Please check the examination details below before entering your candidate information

Candidate surname   Other names

**Pearson Edexcel
Level 3 GCE**

Centre Number   Candidate Number

Time 1 hour 30 minutes

| Paper reference | **8PH0/01** |

**Physics
Advanced Subsidiary
PAPER 1: Core 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 in Sections A and B.
- Answer the questions in the spaces provided
  – *there may be more space than you need*.

Information

- The total mark for this paper is 80.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question*.
- You may use a scientific calculator.
- In questions marked with an **asterisk (*)**, marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.
- 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.
- You are advised to show your working in calculations including units where appropriate.
- Good luck with your examination.

Turn over ▶

P 6 7 0 8 5 A 0 1 2 4

Pearson

SECTION A

Answer ALL questions.

**All multiple choice questions must be answered with a cross in the box ☒
for the correct answer from A to D.
If you change your mind about an answer, put a line through the box ☒ and then
mark your new answer with a cross ☒.**

1 Select the row of the table that identifies an SI base unit and a derived unit.

		Base unit	Derived unit
☒	**A**	coulomb	ampere
☒	**B**	joule	volt
☒	**C**	newton	kilogram
☒	**D**	second	watt

(Total for Question 1 = 1 mark)

2 A constant current maintained in a copper wire causes the temperature of the wire to increase.

Which of the following does **not** increase?

☒ **A** amplitude of vibration of the lattice ions

☒ **B** number of conduction electrons per unit volume

☒ **C** rate of collision of conduction electrons with lattice ions

☒ **D** rate of energy transfer from conduction electrons to lattice ions

(Total for Question 2 = 1 mark)

3 A car of mass 1.5×10^3 kg is travelling at a speed of 25 m s^{-1}. The driver applies the
brakes and the car comes to rest.

Which of the following gives the decrease in kinetic energy, in joules, as the car is brought to rest?

☒ **A** $750 \times (25)^2$

☒ **B** $750 \times \left(\dfrac{25}{2}\right)^2$

☒ **C** $1500 \times (25)^2$

☒ **D** $1500 \times \left(\dfrac{25}{2}\right)^2$

(Total for Question 3 = 1 mark)

4 A rope is used to apply a force F to a box as shown. The box is pulled a distance d along a horizontal surface.
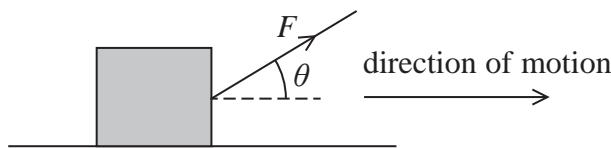
Which of the following could be used to determine the work done on the box?

☒ **A** $Fd \sin \theta$

☒ **B** $\dfrac{Fd}{\sin \theta}$

☒ **C** $Fd \cos \theta$

☒ **D** $\dfrac{Fd}{\cos \theta}$

(Total for Question 4 = 1 mark)

5 A torch is switched on for 5 minutes. The current in the torch bulb is 6 mA.

Which of the following gives the charge, in coulombs, that flows in this time?

☒ **A** $6 \times 10^{-3} \times 5$

☒ **B** $\dfrac{6 \times 10^{-3}}{5}$

☒ **C** $\dfrac{6}{300}$

☒ **D** $6 \times 10^{-3} \times 300$

(Total for Question 5 = 1 mark)

6 The diagram shows the two forces acting on a point mass.

$30\,\text{N}$

$40\,\text{N}$
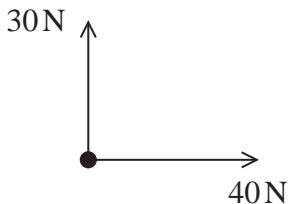
The mass accelerates.

Which of the following gives the angle between the direction of the acceleration and the $40\,\text{N}$ force?

☒ **A** $\cos^{-1}(30/40)$

☒ **B** $\sin^{-1}(40/50)$

☒ **C** $\tan^{-1}(30/40)$

☒ **D** $\tan^{-1}(40/50)$

(Total for Question 6 = 1 mark)

7 Two resistors of resistance R_1 and R_2 are connected to a battery as shown.
The terminal potential difference of the battery is V.

V
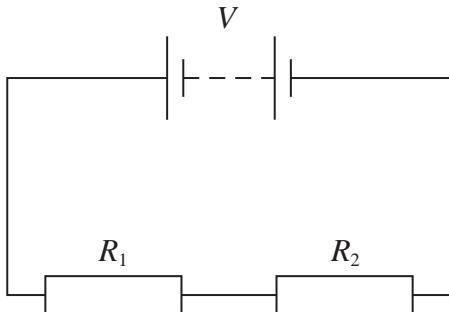
R_1 R_2

Which of the following gives the potential difference across the resistor of resistance R_1?

☒ **A** $\dfrac{R_1}{R_2} \times V$

☒ **B** $\dfrac{R_1}{R_1 + R_2} \times V$

☒ **C** $\dfrac{R_2}{R_1} \times V$

☒ **D** $\dfrac{R_2}{R_1 + R_2} \times V$

(Total for Question 7 = 1 mark)

8 A motor is used to lift an object as shown. The object is raised through a vertical height of 75 cm at a constant speed of $0.40\,\mathrm{m\,s^{-1}}$.
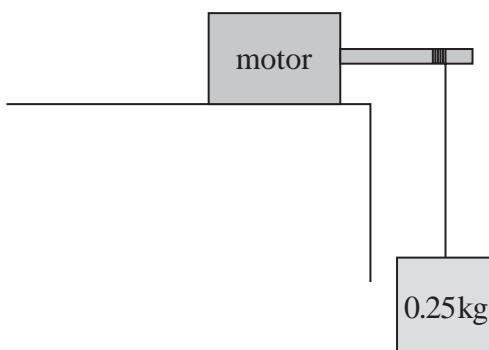
Which of the following gives the rate of increase of potential energy of the object in watts?

☒ **A** $0.25 \times 9.81 \times 0.40$

☒ **B** 0.25×0.75

☒ **C** $0.25 \times 9.81 \times 0.75$

☒ **D** $0.5 \times 0.25 \times (0.40)^2$

(Total for Question 8 = 1 mark)

9 A uniform rigid rod AB of length 1.50 m has a weight W of 6.5 N. A force of 3.5 N applied at A balances the rod on a pivot as shown.

Diagram not to scale

A   B

3.5 N   pivot W
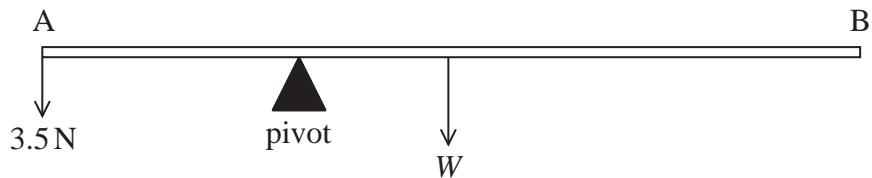
Calculate the distance of the pivot from A when the rod is in equilibrium.

(2)

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Distance of pivot from A = ...

(Total for Question 9 = 2 marks)

10 Two resistors are connected as shown.

$120\,\Omega$

$180\,\Omega$
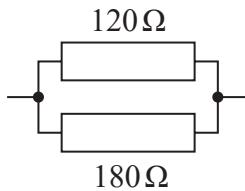
(a) Show that the resistance of the combination is about $70\,\Omega$.

(2)

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(b) This resistor combination is connected to a battery of e.m.f. ε and internal resistance r.

$120\,\Omega$

$180\,\Omega$
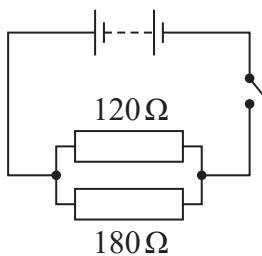
The switch is closed for 5 minutes.

Calculate the energy dissipated in the resistor combination.

$\varepsilon = 9.0\,\text{V}$
$r = 2.5\,\Omega$

(4)

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Energy dissipated in resistor combination = ...

(Total for Question 10 = 6 marks)

11 A skydiver made a skydive from a plane.

(Source: © Sky Antonio/Shutterstock)

The graph shows how the velocity v of the skydiver varied with time t, from the instant she left the plane to the instant just before the parachute opened.
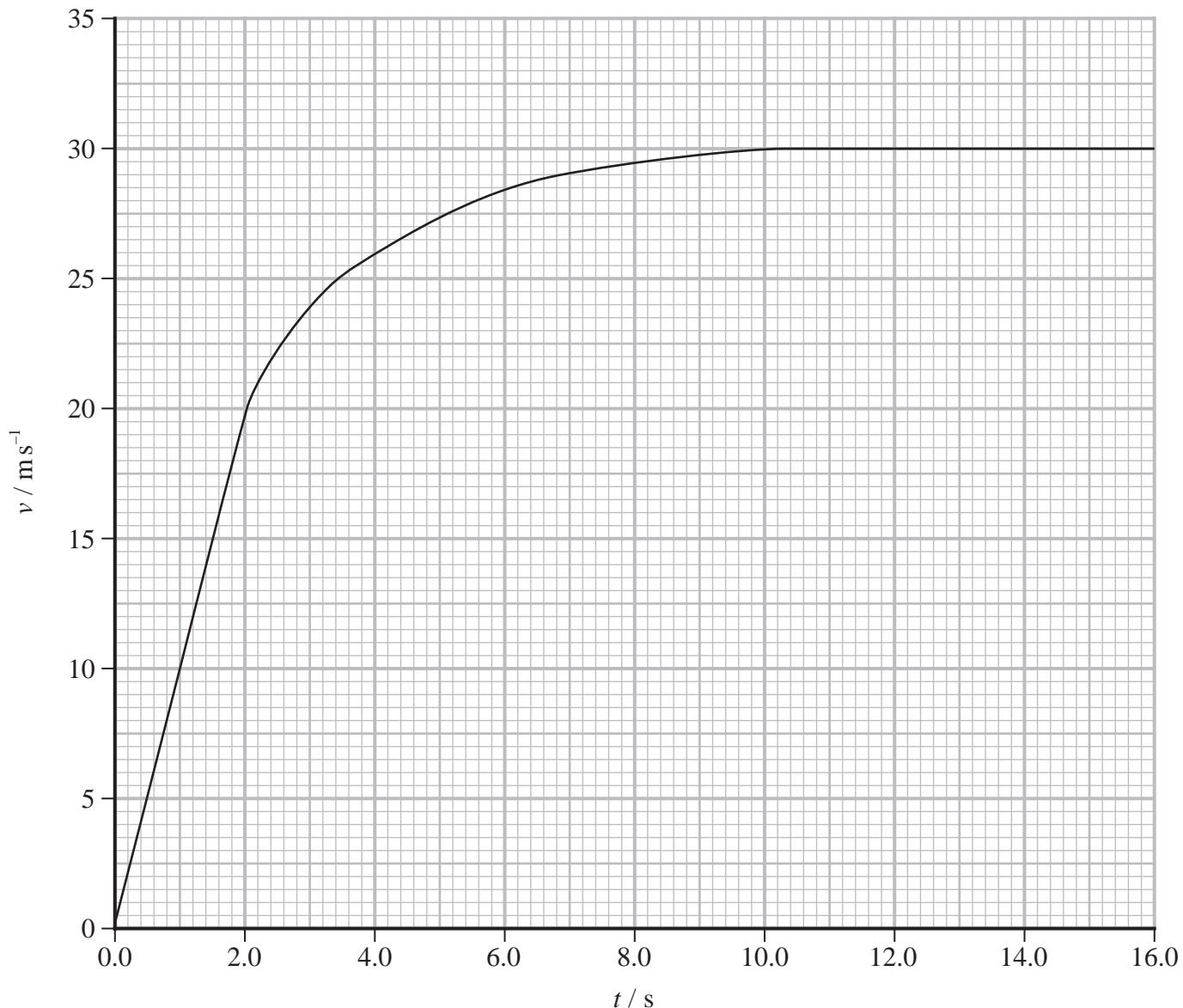
(a) Determine the acceleration of the skydiver when $t = 4.0\,s$.

(3)

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Acceleration of skydiver = ...

(b) Determine an approximate value for the displacement of the skydiver over the first 16.0 s of the skydive.

(3)

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Displacement of skydiver = ...

(Total for Question 11 = 6 marks)

P 6 7 0 8 5 A 0 9 2 4

12 The resistivity of a metal is an important property of wire used in an electric circuit.

(a) A student carried out an experiment to determine the resistivity of a type of wire.
He used a micrometer to measure the diameter d of the wire.

(Source: © Viktor Chursin/Shutterstock)

He recorded the following values.

d_1 / mm	d_2 / mm	d_3 / mm	d_4 / mm
1.40	1.44	1.42	1.41

(i) Calculate the percentage uncertainty in the mean diameter of the wire.

(3)

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% uncertainty in mean diameter of wire = ...

(ii) The student used an ohmmeter to measure the resistance R of a 1.65 m length of the wire.

He looked up the resistivity values of some materials.

Material	Titanium	Constantan	Stainless Steel
Resistivity / $10^{-7}\,\Omega\,m$	4.2	4.7	6.9

Identify the material of the wire.

$R = 0.72\,\Omega$

(3)

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(b) Nichrome wire is often used in heating elements. Nichrome wire is used to make a coil for a 65 W mains powered heater. The nichrome wire has a resistance per metre of $87.5\,\Omega\,m^{-1}$.

Calculate the length of wire required.

potential difference across the coil = 230 V

(3)

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Length of wire required = ...

(Total for Question 12 = 9 marks)

13 Two ice skaters are gliding across the horizontal ice surface at an ice rink.

(Source: © ITAR-TASS News Agency/Alamy Stock Photo)

(a) Initially the skaters move together with a speed of $5.6\,\mathrm{m\,s^{-1}}$.

The male skater pushes the female skater forwards. After being pushed, she has a forward speed of $7.5\,\mathrm{m\,s^{-1}}$.

Calculate the speed of the male skater immediately after pushing the female skater forwards.

mass of male skater = 66 kg
mass of female skater = 52 kg

(3)

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Speed of male skater = ...

(b) Explain why the male skater experiences a change in his velocity when he pushes the female skater forwards.
You should make reference to Newton's laws of motion in your explanation.

(4)

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(c) When the male skater pushes the female skater forwards, the total kinetic energy of the skaters increases.

Explain why kinetic energy is not conserved in this interaction.

(2)

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(Total for Question 13 = 9 marks)

14 Grasshoppers can jump up to twenty times their length to escape predators. The magnitude of the launch velocity v does not vary significantly for a given grasshopper, so the length of the jump mostly depends on the launch angle θ.

The diagram shows a grasshopper at the instant it launches.
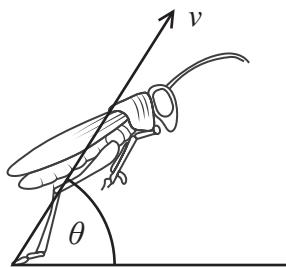
(Source: adapted from http://gclipart.com/grasshopper-clipart_28241/)

(a) The grasshopper jumps from rest on level ground. The launch velocity is $2.6\,\mathrm{m\,s^{-1}}$ at an angle of $57°$ to the horizontal.

(i) Show that the vertical component of the launch velocity is about $2\,\mathrm{m\,s^{-1}}$.

(1)

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(ii) Assess whether the horizontal distance travelled by the grasshopper in the jump is about 20 times the grasshopper's length.

length of grasshopper $= 5.0\,\mathrm{cm}$

(5)

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(b) Grasshoppers with longer legs accelerate to their launch velocity over a longer time.

Leg length has a negligible effect on both the mass of a grasshopper and the energy released in a jump.

Explain how leg length affects the force exerted on the ground during a jump.

(4)

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(c) In a recent study it was discovered that grasshoppers, living in an environment with hunting spiders, increase their launch velocity on average by 20%. The jump length of these grasshoppers was more than doubled.

Assess whether a 20% increase in launch velocity alone is sufficient to double the jump length.

(4)

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(Total for Question 14 = 14 marks)

TOTAL FOR SECTION A = 54 MARKS

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SECTION B

Answer ALL questions in the spaces provided.

15 A force meter measures force by making use of Hooke's Law.

The extension of a spring inside the force meter allows the magnitude of the force applied to be read from a scale.

(a) The spring in one type of force meter extends by 5.5 cm when a force of 2.5 N is applied.

(i) Show that the stiffness of the spring is about $50\,\text{N}\,\text{m}^{-1}$.

(2)

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(ii) Two identical force meters of this type support a mass of 0.400 kg as shown.

Diagram not to scale

60°

0.400 kg
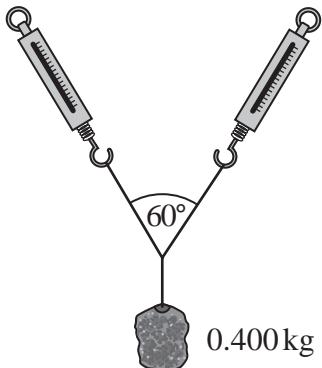
Calculate the extension Δx of each spring.

(4)

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$\Delta x = $ ....

*(b) A beaker of water is placed on a balance and a rock is hung from a force meter as shown in diagram 1.

The initial reading on the balance is *R*, and the initial reading on the force meter is *F*. The rock is lowered gently into the beaker of water until it is completely submerged.

Diagram not to scale

rock

water

balance
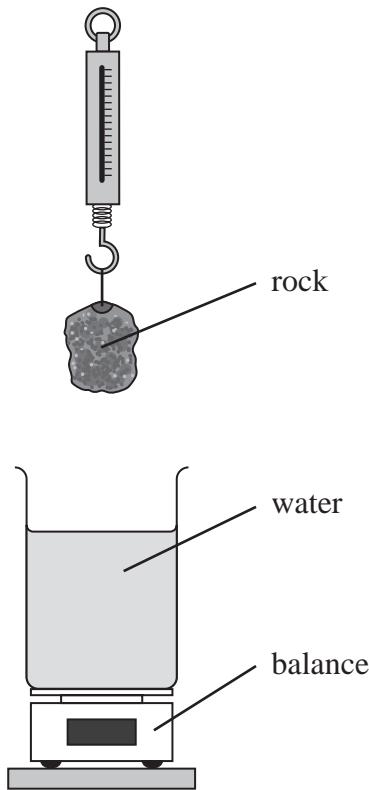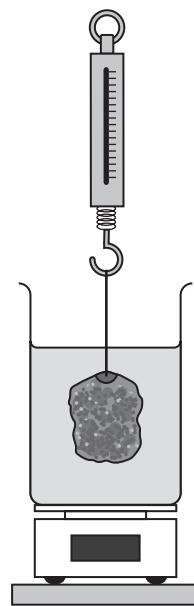
Diagram 1   **Diagram 2**

(Source: adapted from https://passnownow.com/wp-content/uploads/2014/06/upthrust)

Explain any changes in the readings R and F as the rock is lowered into the water as shown in diagram 2.

(6)

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(Total for Question 15 = 12 marks)

16 A student carried out an experiment to determine the focal length of a converging lens. The student used a bulb to illuminate an object as shown. The converging lens produced an image of the object on a screen. The student adjusted the position of the screen until the image was in focus.

He repeated the procedure for different distances between the object and the lens. The distance v from the lens to the screen was measured for each lens position.
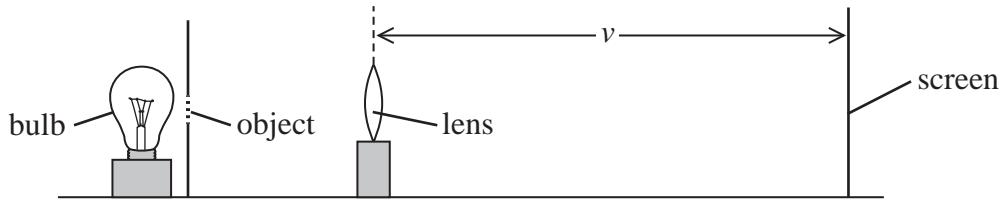
The student measured the height h_o of the object and the height h_i of the corresponding image on the screen for each lens position. The magnification m was calculated.

To determine the focal length f of the lens the student used the equation

$$m = \frac{v}{f} - 1$$

(a) Explain why a graph of m on the y-axis and v on the x-axis should be a straight line.

(2)

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(b) The student obtained the following data.

object height, $h_o = 2.04$ cm

v / cm	h_i / cm	m
61.5	5.92	2.90
47.0	4.24	2.08
39.6	3.30	1.62
31.2	2.15	
23.8	1.33	0.652

(i) Complete the table and plot a graph of m against v on the grid opposite.

(6)
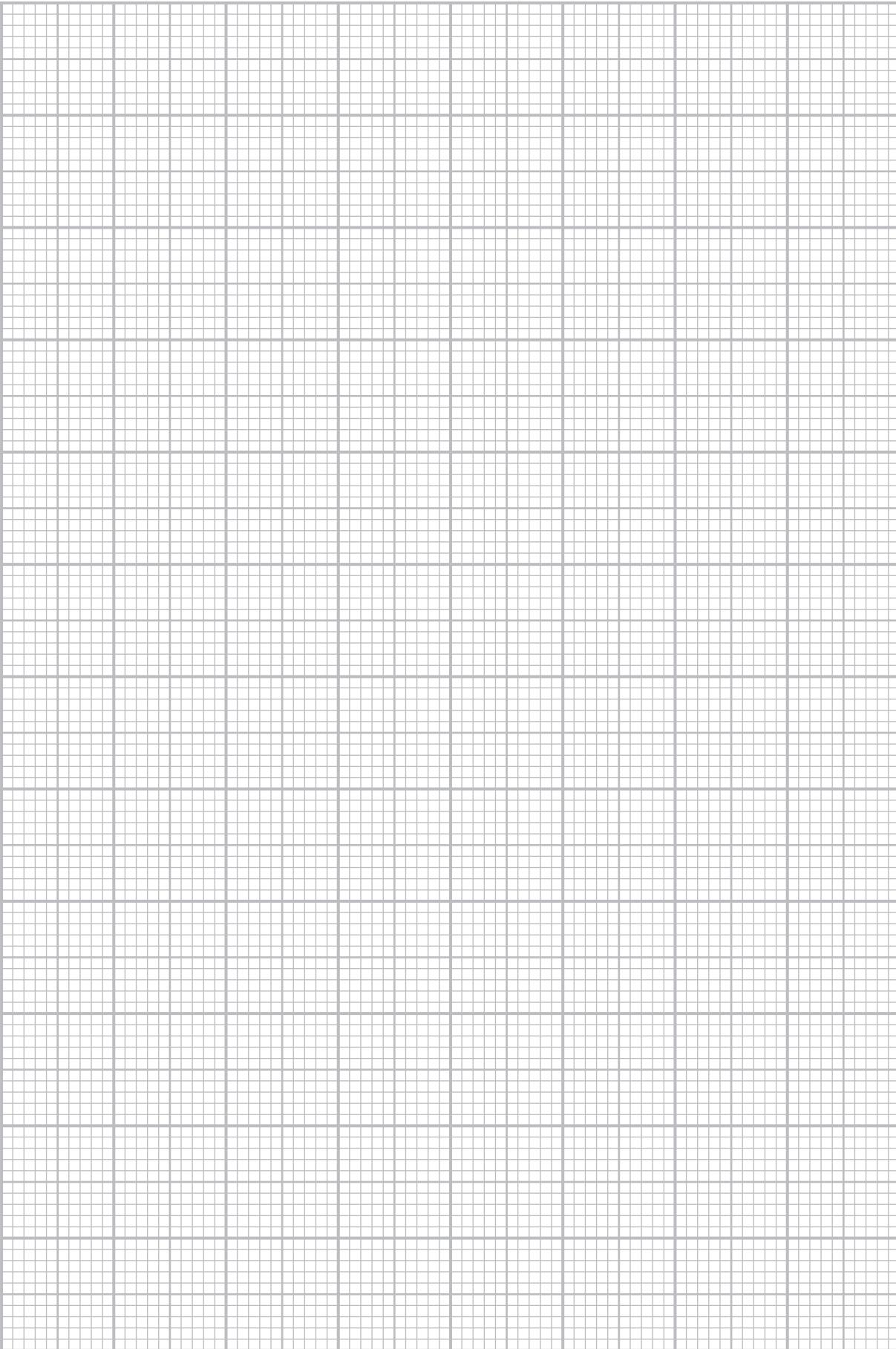
(ii) Determine a value for f.

(3)

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$f =$ ....

(c) If the distance from object to the lens is less than a certain value, no image is produced on the screen.

Explain why.

(3)

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(Total for Question 16 = 14 marks)

TOTAL FOR SECTION B = 26 MARKS
TOTAL FOR PAPER = 80 MARKS

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	$c = 3.00 \times 10^{8} \text{m s}^{-1}$	

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

$$\Sigma F = ma$$

$$g = \frac{F}{m}$$

$$W = mg$$

$$moment\ of\ force = Fx$$

Momentum

$$p = mv$$

Work, energy and power

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

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

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

$$P = \frac{E}{t}$$

$$P = \frac{W}{t}$$

$$efficiency = \frac{useful\ energy\ output}{total\ energy\ input}$$

$$efficiency = \frac{useful\ power\ output}{total\ power\ input}$$

Electric circuits

Potential difference

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

Resistance

$$R = \frac{V}{I}$$

Electrical power and energy

$$P = VI$$

$$P = I^2R$$

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

$$W = VIt$$

Resistivity

$$R = \frac{\rho l}{A}$$

Current

$$I = \frac{\Delta Q}{\Delta t}$$

$$I = nqvA$$

Materials

Density
$$\rho = \frac{m}{V}$$

Stokes' law
$$F = 6\pi\eta rv$$

Hooke's law
$$F = k\Delta x$$

Pressure
$$p = \frac{F}{A}$$

Young modulus

Stress $\sigma = \dfrac{F}{A}$

Strain $= \dfrac{\Delta x}{x}$

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

Elastic strain energy
$$\Delta E_{el} = \frac{1}{2}F\Delta x$$

Waves and Particle Nature of Light

Wave speed
$$v = f\lambda$$

Speed of a transverse wave on a string
$$v = \sqrt{\frac{T}{\mu}}$$

Intensity of radiation
$$I = \frac{P}{A}$$

Power of a lens
$$P = \frac{1}{f}$$
$$P = P_1 + P_2 + P_3 + \ldots$$

Thin lens equation
$$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$$

Magnification for a lens
$$m = \frac{\text{image height}}{\text{object height}} = \frac{v}{u}$$

Diffraction grating
$$n\lambda = d \sin \theta$$

Refractive index
$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$
$$n = \frac{c}{v}$$

Critical angle
$$\sin C = \frac{1}{n}$$

Photon model
$$E = hf$$

Einstein's photoelectric equation
$$hf = \phi + \tfrac{1}{2}mv^2_{max}$$

de Broglie wavelength
$$\lambda = \frac{h}{p}$$