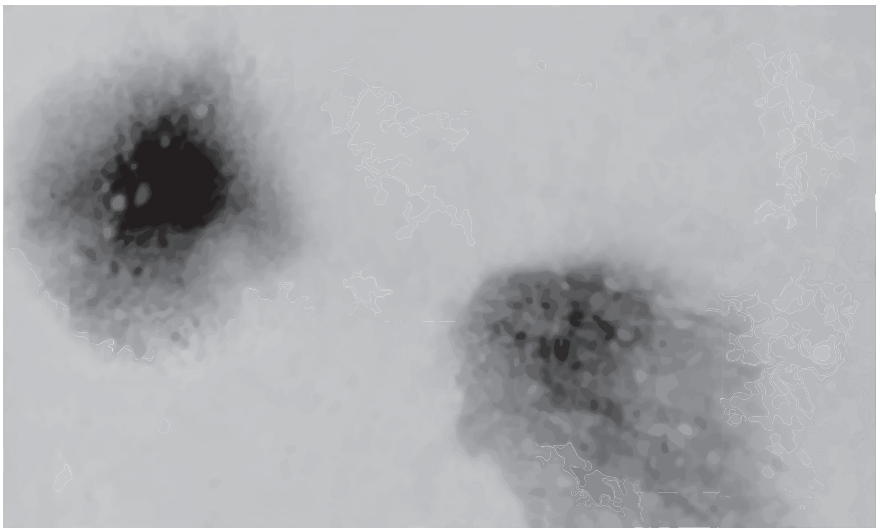
Pearson

Answer ALL questions.

1 A microwave oven uses standing waves to cook food.

When food is put into a microwave oven, a pattern of burn marks may be produced by the standing waves, as shown.



In an experiment to determine the speed of electromagnetic waves, a student measured the distance between two adjacent burn marks as 6.0 cm.

(a) (i) Explain why the wavelength of the microwaves is equal to twice the distance between the burn marks.

(2)

(ii) The manufacturer states that the frequency of the microwaves is 2450 MHz.

Calculate the speed of the microwaves.

(3)

(b) (i) The student uses a 30 cm ruler to measure the distance between burn marks.

State the resolution of a 30 cm ruler.

(1)

(ii) The student states that the uncertainty in their measurement of the distance is half the resolution of the 30 cm ruler.

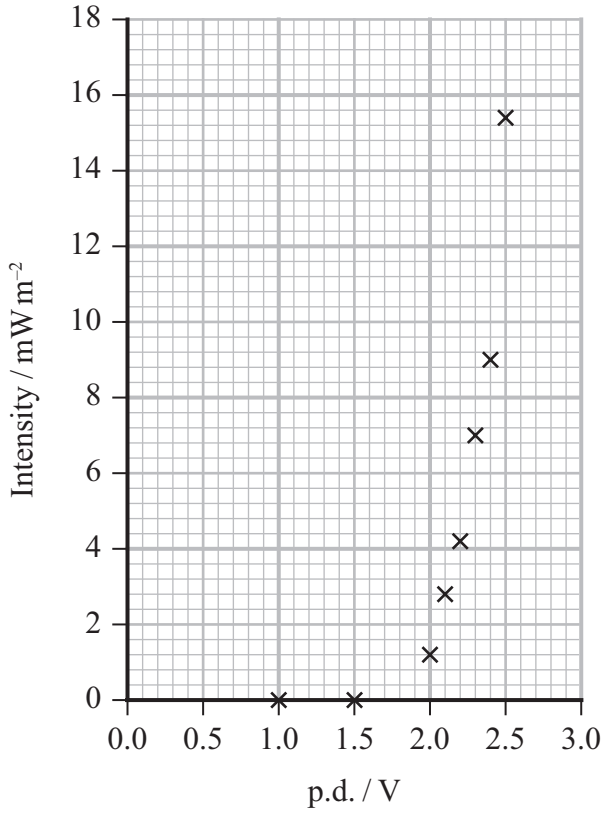
Assess the validity of the student's statement.

(2)

(Total for Question 1 = 8 marks)

2 A student investigated how the intensity of light emitted by a light emitting diode (LED) varied with the potential difference (p.d.) applied across the LED. She measured the intensity of the light using a lightmeter which was shielded from external light sources.

She plotted her results on a graph as shown.



(a) Add a line of best fit to the graph in the answer book.

(1)

(b) (i) Give the value of the p.d. at which the LED starts to conduct.

(1)

(ii) Calculate the minimum energy that must be transferred to an electron in the LED for light to be emitted.

(2)

(c) Light is emitted when the electron releases energy as a photon.

The student tested a second LED that emitted light of wavelength 625 nm.

From her results she determined the minimum electron energy to be 3.1×10^{-19} J.

Calculate the value of the Planck constant from this data.

(3)

(d) The LED does not produce monochromatic light.

Explain how this would affect the value of the Planck constant calculated.

(3)

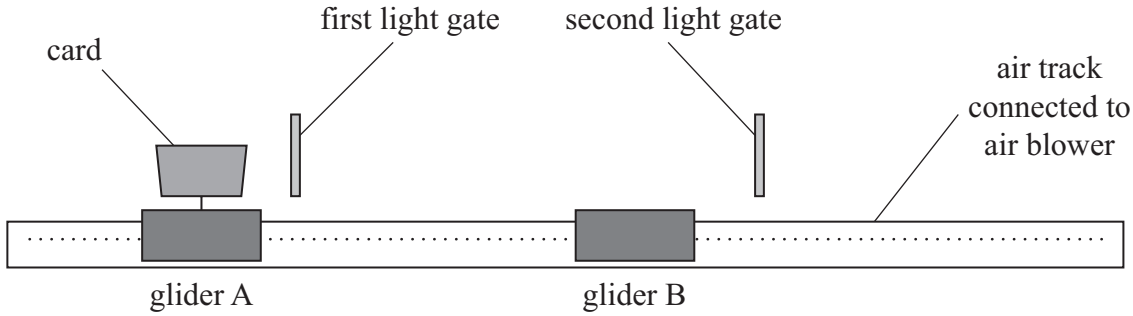
(e) The accuracy of the value of the Planck constant calculated depends on the minimum p.d. determined from the graph.

Explain how the student could reduce the uncertainty in her value of the minimum p.d.

(2)

(Total for Question 2 = 12 marks)

3 A student used light gates connected to a data logger to investigate the collision between two gliders on a level air track, as shown.



Glider B was initially stationary.

Glider A moved through the first light gate and then collided with glider B.

The two gliders joined together, then moved through the second light gate.

(a) The diagram below shows the actual size of the card that was fixed to glider A.

(i) Determine an accurate value for the length of the card.

(2)

(ii) Calculate the percentage uncertainty in your value.

(2)

(b) The student repeated the collision using a card of length 10.5 cm.

The results are shown in the table.

	Mass / kg	Time / ms	Velocity / ms^{-1}	Momentum / $kg\,m\,s^{-1}$
Glider A moving through first light gate	0.147	108	0.972	0.143
Gliders A and B moving through second light gate	0.274	205		

(i) Calculate the values missing from the table.

(4)

(ii) Determine whether the student's values show that momentum was conserved in this collision.

(2)

(c) In the experiment, the student applied a small force with her hand to start glider A moving.

The student repeated the experiment and calculated the mean values of the time taken to pass through each light gate.

Discuss how this affected the uncertainty in the calculated values of momentum.

(3)

(d) Another student used a stopwatch to measure the time taken for the gliders to travel a known distance.

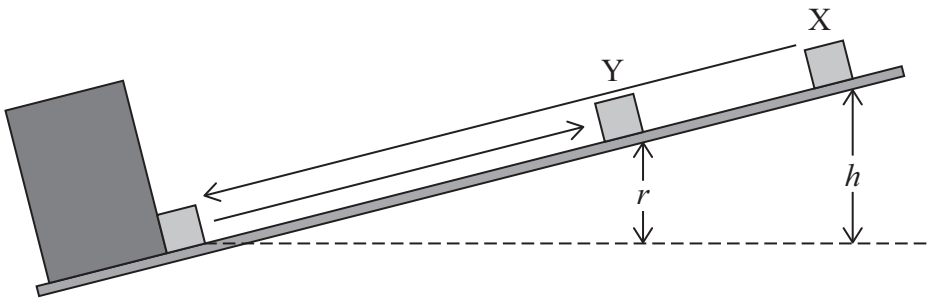
Explain the advantage of using light gates and a data logger, instead of using a stopwatch.

(2)

(Total for Question 3 = 15 marks)

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 in the answer book.

(5)

(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)

(Total for Question 4 = 15 marks)

TOTAL FOR PAPER = 50 MARKS

List of data, formulae and relationships

Acceleration of free fall	$g = 9.81$ m s^{-2}	(close to Earth's surface)
Electron charge	$e = -1.60 \times 10^{-19}$ C	
Electron mass	$m_e = 9.11 \times 10^{-31}$ kg	
Electronvolt	$1\,\text{eV} = 1.60 \times 10^{-19}$ J	
Gravitational field strength	$g = 9.81$ N kg^{-1}	(close to Earth's surface)
Planck constant	$h = 6.63 \times 10^{-34}$ J s	
Speed of light in a vacuum	$c = 3.00 \times 10^{8}$ 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 $F = 6\pi\eta r v$

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

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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

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UNIT 3: Practical Skills in Physics I
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 the question paper.

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) (i)

(2)

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(ii)

(3)

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Speed of microwaves = ...

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(b) (i)

(1)

(ii)

(2)

(Total for Question 1 = 8 marks)

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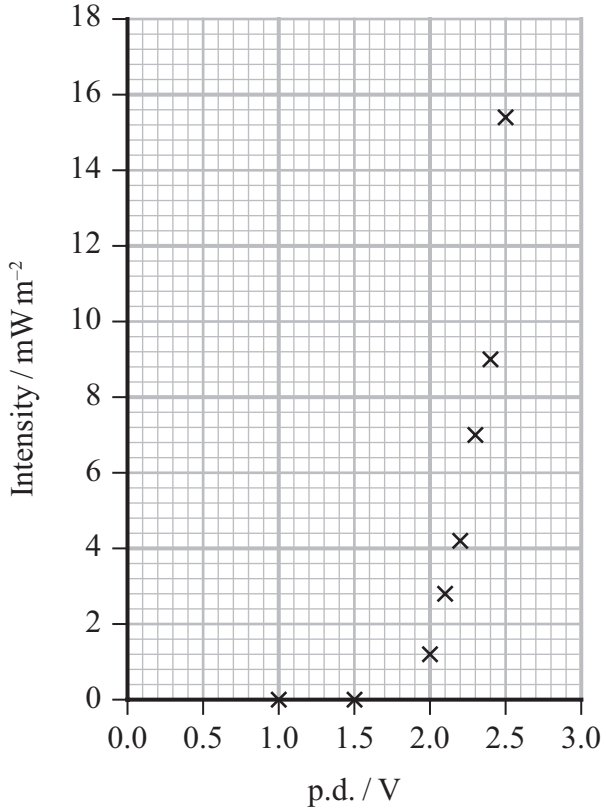
2



(a)

(1)

(b) (i)

(1)

.....

(ii)

(2)

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.....

Minimum electron energy = ...

(c)

(3)

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The Planck constant = ...

(d)

(3)

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(e)

(2)

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(Total for Question 2 = 12 marks)

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3

(a)

(i)

(2)

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Length of card = ...

(ii)

(2)

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Percentage uncertainty = ...

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DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(b)

(i)

(4)

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Velocity = ... $m\,s^{-1}$

Momentum = ... $kg\,m\,s^{-1}$

(ii)

(2)

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.....

.....

(c)

(3)

(d)

(2)

(Total for Question 3 = 15 marks)

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4

(a)

(i)

(2)

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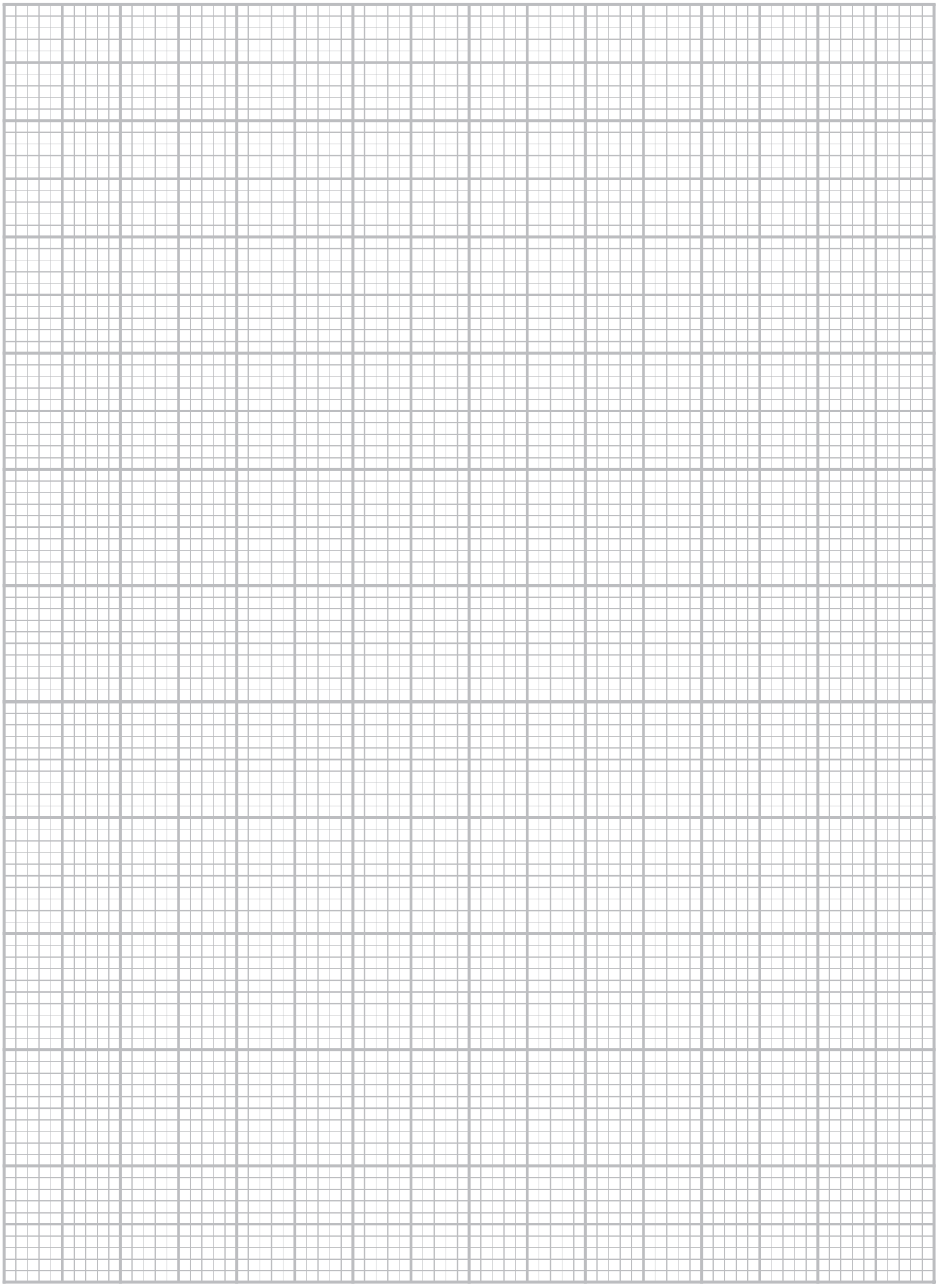
(ii)

(5)



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(b) (i)

(2)

(ii)

(3)

(c)

(3)

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

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