

Please check the examination details below before entering your candidate information

Candidate surname

Other names

**Pearson Edexcel
Level 3 GCE**

Centre Number

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Candidate Number

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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 ►

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SECTION A

Answer ALL questions.

All multiple choice questions must be answered with a cross 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
<input type="checkbox"/> A	coulomb	ampere
<input type="checkbox"/> B	joule	volt
<input type="checkbox"/> C	newton	kilogram
<input type="checkbox"/> 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.

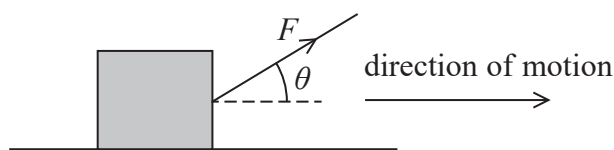
Which of the following gives the decrease in kinetic energy, in joules, as the car is brought to rest?

- A $750 \times (25)^2$
- B $750 \times \left(\frac{25}{2}\right)^2$
- C $1500 \times (25)^2$
- D $1500 \times \left(\frac{25}{2}\right)^2$

(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 $\frac{Fd}{\sin \theta}$
- C $Fd \cos \theta$
- D $\frac{Fd}{\cos \theta}$

(Total for Question 4 = 1 mark)

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

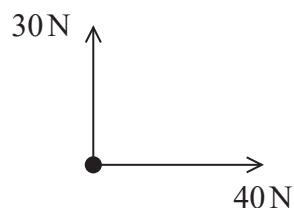
Which of the following gives the charge, in coulombs, that flows in this time?

- A $6 \times 10^{-3} \times 5$
- B $\frac{6 \times 10^{-3}}{5}$
- C $\frac{6}{300}$
- 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.



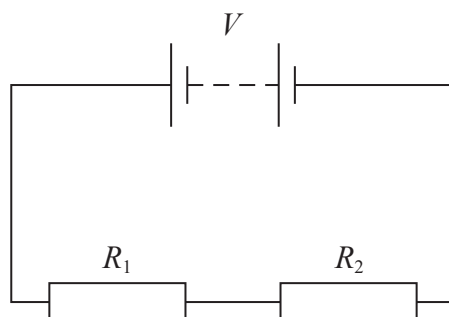
The mass accelerates.

Which of the following gives the angle between the direction of the acceleration and the 40 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 .



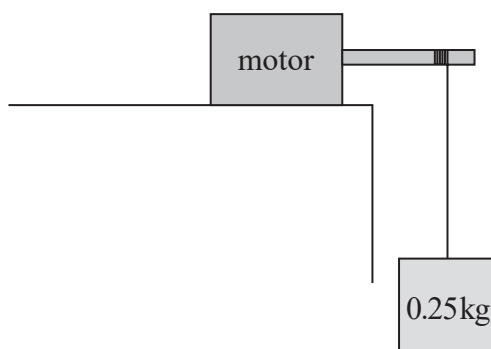
Which of the following gives the potential difference across the resistor of resistance R_1 ?

- A $\frac{R_1}{R_2} \times V$
- B $\frac{R_1}{R_1 + R_2} \times V$
- C $\frac{R_2}{R_1} \times V$
- D $\frac{R_2}{R_1 + R_2} \times V$

(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 m s^{-1} .



Which of the following gives the rate of increase of potential energy of the object in watts?

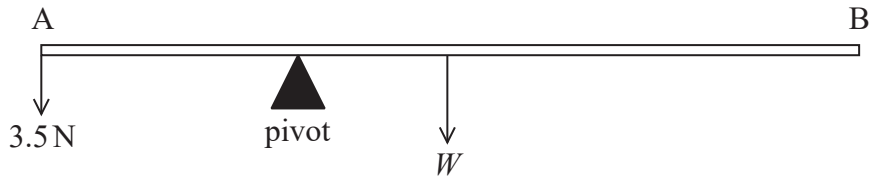
- A $0.25 \times 9.81 \times 0.40$
- B 0.25×0.75
- C $0.25 \times 9.81 \times 0.75$
- D $0.5 \times 0.25 \times (0.40)^2$

(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



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)

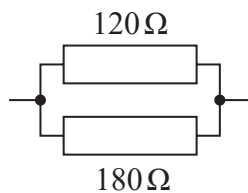
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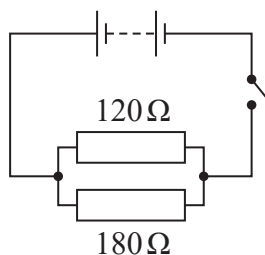
10 Two resistors are connected as shown.



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

(2)

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



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)

Energy dissipated in resistor combination =

(Total for Question 10 = 6 marks)

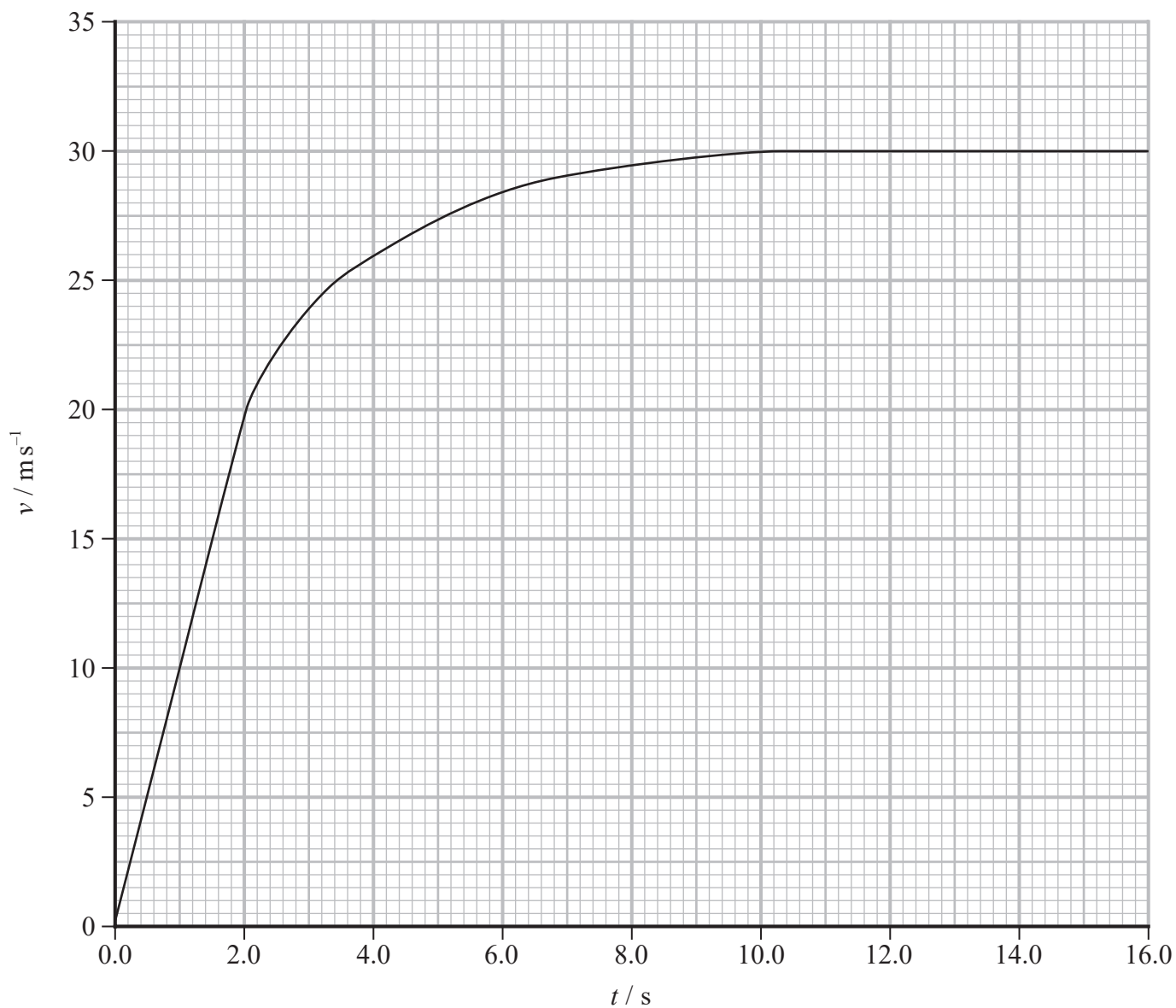


11 A skydiver made a skydive from a plane.



(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.



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(a) Determine the acceleration of the skydiver when $t = 4.0$ s.

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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.

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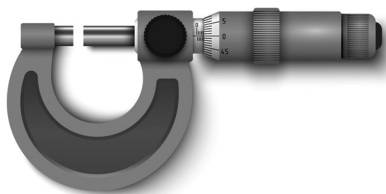
Displacement of skydiver =

(Total for Question 11 = 6 marks)



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 / $10^{-7} \Omega \text{ m}$	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 $87.5 \Omega \text{ m}^{-1}$.

Calculate the length of wire required.

$$\text{potential difference across the coil} = 230 \text{ V}$$

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Length of wire required =

(Total for Question 12 = 9 marks)

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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 m s^{-1} .

The male skater pushes the female skater forwards. After being pushed, she has a forward speed of 7.5 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

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Speed of male skater =

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(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.

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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.

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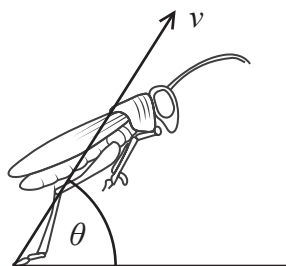
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(Total for Question 13 = 9 marks)



- 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 m s^{-1} at an angle of 57° to the horizontal.

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

- (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 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.

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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 N m^{-1} .

(2)

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

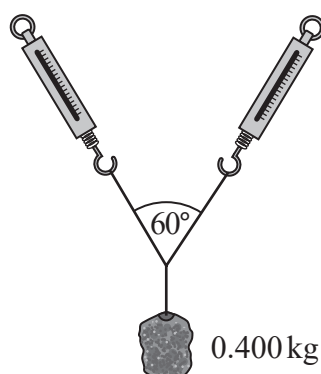


Diagram not to scale

(Source: adapted from <https://image.slidesharecdn.com/balancedunbalancedgravityfriction-170509114658/95/balanced-unbalanced-gravity-friction-14-638.jpg?cb=1494330595>)

Calculate the extension Δx of each spring.

(4)

$\Delta x =$



*(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

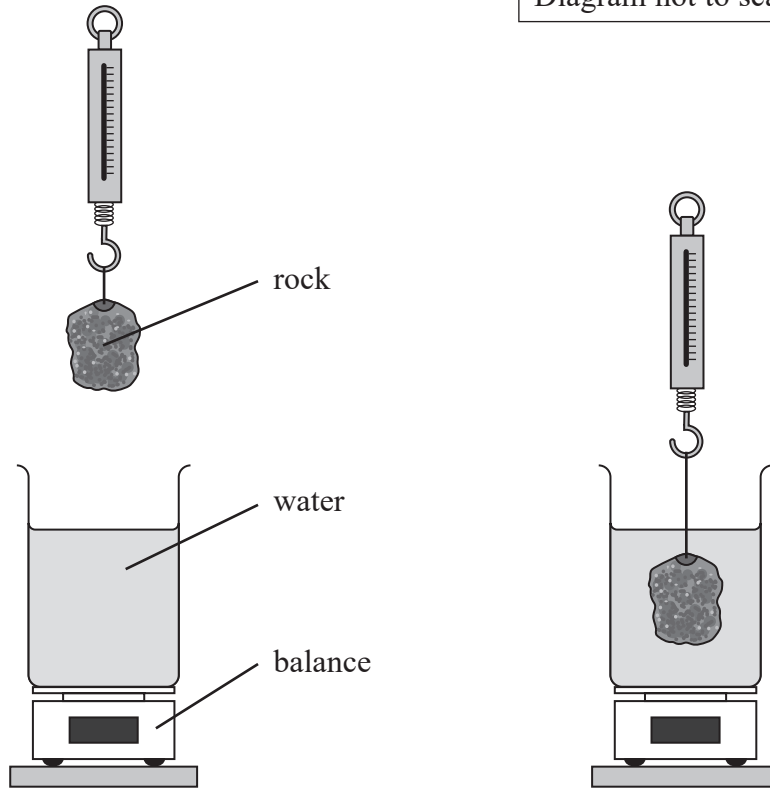


Diagram 1

Diagram 2

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

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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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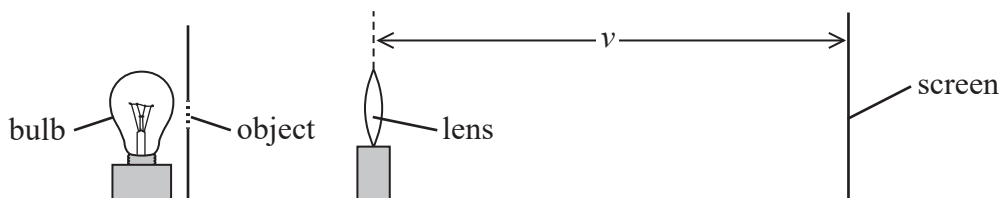
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(Total for Question 15 = 12 marks)



- 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

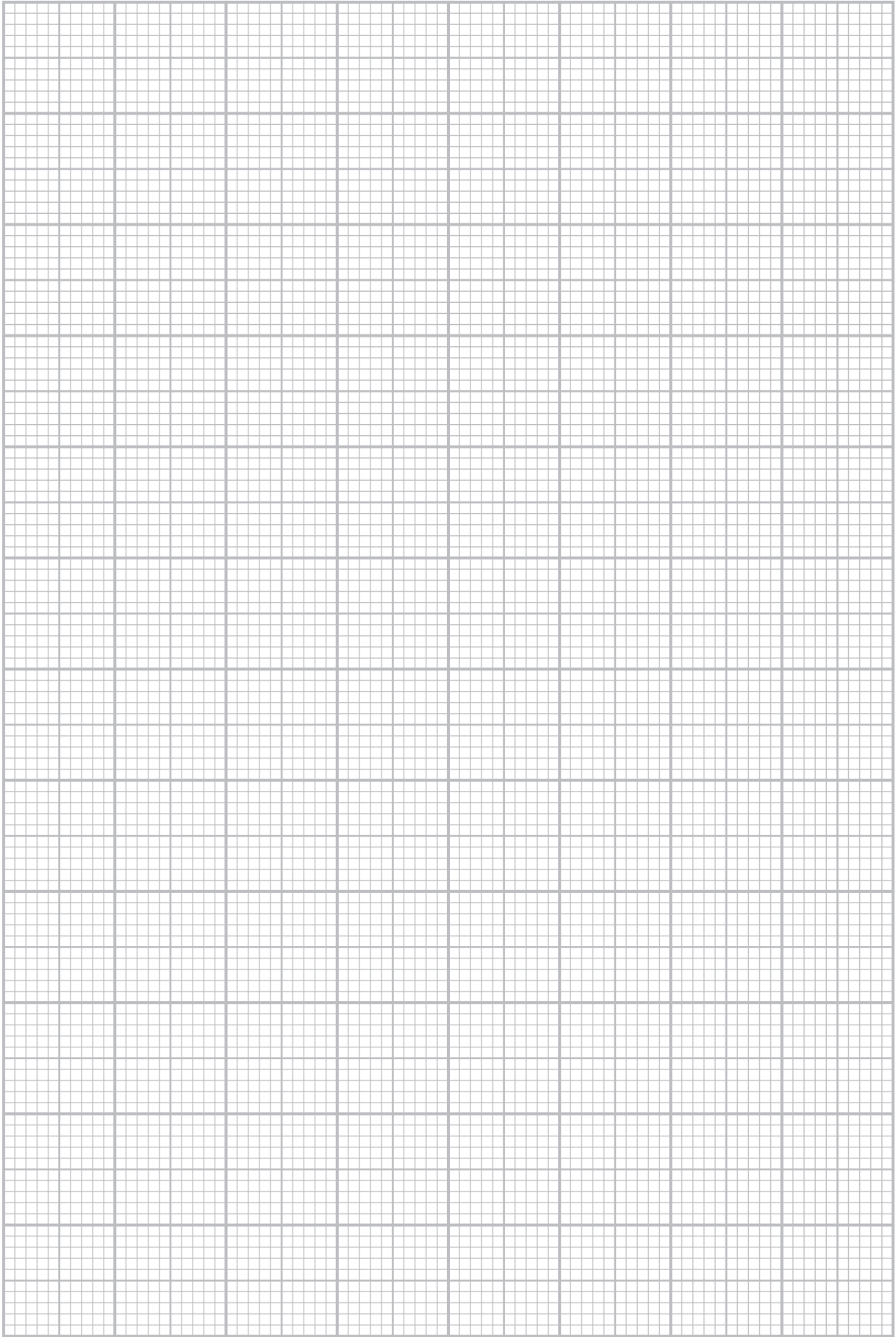
- (i) Complete the table and plot a graph of m against v on the grid opposite. (6)



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(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.

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(Total for Question 16 = 14 marks)

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

$$\Sigma F = ma$$

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

$$W = mg$$

$$\text{moment of force} = Fx$$

Momentum

$$p = mv$$

Work, energy and power

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

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

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

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

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

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

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

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

$$F = 6\pi\eta r v$$

Hooke's law

$$F = k\Delta x$$

Pressure

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

Young modulus

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

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

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

Elastic strain energy

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

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

$$P = \frac{1}{f}$$

$$P = P_1 + P_2 + P_3 + \dots$$

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

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

de Broglie wavelength

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

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