QP_12_JUN_9188-2_PHYSICS

MS_12_JUN_9188-2_PHYSICS

QP_12_NOV_9188-2_PHYSICS

MS_12_NOV_9188-2_PHYSICS

QP_13_JUN_9188-2_PHYSICS

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NOV2017_MS2

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Candidate Name	Centre Number	Candidate Number

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

PHYSICS

PAPER 2

9188/2

JUNE 2012 SESSION 1 hour 15 minutes

Candidates answer on the question paper.
Additional materials:
Electronic calculator and/or Mathematical tables

TIME 1 hour 15 minutes

INSTRUCTIONS TO CANDIDATES

FOR EXAMINER'S USE

Write your name, Centre number and candidate number in the spaces at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided on the question paper.
For numerical answers, **all** working should be shown.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

FOR EXAMINATION'S USE	
1	
2	
3	
4	
5	
6	
TOTAL	

This question paper consists of 12 printed pages.

[Turn over

Data

speed of light in free space,	$c = 3.00 \times 10^{8}\ \mathrm{m\,s^{-1}}$
permeability of free space,	$\mu_0 = 4\pi \times 10^{-7}\ \mathrm{H\,m^{-1}}$
permittivity of free space,	$\epsilon_0 = 8.85 \times 10^{-12}\ \mathrm{F\,m^{-1}}$
elementary charge,	$e = 1.60 \times 10^{-19}\ \mathrm{C}$
the Planck constant,	$h = 6.63 \times 10^{-34}\ \mathrm{J\,s}$
unified atomic mass constant,	$u = 1.66 \times 10^{-27}\ \mathrm{kg}$
rest mass of electron,	$m_e = 9.11 \times 10^{-31}\ \mathrm{kg}$
rest mass of proton,	$m_p = 1.67 \times 10^{-27}\ \mathrm{kg}$
molar gas constant,	$R = 8.31\ \mathrm{J\,K^{-1}\,mol^{-1}}$
the Avogadro constant,	$N_A = 6.02 \times 10^{23}\ \mathrm{mol^{-1}}$
the Boltzmann constant,	$k = 1.38 \times 10^{-23}\ \mathrm{J\,K^{-1}}$
gravitational constant,	$G = 6.67 \times 10^{-11}\ \mathrm{N\,m^{2}\,kg^{-2}}$
acceleration of free fall,	$g = 9.81\ \mathrm{m\,s^{-2}}$

Formulae

uniformly accelerated motion,	$s = ut + \frac{1}{2}at^2$ $v^2 = u^2 + 2as$
work done on/by a gas,	$W = p\Delta V$
gravitational potential,	$\phi = -\frac{Gm}{r}$
refractive index,	$n = \frac{1}{\sin C}$
resistors in series,	$R = R_1 + R_2 + \ldots$
resistors in parallel,	$1/R = 1/R_1 + 1/R_2 + \ldots$
electric potential,	$V = \frac{Q}{4\pi\epsilon_0 r}$
capacitors in series,	$1/C = 1/C_1 + 1/C_2 + \ldots$
capacitors in parallel,	$C = C_1 + C_2 + \ldots$
energy of charged capacitor,	$W = \frac{1}{2}QV$
alternating current/voltage,	$x = x_0 \sin \omega t$
hydrostatic pressure,	$p = \rho gh$
pressure of an ideal gas,	$p = \frac{1}{3}\frac{Nm}{V}\langle c^2\rangle$
radioactive decay,	$x = x_0 \exp(-\lambda t)$
decay constant,	$\lambda = \frac{0.693}{t_{\frac{1}{2}}}$
critical density of matter in the Universe,	$\rho_0 = \frac{3H_0^2}{8\pi G}$
equation of continuity,	$Av = \text{constant}$
Bernoulli equation (simplified),	$p_1 + \frac{1}{2}\rho v_1^2 = p_2 + \frac{1}{2}\rho v_2^2$
Stokes' law,	$F = Ar\eta v$
Reynolds' number,	$R_e = \frac{\rho vr}{\eta}$
drag force in turbulent flow,	$F = Br^2\rho v^2$

*Answer **all** questions.*

For Examiner's Use

1 **(a)** Define *velocity* and state its SI unit.

____

____

____ [2]

(b) A volume of gas is enclosed in an insulated container by a frictionless piston. A molecule of mass, *m,* moving with speed, *u,* collides head-on with a stationary piston as in **Fig.1.1.**

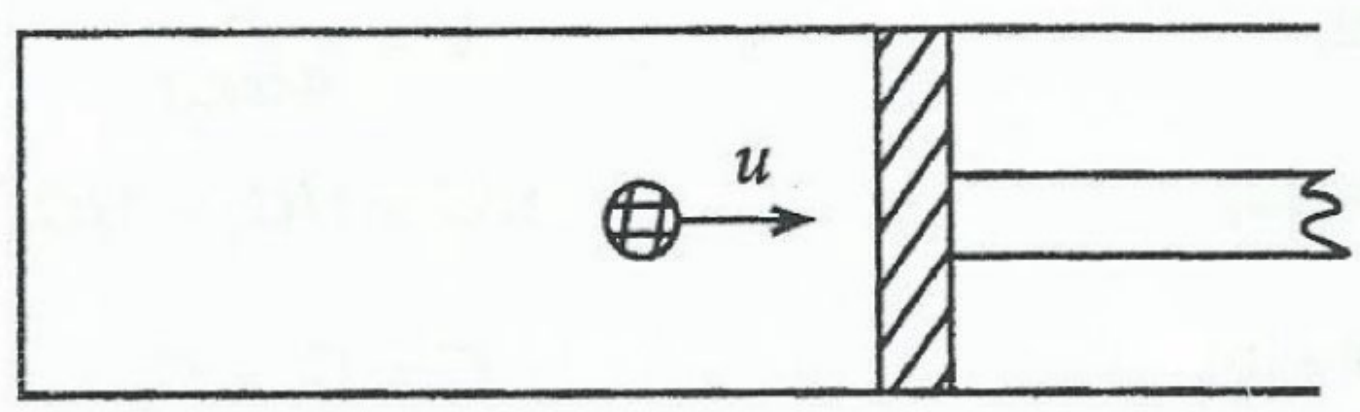


Fig.1.1

(i) Write down an expression for the molecule's momentum change.

____

(ii) State an assumption that you made.

____

____ [2]

For Examiner's Use

(c) The piston is moved outwards with a velocity, v, and collides with the gas molecule in **(b)**. The molecule rebounces with a velocity, v_1, as in **Fig. 1.2.**

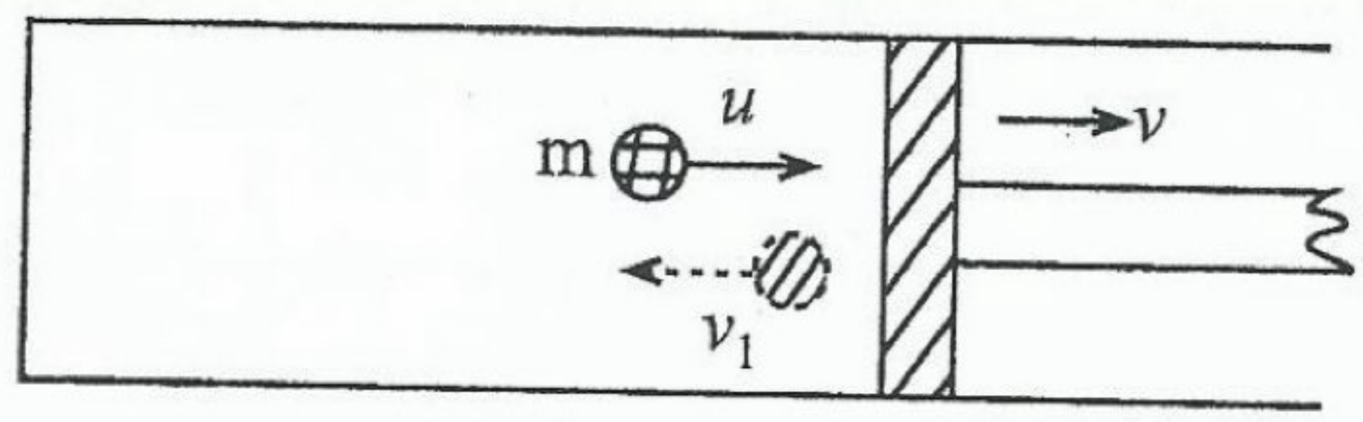


Fig.1.2

(i) Express v_1 in terms of u and v.

____

____

(ii) Hence deduce the effect on the gas, of this movement by the piston.

____

____

____ [5]

2 (a) Define

(i) *force,*

____

____

(ii) *the newton.*

____

____ [5]

For Examiner's Use

(b) A body of mass 4.0 kg is pulled up a smooth plane inclined at 30° to the horizontal by a force of 40.0 N acting parallel to the plane.

(i) Sketch a diagram showing all forces acting on the mass.

(ii) Calculate

1. the resultant force, neglecting all frictional forces,

resultant force = ________________

2. the acceleration of the body up the incline.

acceleration = ________________

[5]

For Examiner's Use

(c) Suggest why, in practice, the value of acceleration is less than that in **b (ii)** 2.

____

____ [1]

3 **Fig. 3.1** shows the variation of displacement, *x*, with time in seconds, *t*, for a simple pendulum.

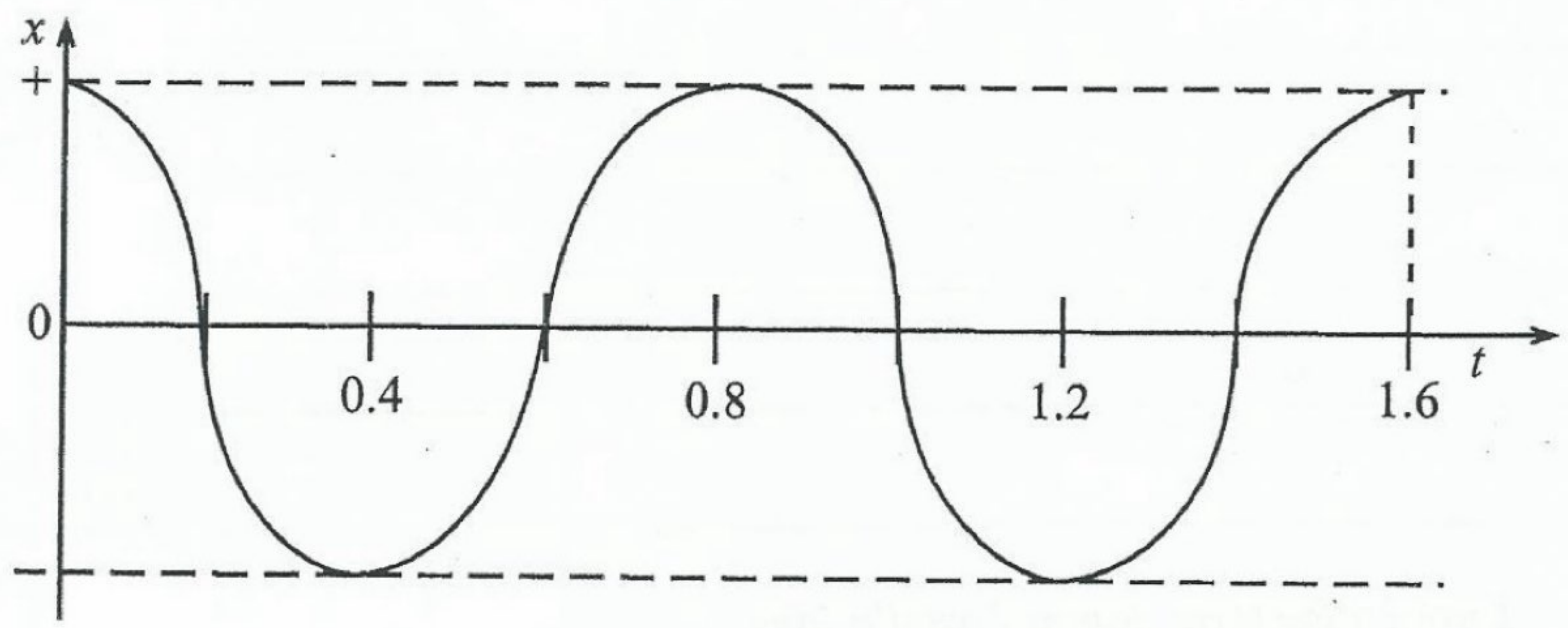


Fig. 3.1

(a) Determine

(i) the period,

period = ____________________

(ii) the frequency of oscillation.

frequency= ____________________ [2]

[Turn over

For Examiner's Use

(b) Sketch on **Fig. 3.1**, a graph of the variation of

(i) velocity with time and label this v,

(ii) acceleration with time and label this a. [4]

(c) Describe the energy changes that take place from the moment the pendulum is released until it completes half an oscillation.

____

____

____

____

____

____ [3]

(d) **(i)** Explain the term *damped oscillations.*

____

____

(ii) Give a practical example where damping is useful and state the type of damping.

example: ____

____

type of damping: ____ [3]

4 **(a)** Define

(i) *stress,*

____

____

(ii) *strain,*

____

____

For Examiner's Use

(iii) *Young Modulus.*

____

____ [3]

(b) A mass of 12.0 kg is suspended from the ceiling by an aluminium wire of length 2.0 m and diameter 2.0 mm. If the Young Modulus of aluminium is 7×10^{10} Pa, calculate

(i) the tensile stress,

tensile stress = ______________

(ii) the tensile strain,

tensile strain = ______________

(iii) the extension,

extension = ______________

(iv) the elastic energy stored in the wire.

elastic energy = ______________

[7]

For Examiner's Use

(c) Explain what happens to the stored energy if the elastic limit is exceeded.

____

____ [1]

5 (a) Explain the term *non-viscous fluid.*

____

____

____ [2]

(b) Air flows over the upper surface of the wings of an aeroplane at a speed of 120 ms^{-1} and past the lower surfaces of the wings at 105 ms^{-1}. The total wing area of the plane is 25 m^2 and the density of air is 1.29 kgm^{-3}.

Calculate

(i) the difference in pressure, Δp, between the upper and lower surfaces of the wings,

$\Delta p =$ ____________________

(ii) the 'lift' force, f, on the aeroplane.

$f =$ ____________________ [4]

For Examiner's Use

(c) Explain why wings are shaped like an aerofoil.

____

____

____

____ [2]

6 The work function of a metal is 2.0 eV. Monochromatic light of wavelength 5.0×10^{-7} m is used to illuminate the metal.

(a) Explain the term *work function.*

____

____

____ [1]

(b) Calculate

(i) the threshold wavelength, λ,

λ = ________________

(ii) the maximum kinetic energy of photoelectrons,

maximum kinetic energy = ________________

For Examiner's Use

(iii) the stopping potential.

stopping potential = ____________________

[6]

(c) Suggest the effects of using an intense light of wavelength 75 nm.

____

____

____ [2]

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL
General Certificate of Education Advanced Level

R. F. Tadu.

MARKING SCHEME

JUNE 2012

PHYSICS 9188/2

1 (a) Rate of change of displacement /speed in a specified direction B1
reject rate of change of displacement w time
$m s^{-1}$ B1

(b) (i) (–) 2 mu B1

(ii) ~~collision is elastic~~ closed system no external force, B1

(c) (i) U – V = V_1 + V   u – v = v_1 + v B1

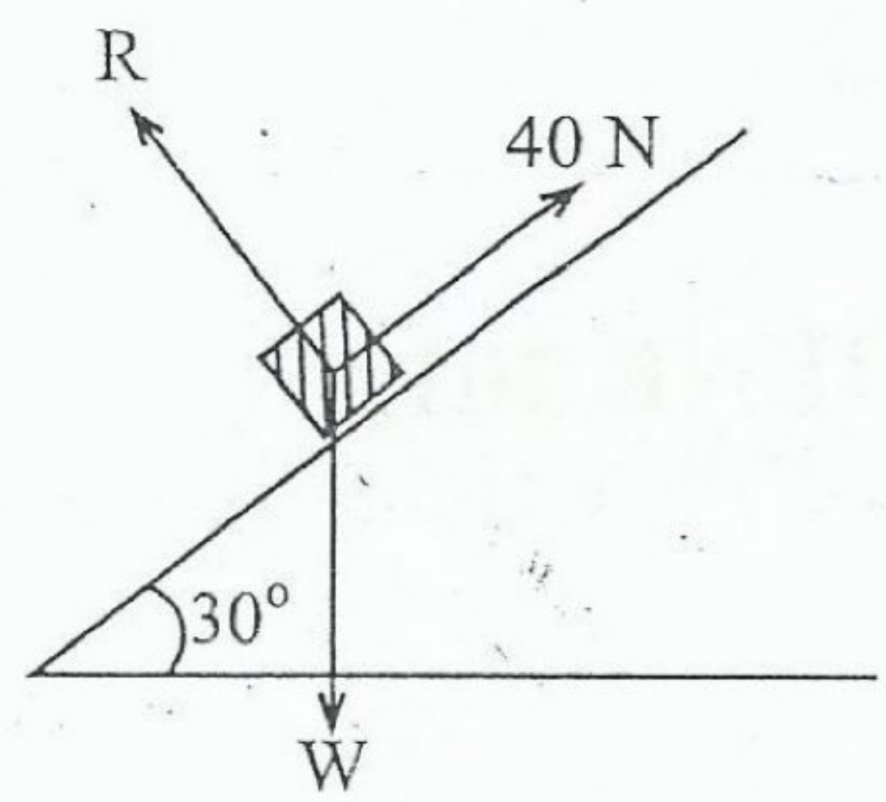
V_1 = U – 2V B1

(ii) Final velocity is less than initial B1
gas has cooled / loses heat B1 [8]

2 (a) product of mass and acceleration / rate of change of momentum B1

The newton is a force which causes acceleration of 1 $m s^{-2}$ on 1 kg mass. B1

(b) (i)



3 correct 2 marks
2 correct 1 mark,

~~-1 for for wrong force~~ B2

(ii) Resultant force = 40 – 4 x 9.81 x 0. 5 C1
40 – 19,62
= 20.4 N A1

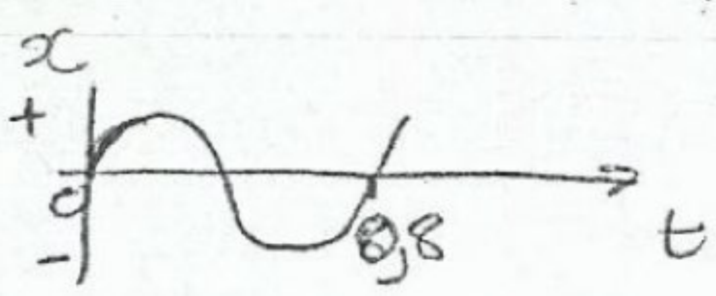
(iii) $a = \frac{F}{M} = \frac{20.4}{4} = 5.1 m s^{-2}$ A1

(c) Air resistance not negligible B1 (8)

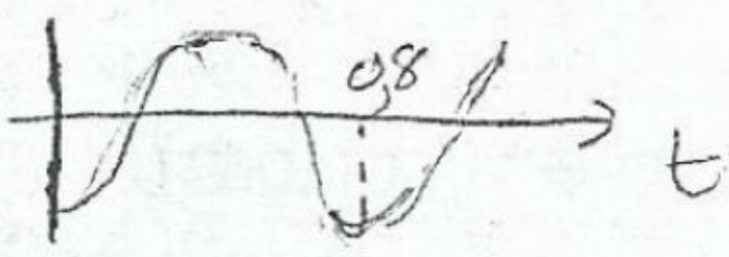
3 (a) (i) T = 0.8 s A1

(ii) $f = \frac{1}{T} = \frac{1}{0.8}$ 1.3 s^{-1} 1,25 s^{-1} ~~B1~~ A1

(b) (i) correct starting point B1
correct shape B1



(ii) correct starting point B1
correct shape B1



(c) E_P maximum at maximum displacement, $E_k = 0$ B1

E_P converted to E_k B1

E_K maximum on passing equilibrium position, $E_P = 0$ B1

E_K converted to E_P B1

E_P maximum at maximum displacement $E_K = 0$ B1

[max 4]

(d) (i) Oscillations where the amplitude becomes smaller and smaller with time B1

(ii) Car suspension system, / moving coil meters / M1

critically damped A1 [13]

4 (a) (i) Stress = $\frac{\text{force}}{\text{cross sectional area}}$ If symbols are used explain the terms B1

(ii) Strain = $\frac{\text{extension}}{\text{original length}}$ B1

(iii) E = stress/ strain B1

(b) (i) stress = $\frac{F}{A} = \frac{12 \times 9.81}{\Pi \times (10^{-3})^2} = 3.7 \times 10^7 \ P_a$ C1

$\frac{117,72}{3,14 \times 10^{-6}}$ → A1

(ii) Strain = $\frac{\text{stress}}{E}$ (~~strain~~) $= \frac{3.7 \times 10^7}{7.0 \times 10^{10}}$ C1

$= 5.4 \times 10^{-4}$ A1

(iii) extension = L x strain = 2 x 5.4 x 10^{-4}

= 1.1mm A1

$1,1 \times 10^{-3}$ m

(iv) energy = $\frac{1}{2} \times 12 \times 9.81\ 1.1 \times 10^{-3}$ C1

= 0.063J A1

0,065J

(c) Part of energy permanently deform the wire | energy lost as heat B1 [11]

5 (a) incompressible fluid | constant density B1

NO frictional force between layers | B1

(b) (i) $\Delta P = \frac{1}{2}\rho\left(V_2^2 - V_1^2\right) = \frac{1}{2} \times 1.29 \times \left(120^2 - 105^2\right)$ C1

$= 2.18 \times 10^3$ Pa A1

(ii) F $= \Delta P \times A = 2.18 \times 10^3 \times 25$ C1

5.45×10^4 N

$= 5.44 \times 10^4$ N A1

(c) so that air flows faster at top than at bottom creating pressure difference B1

and ∴ lift force is generated B1 (8)

6 (a) minimum energy required to extract electrons fro m a metal surface B1

eqn terms defined.

(b) (i) E = hf

$hf_o = 2.0\ eV = 2.0 \times 1.6 \times 10^{-16}$ C1

$\therefore h\frac{c}{\lambda_o} = 2.0 \times 1.6 \times 10^{-16}$ C1

$\lambda_o = \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{2.0 \times 1.6 \times 10^{-19}} = 6.2 \times 10^{-7}$ m A1

(ii) Maximum energy $= hf - \varphi$ B1

$= \frac{6.63 \times 10^{-34} \times 3 \times 10^8}{5.0 \times 10^{-7}} - 2 \times 1.6 \times 10^{-19}$ C1

= ~~7.6×10^{-20} J~~ ~~0,48eV~~ A1

7.78×10^{-20} J

Scanned with CamScanner

(iii) Stopping V

eV = maximum energy B1

eV = 7.67×10^{-20}

$V = \frac{7.7 \times 10^{-20}}{1.6 \times 10^{-19}}$ C1

= 0.48 V A1

0,49 V

(c) No emission of electrons A1

$\lambda > \lambda_0$ / equivalent statements in terms of frequency M1

(12)

Candidate Name	Centre Number	Candidate Number

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

PHYSICS **9188/2**

PAPER 2

NOVEMBER 2012 SESSION 1 hour 15 minutes

Candidates answer on the question paper.
Additional materials:
Electronic calculator and/or Mathematical tables

TIME 1 hour 15 minutes

INSTRUCTIONS TO CANDIDATES

FOR EXAMINER'S USE

Write your name, Centre number and candidate number in the spaces at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided on the question paper.
For numerical answers, **all** working should be shown.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

FOR EXAMINATION'S USE	
1	
2	
3	
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9	
TOTAL	

This question paper consists of 12 printed pages.

[Turn over

*Answer **all** questions.*

For Examiner's Use

1 Express each of the following units in terms of base units.

(i) *volt*

(ii) *ohm*

(iii) *watt*

[6]

2 (a) Define

(i) *distance,*

___

___

___

(ii) *displacement,*

___

___

___

For Examiner's Use

(iii) *acceleration.*

[3]

(b) Some of Newton's equations of motion are as follows:

$$v = u + at$$

$$s = \frac{1}{2}(u+v)t$$

$$v^2 = u^2 + 2as$$

State the **two** conditions which are considered in the derivation of the equations.

[2]

(c) Explain how it is possible for a car to move a distance of 50 km but with zero displacement.

[1]

3 (a) Explain what is meant by *a geostationary orbit* of a satellite.

[1]

For Examiner's Use

(b) A geostationary satellite of mass 120 kg is placed at a distance of 4.4×10^7 m from the centre of the earth.

(i) Calculate the

1. angular velocity, ω, of the satellite,

ω = ____________________

2. speed, v, of the satellite,

v = ____________________

3. acceleration, a, of the satellite.

a = ____________________

(ii) State **one** use of such a satellite.

____ [7]

4 (a) Give **two** similarities and **two** differences between longitudinal and transverse waves.

similarities:

1.____

2.____

For Examiner's Use

differences:

1.____

2.____

[4]

(b) Calculate the period, T, of an electromagnetic wave, with a wavelength of 700 nm, travelling in a vacuum.

$T =$ ____________________ [2]

5 **Fig.5.1** shows an electrical circuit.

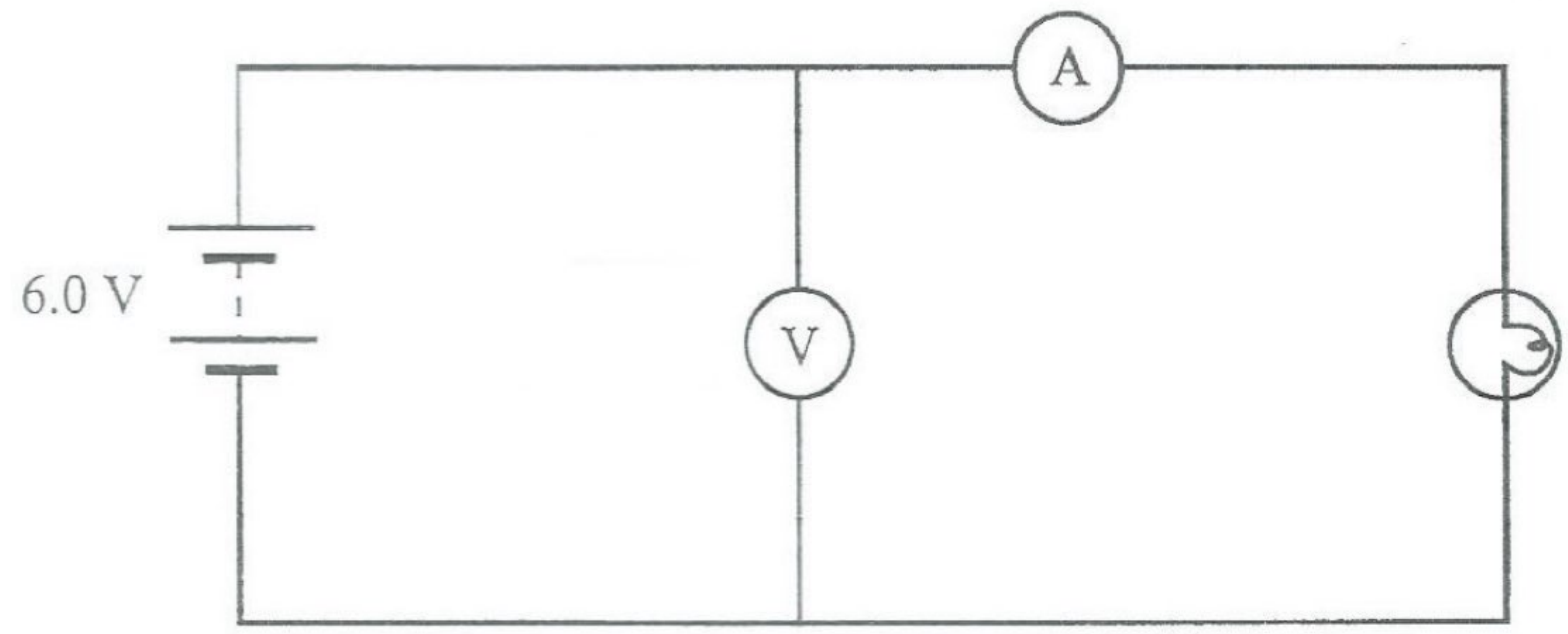


Fig.5.1

The battery in the circuit in **Fig.5.1** has an e.m.f of 6.0 V and drives a current of 0.3 A through the lamp. The voltmeter reading is 4.8 V.

(a) Explain why the voltmeter reading is less than 6.0 V.

____

____

____ [1]

For Examiner's Use

(b) **(i)** Calculate

1. internal resistance, r, of the battery,

$r =$ ______________________

2. energy transfer per second, P, in the lamp.

$P =$ ______________________

(ii) State **two** assumptions you made in order to complete the calculations in **(i)**.

1. ____

____

2. ____

____ [6]

6 **(a)** Define *magnetic flux density*.

____

____ [1]

For Examiner's Use

(b) Section AB of a rectangular current-carrying conductor, of length 7.0 cm, is in a magnetic field, of field strength 0.021 T, as shown in **Fig. 6.1.**

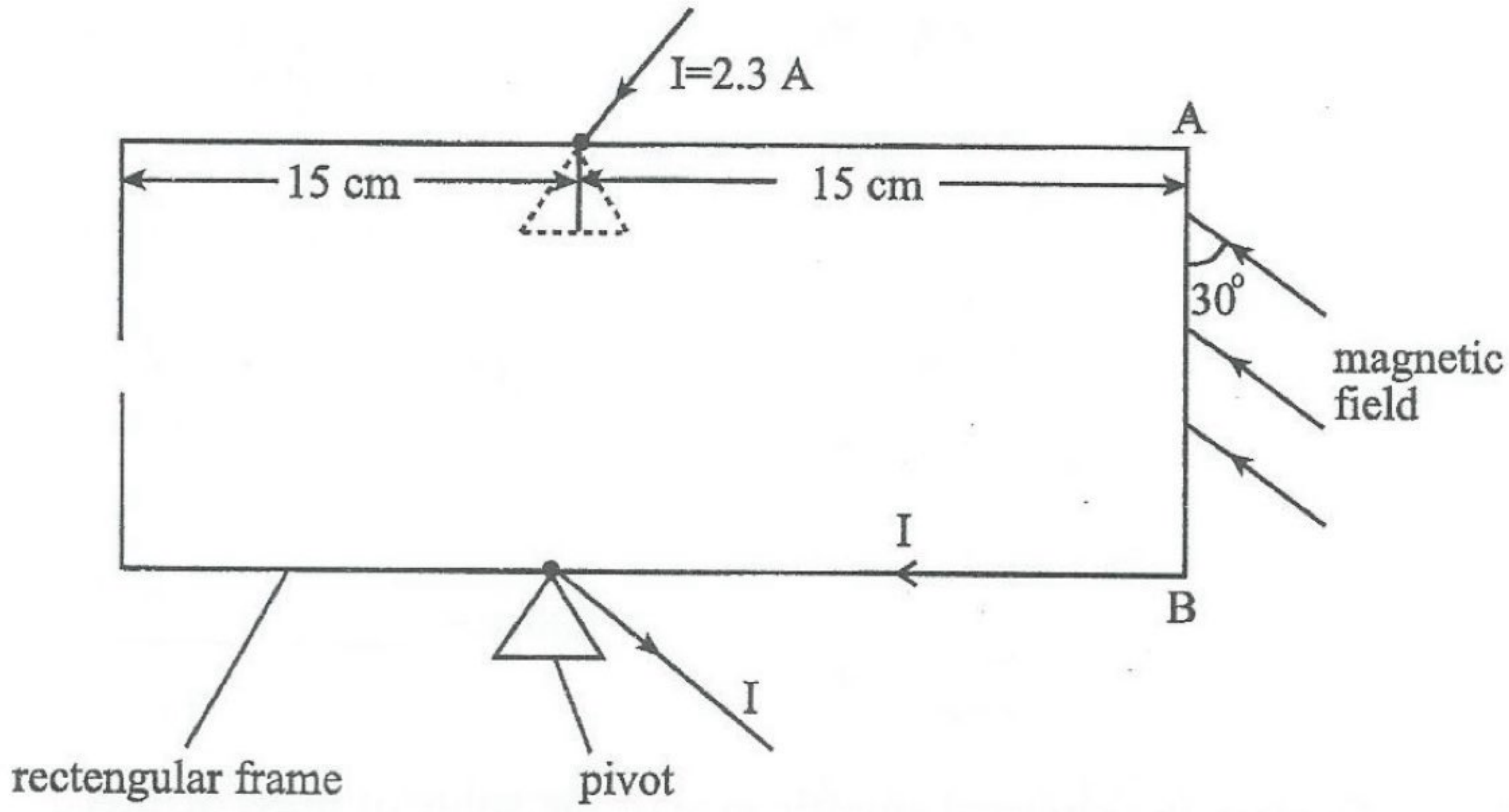


Fig. 6.1

A current of 2.3 A is allowed to pass through the conductor.

(i) Describe the effect of passing the current through part AB.

____

____

____

(ii) Calculate the magnitude of the force experienced by the frame due to the current.

force = ____________________

For Examiner's Use

(iii) Deduce a value of mass that has a weight equal to the force calculated in **(b) (ii)**.

mass = ____________

(iv) Explain the physical significance of the value of mass deduced in **(b) (iii)**.

____

____

____ [6]

7 **(a)** Distinguish between *elastic* and *plastic* deformation of a material.

____

____

____

____ [2]

(b) (i) Sketch a typical load-extension graph for a ductile material.

For Examiner's Use

(ii) On your sketch in **(i)** mark the region where Hooke's Law is obeyed. [3]

(c) A spring of spring constant, B, undergoes an elastic change resulting in an extension, e. Show that its strain energy, W, is given by

$$W = \frac{1}{2}Be^2.$$

[3]

8 **(a)** State **four** assumptions of the kinetic theory of ideal gases.

1. ____

____

2. ____

____

3 . ____

____

4. ____

____ [4]

(b) Nitrogen gas enclosed in a cubic container is assumed to behave ideally at 10 °C.

Given that the molar mass of nitrogen is 28 g, determine the r.m.s speed of nitrogen molecules.

r.m.s. speed = ____________________

[2]

[Turn over

For Examiner's Use

9 **Fig.9.1** shows a photoemissive cell circuit.

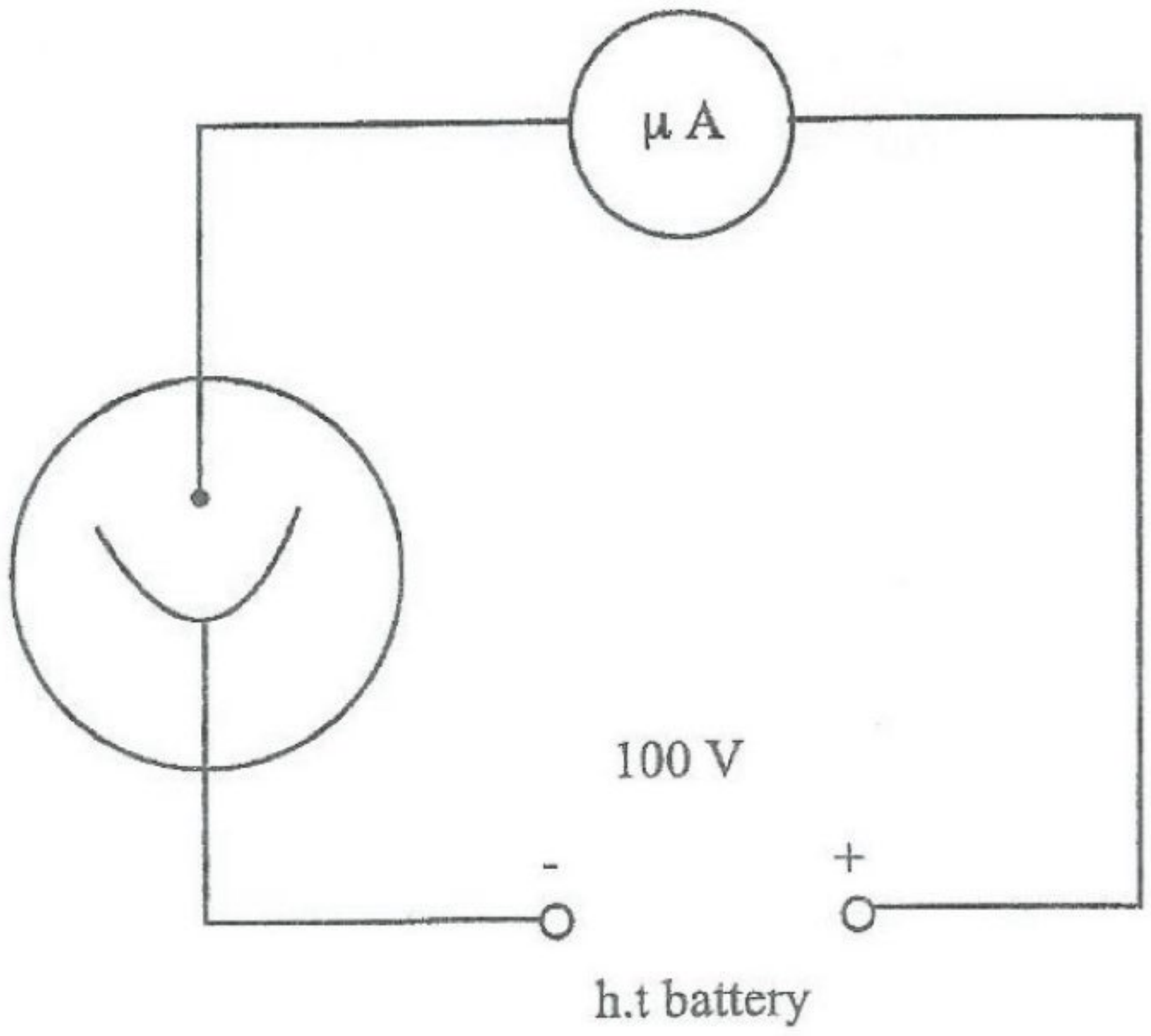


Fig. 9.1

(a) Draw a circuit design, incorporating part or the whole of **Fig.9.1,** for a 12 V burglar alarm which rings if a light beam is broken by an intruder.

[2]

(b) A UV and **not** an infrared source of light might be a good idea for the burglar alarm using a photocell with a cathode-coating work function of 3 eV.

Explain.____

____

____

____ [4]

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

R.F. Tachu

MARKING SCHEME

NOVEMBER 2012

PHYSICS 9188/2

1 (i) $V = \frac{J}{C} = \frac{kgmms^{2}A^{-2}s^{-3}}{As}$ $\frac{kgms^{-2} \times m}{As}$ reject mixing of quantities & units M1

$= kgm^2s^{-3}A^{-1}$ A1

(ii) $\Omega = \frac{kgms^{-2}m}{A^2s}$ M1

$= kgm^2s^{-3}A^{-2}$ A1

(iii) $W = \frac{J}{s} = \frac{kgmms^{-2}}{s}$ M1

$= kgm^2s^{-3}$ A1

2 (a) (i) length of path (between two points) reject length. B1

(ii) distance in a stated direction / shortest distance btwn two points; reject D = S x t B1

(iii) rate of change of velocity reject rate of change of velocity with time / change of velocity B1

(b) (i) acceleration must be constant with time B1

(ii) object moves in a straight line max 2 B1

(c) (i) The car moved a distance of 50 km along a path which led back to its original position B1

3 (a) This is a circular path of a satellite in the plane of the equator such that its orbital period (of 24 hours) equals the rotational period of the earth. B1

idea of circular path / orbit should be stated

(b) (i) 1. $\omega = \frac{2\pi}{T} = \frac{2\pi}{24 \times 60 \times 60}$ C1

$= \underline{\underline{7.3 \times 10^{-5} rads^{-1}}}$ 2 or 3 sig fig A1

2. $V = \omega r$

$= 7.3 \times 10^{-5} \times 4.4 \times 10^{7}$ C1

$= \underline{\underline{3.21 \times 10^{3} ms^{-1}}}$ / 3.20×10^3 m/s 2 or 3 sig fig A1

3 $a = \frac{v^2}{r} = \frac{(3.21 \times 10^{3})^2}{4.4 \times 10^{7}}$ C1

$= 2.34 \times 10^{-1} ms^{-2}$ / 2.33×10^{-1} m/s 2 or 3 sig fig A1

(ii) telecommunications / weather forecast / ~~military~~ surveillance. B1

4 (a) Similarities

- they both transmit energy from source B1
- have a definite wavelength B1
- definite frequency B1
- travel at speed given by $V = f\lambda$ B1
- have definite amplitude B1
- both can be reflected to produce (stationary waves) [max 2]
- interefferred, refracted diffracted
- wave profile travels along direction of propogation.

Differences

longitudinal	transverse	
- oscillations are in a direction parallel to direction of travel of the wave	- oscillations in a direction that is perpendicular to the direction of travel of wave	B1
- cannot be polarised	- can be polarised	B1
- example	- example	B1

[max 2]

(b) $V = f\lambda$

$f = \frac{V}{\lambda}$

$T = \frac{\lambda}{V}$ C1

$T = \frac{700 \times 10^{-9}}{3 \times 10^{8}}$

$= 2.33 \times 10^{-15}$ s 2/3. sig fig A1

5 (a) Internal resistance of the battery. B1

(b) (i) $E = V + Ir$

$Ir = E - V$

$r = \frac{E - V}{I}$ ~~CF~~

$= \frac{6 - 4.8}{0.3}$ C1

$= 4\Omega$ A1

(ii) $P = VI$

= 4.8 x 0.3 C1

= 1.44 MW reject 1,4W A1

(iii) - No potential drop across ammeter/ ammeter has zero resistance B1

- no current through the voltmeter/ voltmeter has infinite resistance B1

6 (a) Force **per** unit current length Accept formula w terms defined $\frac{F}{Il\sin\theta}$ θ btwn field & conductor. B1

(b) (i) AB experiences a force downwards B1
This raises the opposite side / end of frame B1

(ii) F = $BIl\sin\theta$

= 0.021 x 2.3 x 0.07 sin 30° C1

= $1.69 \times 10^{-3} N$ Accept $1,7 \times 10^{-3}$ N " 2 or more sig fig A1

(iii) m = $\frac{F}{g}$

= $\frac{1.69 \times 10^{-3}}{9.81}$

= 1.72×10^{-4} kg, $1,73 \times 10^{-4}$ kg, $1,7 \times 10^{-4}$ kg A1

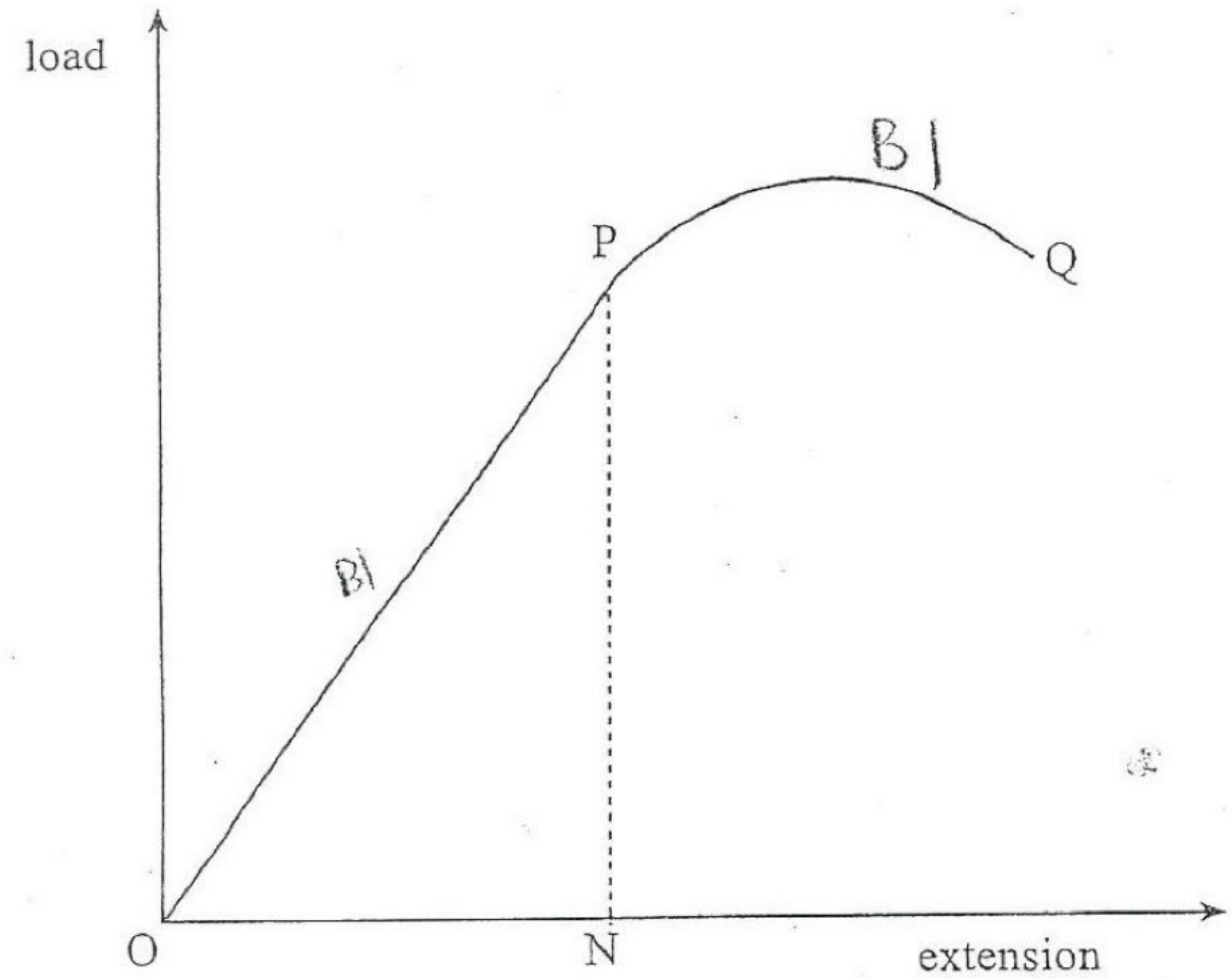
(v) This is the value of mass needed on the opposite side of frame for the frame to balance. B1

7 (a)

Plastic deformation	Elastic deformation
energy lost	energy lost
- causes permanent extension (1)	- causes temporary extension (1)
- occurs beyond elastic limit (1)	- occurs before elastic limit (1)

[max 2] B2

(b) (i)



Show a region where

- load $\propto$ extension OP
- plastic deformation occur PO

B2

(ii) OP B1

(c) Strain energy $=$ area Δ OPN M1

$= \frac{1}{2}$ base $\times$ h base $= e$ B1

$h =$ force/ load C1

$= Be$

$= \frac{1}{2}e \times Be^2$ AO

8 (a)

- the molecules of a particular gas use identical B1
- gas particles are in continuous random motion
- collision between the molecules and with the walls are perfectly elastic B1
- the attraction between molecules is negligible B1
- the volume of the molecules is negligible compared with the volume occupied by the gas B1
- duration of a collision is negligible compared with the time between collisions B1
- there are a sufficiently large number of molecules (for statistics to be meaningfully applied.) B1
- Newtonian mechanics can be applied [max 4]

(b)

$$m\bar{v}^2 = 3kT$$

$$\sqrt{\langle \bar{v}^2 \rangle} = \sqrt{\frac{3PV}{Nm}}$$

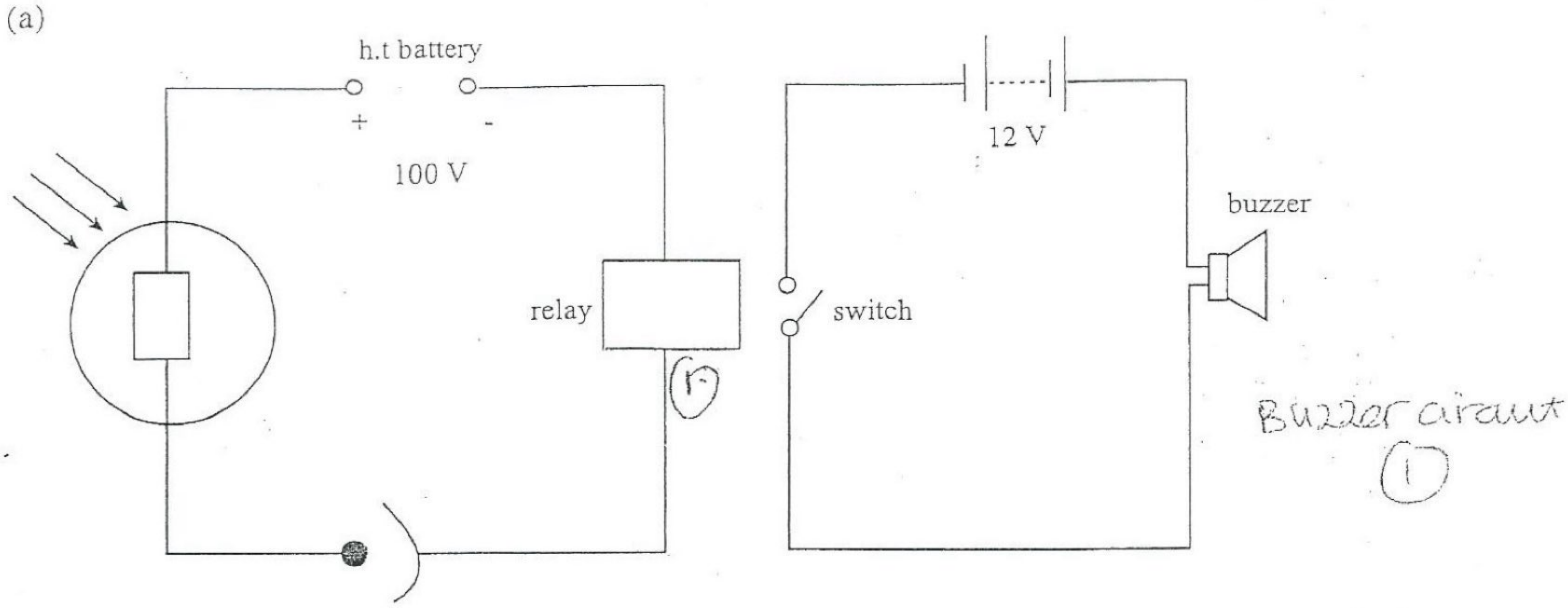
$$\bar{v}^2 = \frac{3kT}{m}$$

$$\bar{v}rms = \sqrt{\frac{3KT}{m}}$$

$$= \sqrt{\frac{3 \times 283 \times 1.38 \times 10^{-23}}{0.028/6 \times 10^{23}}}$$ C1

$$= 501\ ms^{-1}$$ A1

9 (a)



B2

(b) $hf_0 = 3eV$ or

$f_o = \dfrac{3 \times 1.6 \times 10^{-19}}{6.63 \times 10^{-34}}$ C1

$= 7.2 \times 10^{14}$ Hz A1

$\lambda_0 = 4.17 \times 10^{-7}$ m

0.12λ IR $(10^{-3} - 10^{-6}$ m$)$

13.8eV λ UV, ( )

$f_{IR} << 7.2 \times 10^{14}$ Hz M1

So would not cause any
Photoelectric emission B1

Candidate Name	Centre Number	Candidate Number

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

PHYSICS — 9188/2

PAPER 2

JUNE 2013 SESSION — 1 hour 15 minutes

Candidates answer on the question paper.
Additional materials:
Electronic calculator and/or Mathematical tables

TIME 1 hour 15 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided on the question paper.
For numerical answers, **all** working should be shown.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

FOR EXAMINER'S USE	
1	
2	
3	
4	
5	
6	
7	
TOTAL	

This question paper consists of 12 printed pages.

[Turn over

*Answer **all** questions.*

For Examiner's Use

1 **(a)** Distinguish between *base* and *derived units*.

____

____

____ [1]

(b) The equati

For Examiner's Use

(c) Explain the limitation of using base units in the formulation of equations.

[1]

2 (a) (i) Define *acceleration.*

(ii) An object can undergo acceleration at constant speed. Explain.

[3]

(b) Distinguish between *elastic collision* and *inelastic collision.*

[2]

(c) A mass, m, travelling with velocity, u, collides with a stationary mass, M. After the collision the two masses move off with speed, v and V, respectively in the original direction of m.

(i) Assuming the collision to be elastic, write down the equation for the conservation of

1. kinetic energy,

2. momentum.

(ii) Hence show that $V = \frac{2mu}{M+m}$.

[4]

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3 (a) Define *gravitational potential energy*.

____

____ [1]

(b) (i) A man of mass 55.0 kg jumped 1.50 m high on earth.

Deduce

1. the gravitational potential energy, P, gained,

$P =$ ______________________

2. the initial velocity, u.

$u =$ ______________________ [3]

(ii) The acceleration due to gravity on the moon is $\frac{1}{6}$ that on the earth. The man in **(i)** jumps with the same initial velocity from the surface of the moon.

Comment on the height reached.

____

____

____

____ [3]

For Examiner's Use

4 **(a)** Explain what is meant by *monochromatic light*.

____

____ [1]

(b) A parallel beam of monochromatic light of wave length 650 nm is directed normally at a diffraction grating which has 600 lines per mm.

Determine

(i) the slit spacing,

slit spacing = ______________

(ii) the highest order number,

highest order number = ______________

(iii) the angle of diffraction for the highest order.

angle of diffraction = ______________ [5]

5 Electric forces can either be attractive or repulsive, while gravitational forces are always attractive. Consider an electron of charge $-e$ and a proton of charge $+e$ in an atom separated by a distance r.

For Examiner's Use

(a) Write down the expression for the

(i) electric force, F_E, between the electron and the proton,

____

____

(ii) gravitational force, F_g, between the electron and the proton.

____

____

____

[2]

(b) State with a reason whether F_E in **(a) (i)** is attractive or repulsive.

____

____ [2]

(c) Using your answers in **(a)** and the appropriate numerical data, find the ratio of the magnitude of F_E to F_g.

[3]

For Examiner's Use

6 (a) Define the term *strain.*

____

____ [1]

(b) In an attempt to push a nail into a hole in a concrete wall a builder hammers a 1.50 m long cylindrical rod of cross-sectional area 12.7 mm^2 to produce a compression of 1.80 mm as in **fig 6.1**

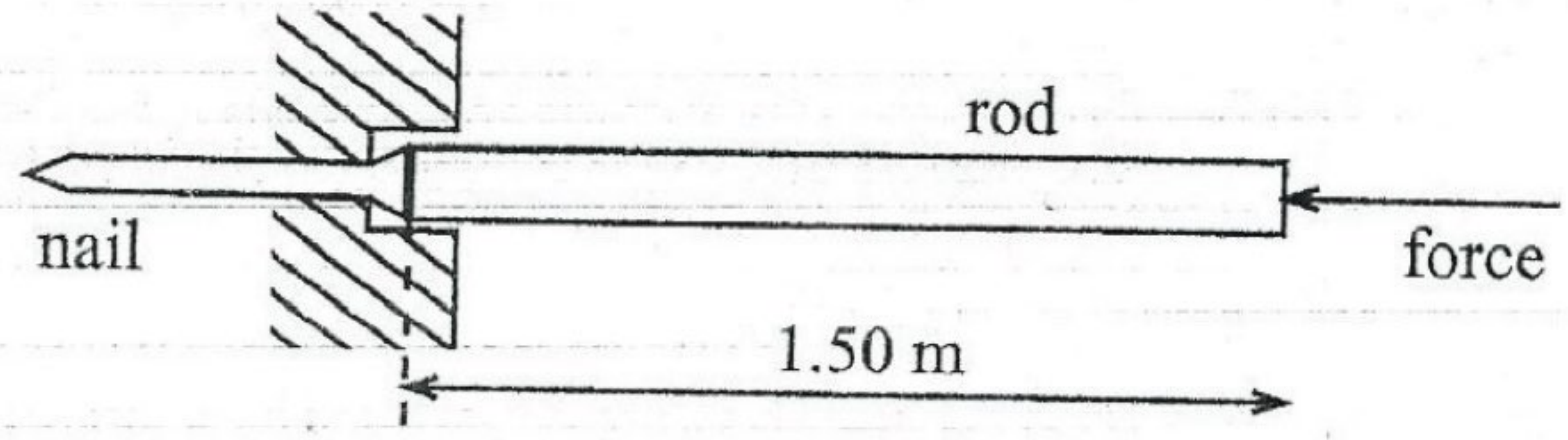


Fig 6.1

(i) Calculate the maximum strain in the rod.

maximum strain = ______________ [2]

(ii) The hammer used has a mass of 4.0 kg and hits the nail with a velocity of 45m/s.

Determine

1. the kinetic energy of the hammer on hitting the rod,

kinetic energy = ______________

2. the elastic potential energy stored in the cylindrical rod when fully compressed stating any assumption made,

elastic potential energy = ______________

[Turn over

For Examiner's Use

3. the average force the cylinder exerts on the nail,

average force = ______________

4. the maximum force exerted on the nail by the cylinder.

maximum force = ______________

[8]

7 **(a)** Define

(i) *binding energy of a nuclide,*

____

____

____

(ii) *mass defect.*

____

____

____

[4]

For Examiner's Use

(b) An atom of an isotope of potassium, ${}^{39}_{19}K$, has a mass of 38.9533 u.

Given that the mass of a proton is 1.0073 u and that of a neutron is 1.0087 u, calculate

(i) the binding energy for the ${}^{39}_{19}K$ isotope in MeV,

binding energy = ______________

(ii) the binding energy per nucleon for the ${}^{39}_{19}K$.

binding energy per nucleon = ______________

[4]

(c) Uranium-235 can split into molybdenum-95 and Lanthanum-139 by a process called nuclear fission. Two neutrons and unidentified particles are emitted in the process, as follows:

$$ {}^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{95}_{42}Mo + {}^{139}_{57}La + 2{}^{1}_{0}n + mX $$

(i) Define *nuclear fission.*

____

____

____

(ii) State how nuclear fission affects binding energy per nucleon.

____

(iii) Identify particle X and the integral value of m.

For Examiner's Use

[4]

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL
General Certificate of Education Advanced Level

MARKING SCHEME

NOVEMBER 2013

PHYSICS 9188/2

1 (a) (i) is a unit which can only be used to derive other units / independent of other units B1

(ii) Not true A1

Base units can only show that an equation is homogeneous but can not check on constants M1

(b) $\rho = \frac{RA}{L} = \frac{R\pi d^2}{4L}$

$= \frac{25.1 \times \pi \times (0.45 \times 10^{-3})^2}{4 \times 1.94}$ C1

$= 2.057 \times 10^{-6}\Omega m$ A1

$\frac{\Delta\rho}{\rho} = \frac{\Delta R}{R} + 2\frac{\Delta d}{d} + \frac{\Delta l}{L}$ A0

$= \frac{0.1}{25.1} + \frac{2(0.02)}{0.45} + \frac{0.02}{1.94}$ C1

$= \Delta\rho = 2 \times 10^{-7}$ (accept any value that can be rounded off to this) A1

$= \therefore \rho = (2.1 \pm 0.2) \times 10^{-6}\Omega m$ c.a.o A1

[8]

2 (a) Resultant force = 0 / acceleration = 0 B1

Resultant torque = 0 / moment = 0 B1

(b) $T_2 \sin 60 = mg$ A0

$T_2 = \dfrac{2 \times 9.81}{\sin 60}$ = Tension in CD C1

= 22.7 N 2 or 3 sig fig A1

$T_1 = T_2 \cos 60$ A0

= 22.7 cos 60 C1

= 11.3 N (Tension in AB) 2 or 3 sig fig A1

11,5 N

[6]

3 (a) (i) In a progressive wave the wave profile moves in the direction of the wave B1

In a stationary wave the wave profile does not move in any direction. B1

(ii) In a progressive wave neighbouring points are not in phase B1

In a stationary wave all points between two successive nodes/adjacent vibrate in phase (with one another). B1

Accept correct diagram.

(iii) In a progressive wave every point has the same amplitude B1

In a stationary wave points between two (successive) nodes have different amplitudes B1

[6]

4 (a) Liquid should be incompressible /

Liquid should be of constant density — B1

Liquid should be nonviscous — B1

(b) (i)

Lift / Upthrust shown — B1

Weight shown — B1

Arrow spacings above
> Spacing below — B1

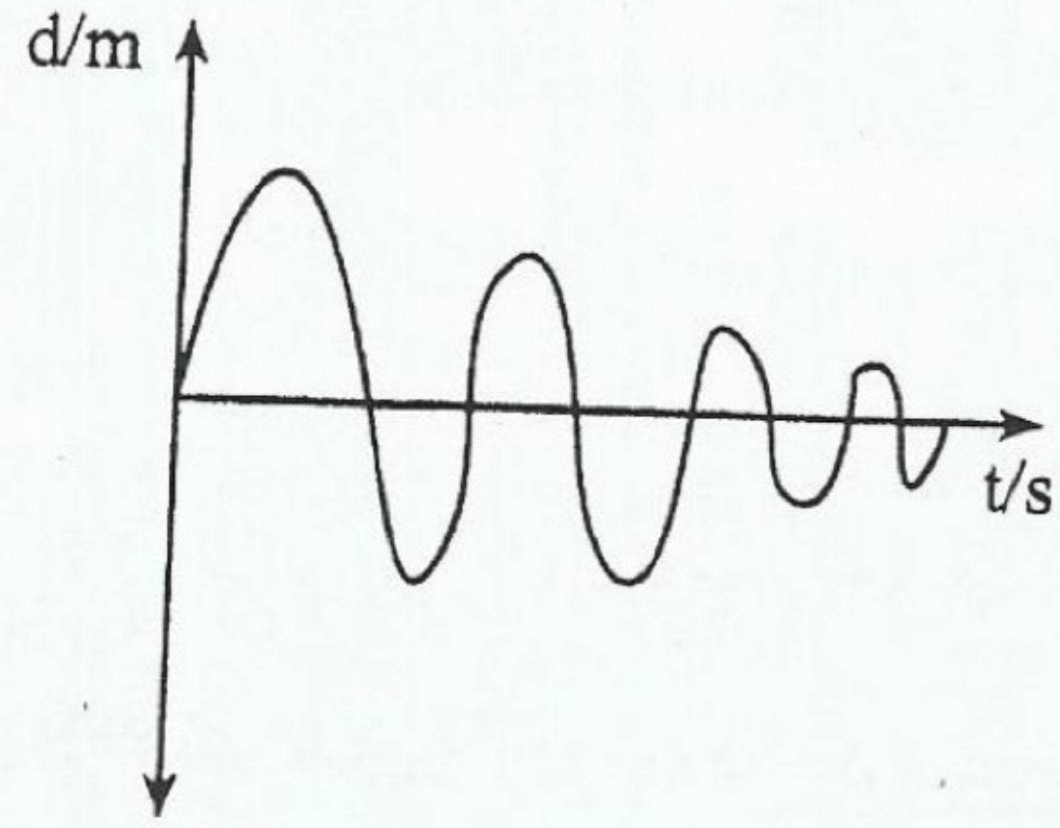
(ii) not constant — A1

the fluid on top of the aerofoil travels faster — M1

[7]

5 (a)

B1



Changes in the magnetic flux linked with the plate induce eddy currents in the sliced copper plate. The slits have high resistance B1
low eddy currents are induced and hence dumping the oscillation lightly B1

(b) Lenz's law B1

current flows in such a way as to oppose the change that has produced it B1

(c) use unsliced copper plate B1

The resistance of the copper plate will be very low hence high eddy current flow in such a way as to produce a strong braking effect B1

[7]

6 (a) 3.34 × 10^5 J of energy is required to change 1 kg of ice into ~~water~~; solid liquid — B1
at constant temperature — B1

(b) In latent heat of fusion bonds are only weakened — B1

In latent heat of vaporisation bonds are broken ~~and~~/energy is done by the particles against the atmosphere as they evaporate — B1

(c) (i) random motion of smoke particles / smoke particles colliding w air molecules — B1
in a zig zag path / continuously changing direction — B1

(ii) speed decreases — ~~B1~~ A1

greater mass would make them more difficult to push around — ~~B1~~ M1
/ inertia

[8]

7 (a) Is a device which has one or more inputs and one output only B1

(b) (i)

A	B	Y
0	0	1
0	1	0
1	0	0
1	1	1

4 correct 3 marks C3

(ii) Y = 1 if and only if A = B B1

[5]

8 (a) (i) a quantum of an electromagnetic radiation/discrete packet of an electromagnetic radiation / light energy B1

(ii) the wavelength above which no photoelectric emission can occur / maximum wavelength B1

(iii) the reverse / negative potential needed just to stop emission of electrons B1

(b) (i) $E = hf = \frac{hc}{\lambda}$ reject formula

$= \frac{6.63 \times 10^{-34} \times 3 \times 10^{8}}{5.89 \times 10^{-7}}$ C1

$= 3.38 \times 10^{-19}$ J A1

2 or max 3. sig fig.

(ii) $p = \frac{h}{\lambda} = \frac{6.63 \times 10^{-34}}{5.89 \times 10^{-7}} = 1.13 \times 10^{-27}$ Ns C1 A1

[7]

9 (a) (i) Is the time taken for the activity of any given sample to fall to half its original value /mass/countrate/no of particles B1

(ii) Is the number of disintegrations per unit time B1

A = −λN ~~define~~ terms explained.

(b) (i) $\frac{dN}{dt} = \frac{\ln 2}{t_{\frac{1}{2}}} \times N$ A0

$$= \frac{\ln 2 \times 0.002 \times 6.02 \times 10^{23}}{5.5 \times 365 \times 3600 \times 24 \times 60}$$ C1

$= 8.02 \times 10^{10}$ Bq $2{,}43 \times 10^{13}$ year^{-1} A1

(ii) $A = A_o e^{-\lambda t}$ A0

$= 8.02 \times 10^{10} \times e^{\frac{-\ln 2}{5.5} \times 4}$ C1

$= 4.84 \times 10^{10}$ Bq A1

$4{,}61 \times 10^{10}$ Bq. 2 or 3 sigfig

[6]

Candidate Name	Centre Number	Candidate Number

For Performance Measurement

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

PHYSICS — 9188/2

PAPER 2

JUNE 2014 SESSION — 1 hour 15 minutes

Candidates answer on the question paper.
Additional materials:
Electronic calculator and/or Mathematical tables

TIME 1 hour 15 minutes

INSTRUCTIONS TO CANDIDATES

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FOR EXAMINER'S USE	
1	
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8	
TOTAL	

This question paper consists of 12 printed pages.

[Turn over

Formulae

uniformly accelerated motion,	$s = ut + \frac{1}{2}at^2$ $v^2 = u^2 + 2as$
work done on/by a gas,	$W = p\Delta V$
gravitational potential,	$\phi = -\frac{Gm}{r}$
refractive index,	$n = \frac{1}{\sin C}$
resistors in series,	$R = R_1 + R_2 + \ldots$
resistors in parallel,	$1/R = 1/R_1 + 1/R_2 + \ldots$
electric potential,	$V = \frac{Q}{4\pi\epsilon_0 r}$
capacitors in series,	$1/C = 1/C_1 + 1/C_2 + \ldots$
capacitors in parallel,	$C = C_1 + C_2 + \ldots$
energy of charged capacitor,	$W = \frac{1}{2}QV$
alternating current/voltage,	$x = x_0 \sin \omega t$
hydrostatic pressure,	$p = \rho gh$
pressure of an ideal gas,	$p = \frac{1}{3}\frac{Nm}{V}\langle c^2 \rangle$
radioactive decay,	$x = x_0 \exp(-\lambda t)$
decay constant,	$\lambda = \frac{0.693}{t_{\frac{1}{2}}}$
critical density of matter in the Universe,	$\rho_0 = \frac{3H_0^2}{8\pi G}$
equation of continuity,	$Av = \text{constant}$
Bernoulli equation (simplified),	$p_1 + \frac{1}{2}\rho v_1^2 = p_2 + \frac{1}{2}\rho v_2^2$
Stokes' law,	$F = Ar\eta v$
Reynolds' number,	$R_e = \frac{\rho v r}{\eta}$
drag force in turbulent flow,	$F = Br^2\rho v^2$

Data

speed of light in free space,	$c = 3.00 \times 10^{8}\ \mathrm{m\,s^{-1}}$
permeability of free space,	$\mu_0 = 4\pi \times 10^{-7}\ \mathrm{H\,m^{-1}}$
permittivity of free space,	$\epsilon_0 = 8.85 \times 10^{-12}\ \mathrm{F\,m^{-1}}$
elementary charge,	$e = 1.60 \times 10^{-19}\ \mathrm{C}$
the Planck constant,	$h = 6.63 \times 10^{-34}\ \mathrm{J\,s}$
unified atomic mass constant,	$u = 1.66 \times 10^{-27}\ \mathrm{kg}$
rest mass of electron,	$m_e = 9.11 \times 10^{-31}\ \mathrm{kg}$
rest mass of proton,	$m_p = 1.67 \times 10^{-27}\ \mathrm{kg}$
molar gas constant,	$R = 8.31\ \mathrm{J\,K^{-1}\,mol^{-1}}$
the Avogadro constant,	$N_A = 6.02 \times 10^{23}\ \mathrm{mol^{-1}}$
the Boltzmann constant,	$k = 1.38 \times 10^{-23}\ \mathrm{J\,K^{-1}}$
gravitational constant,	$G = 6.67 \times 10^{-11}\ \mathrm{N\,m^2\,kg^{-2}}$
acceleration of free fall,	$g = 9.81\ \mathrm{m\,s^{-2}}$

*Answer **all** questions.*

For Examiner's Use

1 **(a)** Define the following terms:

(i) *derived quantity*

____

____

(ii) *physical quantity*

____

____

____ [2]

(b) The equation of state for one mole of a real gas is

$$\left(P + \frac{a}{V^2}\right)(V - b) = RT,$$

where P, V and T are the pressure, volume and absolute temperature of the gas respectively.

(i) Determine the base units of

1. a,

base units of a = ______________

2. R.

base units of R = ______________

For Examiner's Use

(ii) State any **two** cases where an equation can be homogeneous but incorrect.

____

____

____ [5]

2 (a) Define *impulse*.

____

____ [1]

(b) A 2 kg body at rest is subjected to a 200 N force for 0.20 s followed by a 400 N force for 0.30 s. The forces are acting in the same direction.

Determine

(i) the momentum of the body,

momentum = ______________

(ii) the final speed of the body.

final speed = ______________ [4]

(c) Explain why, when a tennis player strikes a ball, he 'follows through'.

____

____

____

____ [3]

For Examiner's Use

3 (a) Explain the terms:

(i) *diffraction*

____

____

(ii) *superposition*

____

______________________________ [2]

(b) State **two** conditions needed for an observable interference pattern.

____

____

______________________________ [2]

(c) **Fig. 3.1** shows laser light passing through a double slit.

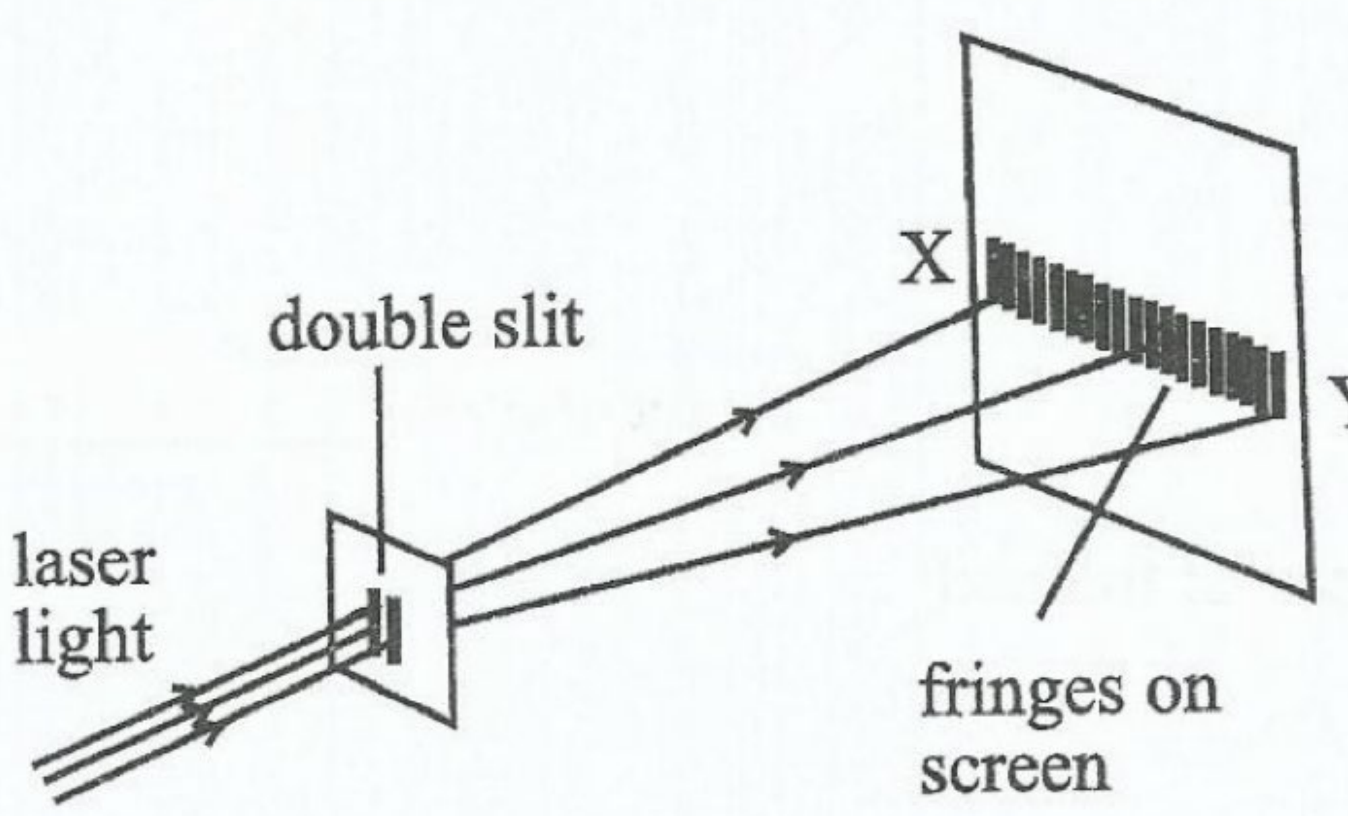


Fig. 3.1

(i) State what would happen to the positions of X and Y when the doubleslit is rotated through 90°.

____

(ii) Explain what would happen to the positions of X and Y when the double slit is replaced by a 1 m wide door.

____

____

______________________________ [3]

4 (a) Define

(i) *streamline flow,*

____

____

(ii) *non-viscous flow.*

____

____

[2]

(b) **Fig. 4.1** shows a pipe carrying a fluid of density 1 000 kgm^{-3}. The diameter of end A is 6 cm while that of end B is 2 cm. At A the fluid is flowing at 2 m/s and has a pressure of 180 kPa.

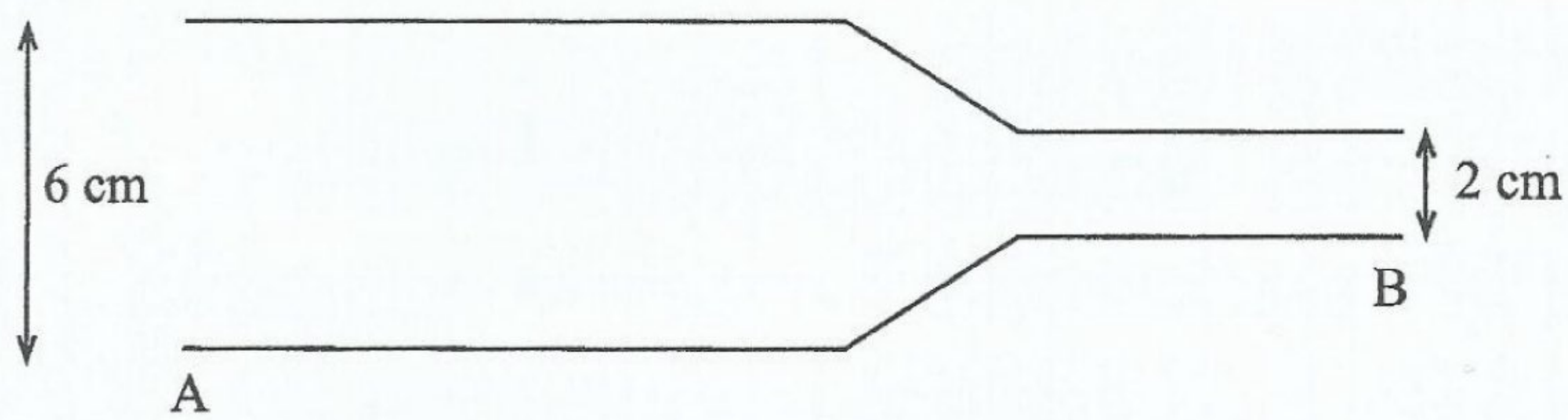


Fig. 4.1

Calculate

(i) the velocity at end B,

velocity = ______________

(ii) the pressure at end B.

pressure = ______________

[4]

5 (a) Define

(i) *stress*,

____

____

(ii) *strain*.

____

______________________________ [2]

(b) Sketch a force-extension graph for a

(i) ductile material,

(ii) brittle material,

(iii) polymeric material.

[3]

For Examiner's Use

6 (a) State and explain Kirchhoff's first and second laws.

first law: ______________________________

explanation: ______________________________

____

second law: ______________________________

explanation: ______________________________

______________________________ [4]

(b) **Fig. 6.1** shows a simple circuit.

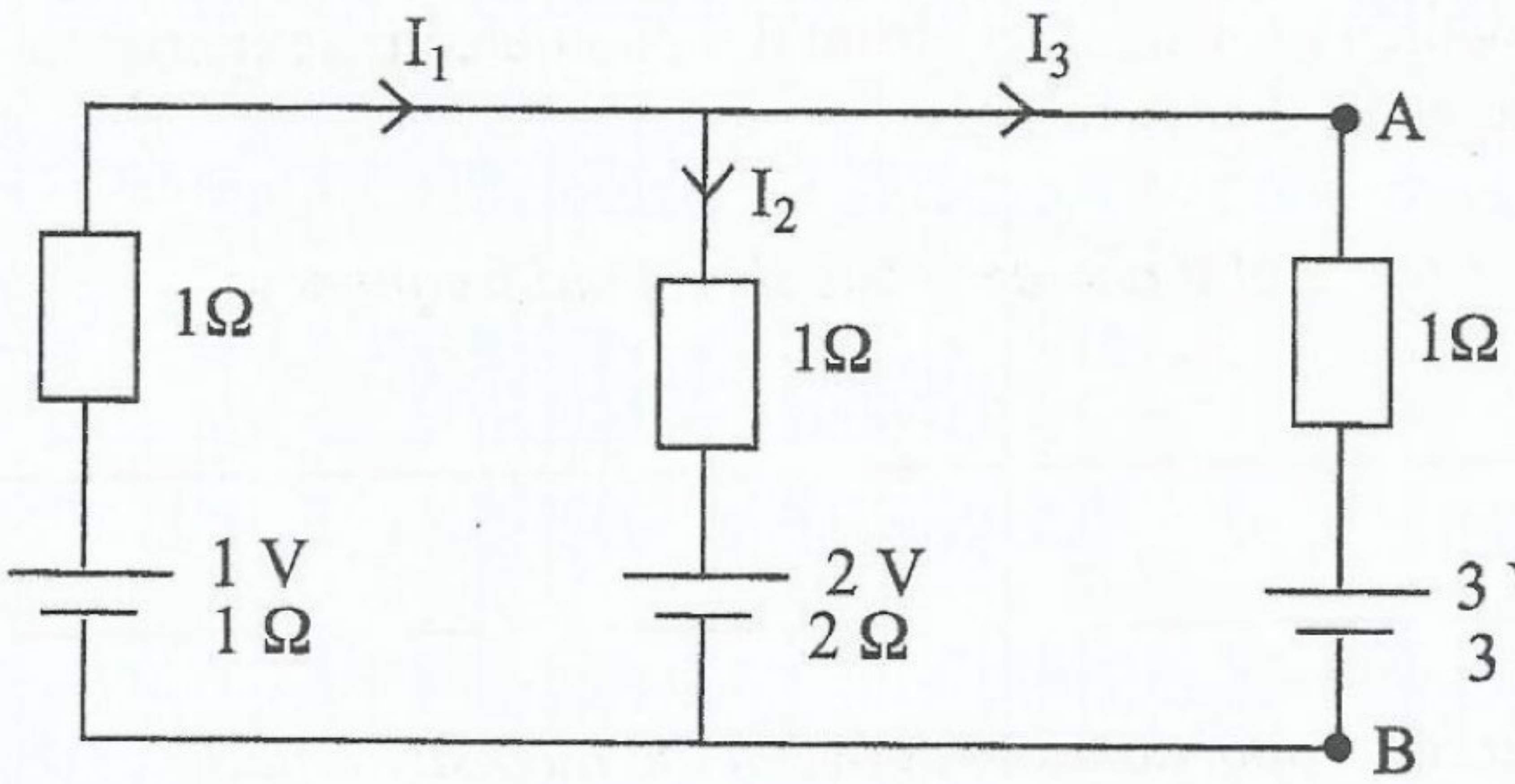


Fig. 6.1

(i) Calculate the values of I_1, I_2 and I_3.

I_1 = ______________

I_2 = ______________

I_3 = ______________ [6]

For Examiner's Use

(ii) Hence determine the potential difference between points A and B.

p.d. = ____________ [1]

7 (a) Define *the photoelectric effect.*

____

____

______________________________ [2]

(b) Describe how the following facts from the photoelectric experiment contradict the wave theory of light:

(i) *the existence of a photoelectric threshold frequency*

____

____

(ii) *the direct proportionality between the intensity and the photoelectric current*

____

____

(iii) *instantaneous emission of electrons*

____

____

[3]

For Examiner's Use

(c) Light of wavelength 400 nm is incident on a metal surface with a work function of 3.6×10^{-19} J.

Calculate

(i) the energy of the incident light,

energy = __________

(ii) the maximum kinetic energy of the emitted electron.

kinetic energy = __________

[4]

8 (a) Explain the following properties of an ideal opamp:

(i) *infinite slew rate*

____

____

(ii) *infinite bandwidth*

____

____

(iii) *zero output impedance*

____

____

(iv) *voltage gain*

____

____

[4]

(b) **Fig. 8.1** shows a summing amplifier.

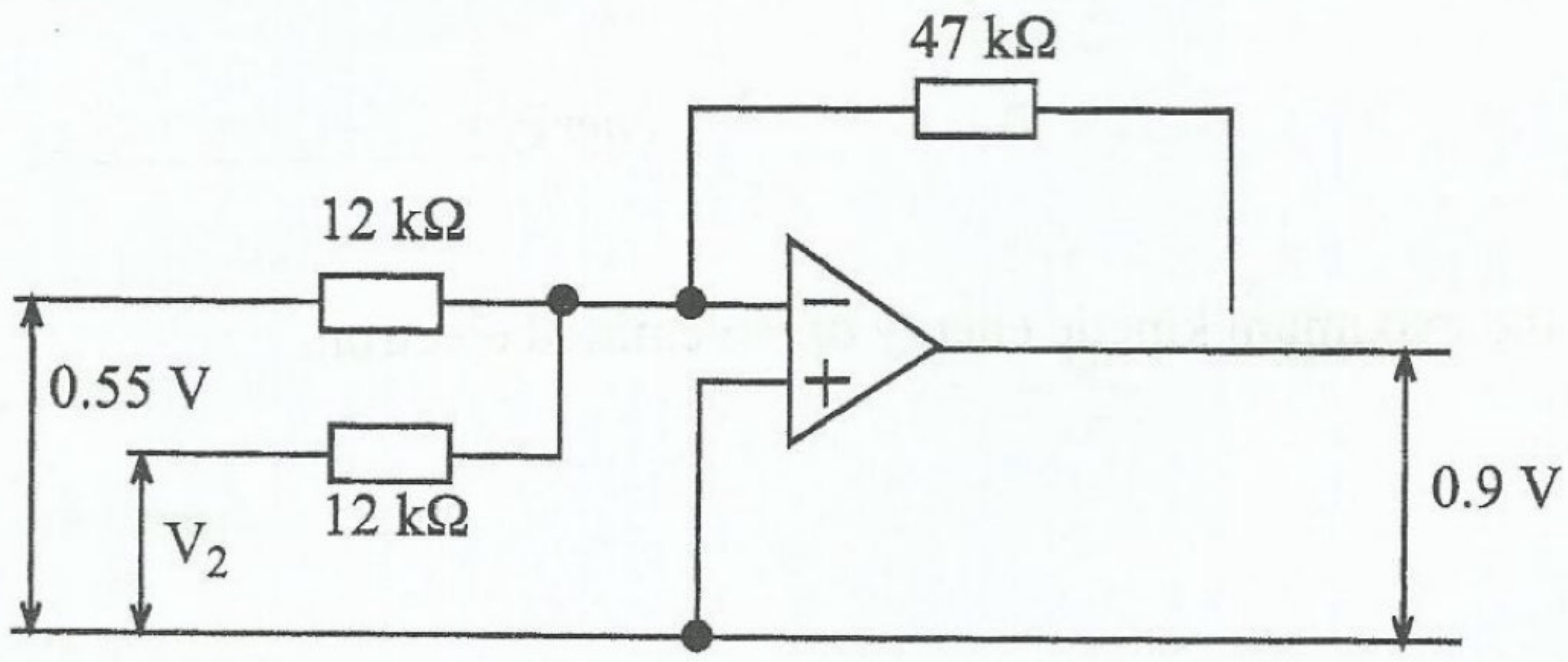


Fig. 8.1

The opamp has inputs 0.55 V and V_2 and an output is 0.9 V.

(i) Calculate V_2.

V_2 = ______________ [2]

(ii) State **one** industrial application of the circuit.

____ [1]

JUNE 2014 9188/2

1 (a) (i) is a product or quotient of two or more base ~~units~~ qties. Reject units B1

(ii) It has a numerical value and a unit/ It can be expressed in measureable terms./ Any measurable quantity. B1

(b) (i) $[a] = [pV^2]$ = kgm^5s^{-2}

= kgm^5s^{-2} A1

(2) $[R]$ = $kgm^{-1}s^{-2}k^{-1} \times m^3$ C1

= $kgm^2s^{-2}k^{-1}$ A1

(ii) incorrect coefficient / wrong dimensionless coefficient B1

missing terms B1

extra term added B1

Max B2

2 (a) Impulse = Force × time/change in momentum / impulse = mΔV terms explained B1

(b) (i) total impulse = Ft = (200 × 0.2) + (400 × 0.3) C1

= 160 Ns   Accept Ft = 200×0.2 = 40Ns or Ft = 400×0.3 = 120Ns A1

(ii) Ft = mv − mu   Accept : kgms⁻¹ as unit. C1

$\therefore v = \frac{Ft}{m} = \frac{160}{2} = 80m/s$ A1

(c) In order to increase time taken in contact with the ball. B1

Impulse increase ~~and~~ a large change in momentum. B1

The ball leaves the bat with high speed B1

3 (a) (i) the bending or spreading of waves when passing an obstacle (of comparable size to its wavelength.) B1

(ii) combined effect at any point in a medium due to two or more waves travelling in the medium B1

(b) waves must be coherent /constant phase difference B1

waves must be of almost the same amplitude / sources must be close to each other B1

June 2014 P2

(c) (i) also rotate through 90° B1

(ii) ~~No observation~~
width of door not comparable to wavelength of laser light ~~A1~~ ~~B1~~
No distinctive ~~fringes~~ diffraction pattern observed B1

4 (a) (i) is when particles follow a smooth path/steady flow/paths do not cross each other B1

(ii) is when there is no internal friction between particles in an ideal fluid. B1

(b) (i) $A_1V_1 = A_2V_2$

$V_2 = V_1\frac{A_1}{A_2} = 2\left(\frac{r_A}{r_B}\right)^2$ C1

$= 2 \times 9$

$= 18$ m/s A1

(ii) $P_2 = P_1 + \frac{1}{2}\rho(V_A^2 - v_B^2)$

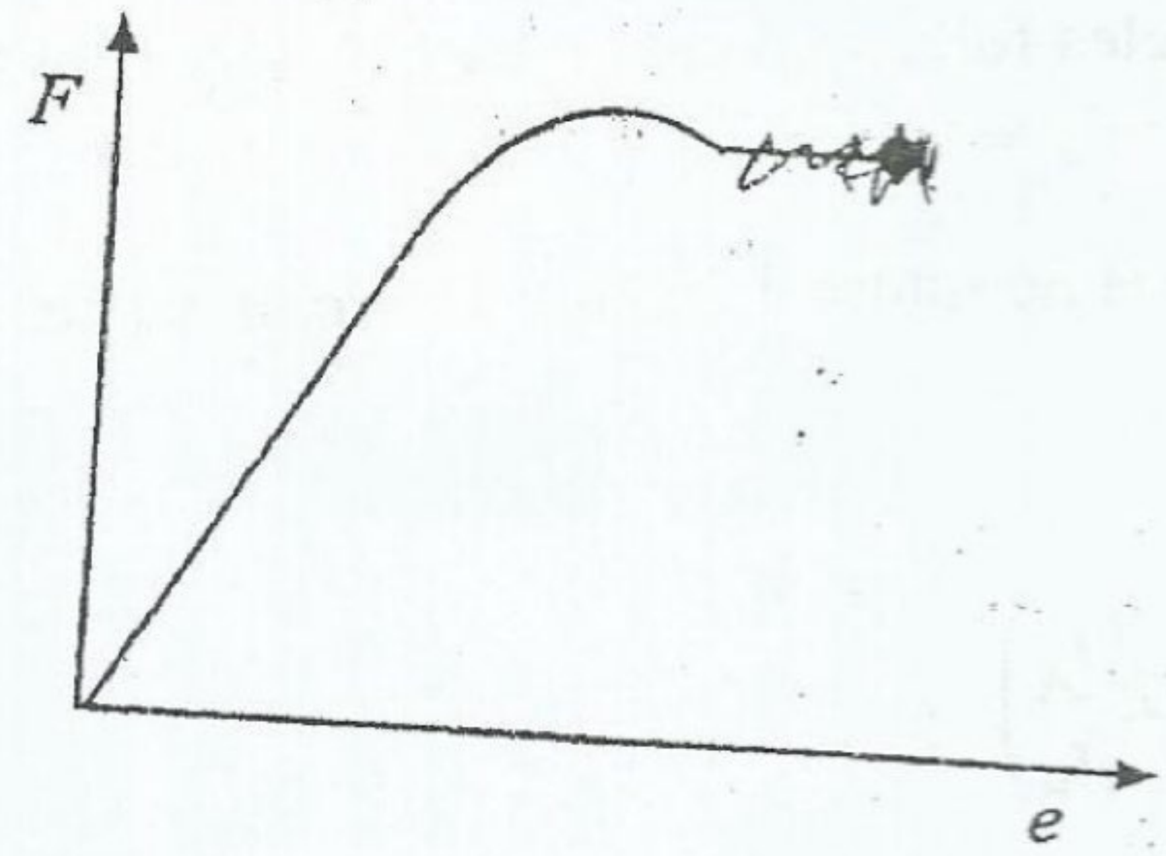
$= 1.8 \times 10^5 + \frac{1}{2}[1\,000 \times (2^2 - 18^2)]$ C1

$= 20$ kPa A1

5 (a) (i) Force (acting) per unit (crossectional) area

(ii) Extention per unit ~~natural~~ original length B1

(b) B1



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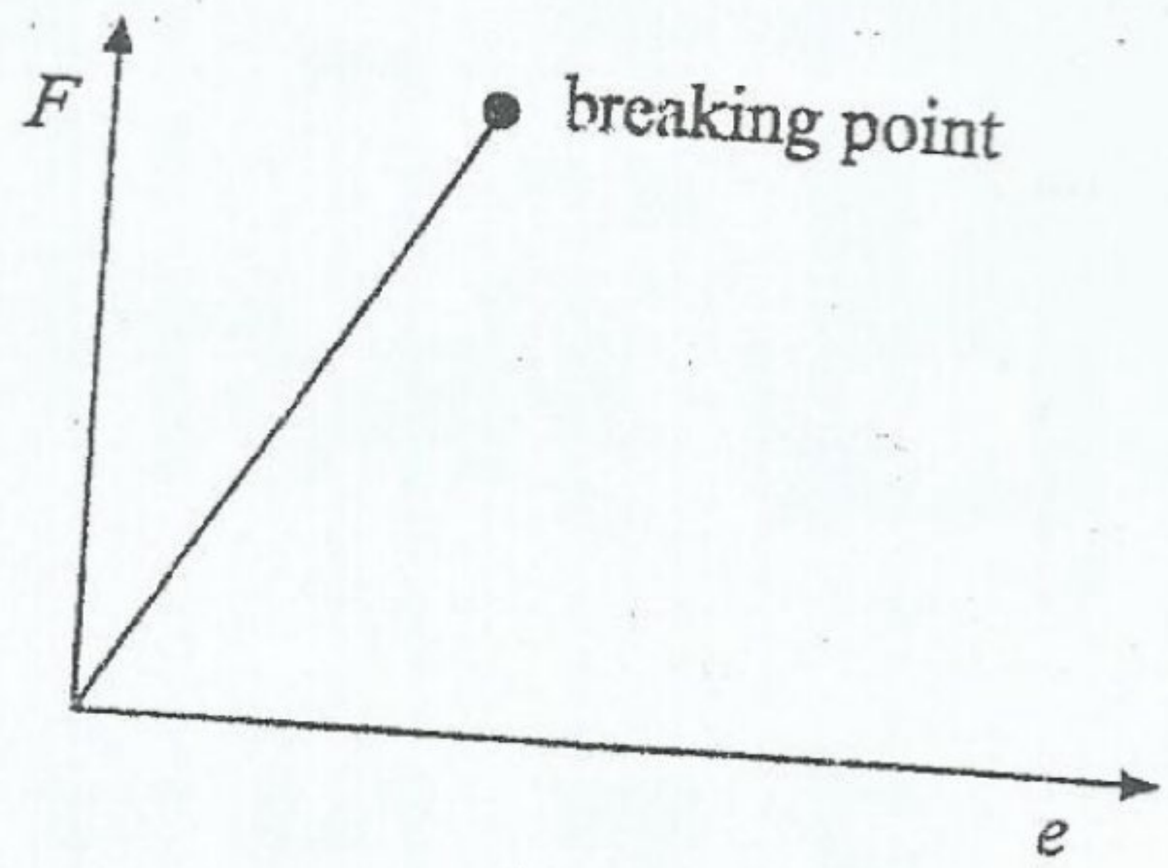
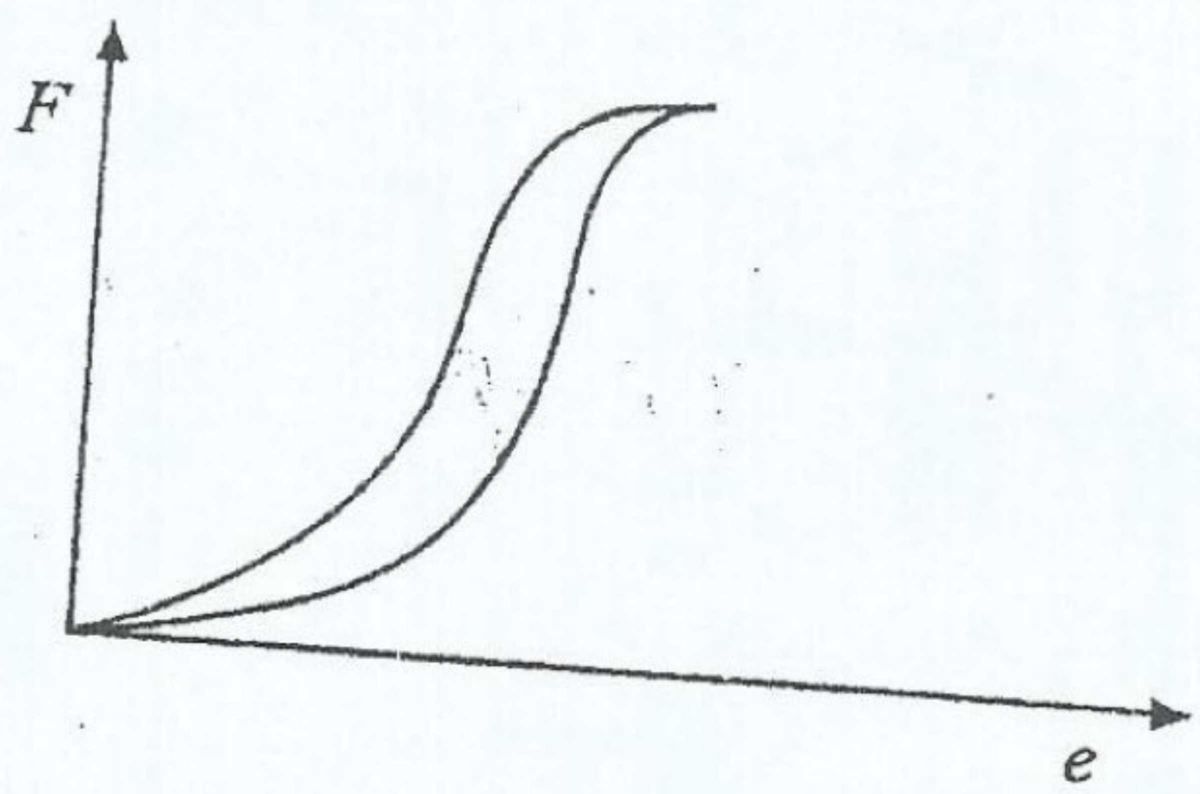


B1



B1

Correct shape & axes labelled but penalise once for axes.

6 (a) First law

Current into a junction = current leaving the junction/sum of currents into a Junction = sum of currents leaving the junction B1

It follows from the conservation of charge B1

Second law

$\sum e.m.f = \sum IR$ in a closed loop. B1

It follows from the principle of conservation of energy B1

(b) (i) $I_1 = I_2 + I_3$ C1

$2I_1 + 3I_2 = -1$ (1) C1

$4I_3 - 3I_2 = -1$ (2) C1

$2I_1 + 4I_3 = -2$ C1 max C3

~~but $I_3 = I_1 - I_2$~~

$\therefore 4I_1 = 7I_2 = -1$ (3)

solve eqn (1) and (3) simultaneously

$4I_1 + 6I_2 = -2$

$4I_1 - 7I_2 = -2$

subtract

$-13\ I_2 = 1$

$I_2 = -\frac{1}{13} = -0.0769A$ A1

(i) substitute for I_1 in equation (1)

$2I_1 = -1 - 3(0.0769)$

$I_1 = \frac{-1+3(0.0769)}{2}$

$= -0.385\ A$ A1

$\therefore I_3 = I_1 - I_2$

$= -0.385 + 0.0769$

$= -0.30775$ A

A1

(ii) $3 - 4(0.30775) = 1.77$ V

Or

$1 + 2(0.385) = 1.77$ V

A1

Or

$2 - 3(0.0769) = 1.77$ V

NB: fractions penalize once per question.

7 (a) is the ejection of electrons from a ~~cold~~ metal surface when radiation of sufficiently high frequency falls on it /A(W) B1

(b) 1. Any frequency can cause emission of electrons
~~The higher the intensity of illumination the higher the energy~~ B1 B1

2. if intensity of illumination increases, each electron would receive more energy and emitted with a greater velocity B1

3. The electron would take some time to accumulate sufficient energy that would enable it to escape from the metal surface B1

(c) (i) $E = hf = \frac{hc}{\lambda}$

$= \frac{6.63 \times 10^{-34} \times 3 \times 10^{8}}{400 \times 10^{-9}}$ C1

$= 4.97 \times 10^{-19} J$ Reject more than 3 sig fig. A1

(ii) $E_{max} = hf - W_0$

$= 4.97 \times 10^{-19} - 3.6 \times 10^{-19}$ C1

$= 1.37 \times 10^{-19} J$ A1

8 (a) (i) If the input suddenly changes, the output suddenly changes instep without any time delay B1

(ii) it amplifies all frequencies by the same amount B1

(iii) the amplifier can provide the correct current for any load no matter how small its resistance B1

(iv) voltage gain $= \dfrac{\text{output voltage}}{\text{input voltage}}$ B1

(b) (i) $V_0 = -\left[\dfrac{R_3}{R_1}.V_1 + \dfrac{R_3}{R_2}V_2\right]$ C1

$0.9 = -\left[\dfrac{47}{12}.0.55 + \dfrac{47}{12}.V_2\right]$

$V_2 = \dfrac{-0.9 \times 12}{47} - 0.55$ C1

$= -0.78\text{ V}$ A1

(ii) music as a mixer / mathematical process of addition in analogue computing. B1

Candidate Name	Centre Number	Candidate Number

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

PHYSICS **9188/2**

PAPER 2 Theory

NOVEMBER 2014 SESSION 1 hour 15 minutes

Candidates answer on the question paper.
Additional materials:
Electronic calculator and/or Mathematical tables

TIME 1 hour 15 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.
Write your answers in the spaces provided on the question paper.
For numerical answers, **all** working should be shown.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

FOR EXAMINER'S USE	
1	
2	
3	
4	
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6	
7	
8	
9	
10	
TOTAL	

This question paper consists of 14 printed pages and 2 blank pages.

[Turn over

Formulae

uniformly accelerated motion,	$s = ut + \frac{1}{2}at^2$ $v^2 = u^2 + 2as$
work done on/by a gas,	$W = p\Delta V$
gravitational potential,	$\phi = -\frac{Gm}{r}$
refractive index,	$n = \frac{1}{\sin C}$
resistors in series,	$R = R_1 + R_2 + \ldots$
resistors in parallel,	$1/R = 1/R_1 + 1/R_2 + \ldots$
electric potential,	$V = \frac{Q}{4\pi\epsilon_0 r}$
capacitors in series,	$1/C = 1/C_1 + 1/C_2 + \ldots$
capacitors in parallel,	$C = C_1 + C_2 + \ldots$
energy of charged capacitor,	$W = \frac{1}{2}QV$
alternating current/voltage,	$x = x_0 \sin \omega t$
hydrostatic pressure,	$p = \rho gh$
pressure of an ideal gas,	$p = \frac{1}{3}\frac{Nm}{V}\langle c^2 \rangle$
radioactive decay,	$x = x_0 \exp(-\lambda t)$
decay constant,	$\lambda = \frac{0.693}{t_{\frac{1}{2}}}$
critical density of matter in the Universe,	$\rho_0 = \frac{3H_0^2}{8\pi G}$
equation of continuity,	$Av = \text{constant}$
Bernoulli equation (simplified),	$p_1 + \frac{1}{2}\rho v_1^2 = p_2 + \frac{1}{2}\rho v_2^2$
Stokes' law,	$F = Ar\eta v$
Reynolds' number,	$R_e = \frac{\rho vr}{\eta}$
drag force in turbulent flow,	$F = Br^2\rho v^2$

Data

speed of light in free space,	$c = 3.00 \times 10^{8}$ m s^{-1}
permeability of free space,	$\mu_0 = 4\pi \times 10^{-7}$ H m^{-1}
permittivity of free space,	$\epsilon_0 = 8.85 \times 10^{-12}$ F m^{-1}
elementary charge,	$e = 1.60 \times 10^{-19}$ C
the Planck constant,	$h = 6.63 \times 10^{-34}$ J s
unified atomic mass constant,	$u = 1.66 \times 10^{-27}$ kg
rest mass of electron,	$m_e = 9.11 \times 10^{-31}$ kg
rest mass of proton,	$m_p = 1.67 \times 10^{-27}$ kg
molar gas constant,	$R = 8.31$ J K^{-1} mol^{-1}
the Avogadro constant,	$N_A = 6.02 \times 10^{23}$ mol^{-1}
the Boltzmann constant,	$k = 1.38 \times 10^{-23}$ J K^{-1}
gravitational constant,	$G = 6.67 \times 10^{-11}$ N m^2 kg^{-2}
acceleration of free fall,	$g = 9.81$ m s^{-2}

Answer all questions.

For Examiner's Use

1 A motorist is moving along a 2 m wide road at 40 ms^{-1}. He spots a wild pig 5 m away from the road moving at 2.5 ms^{-1}.

If their direction of travel are at right angles, calculate the time taken by the pig

(i) to reach the road,

time = ____________

(ii) to cross the road.

time = ____________

(iii) The motorist applied brakes after 0.5 s some 10 m away from the pig's crossing point to avoid hitting it. The mass of the motorist and his car is 12 000 kg.

State the motorist's reaction time.

____

(iv) Determine the distance from where the motorist noticed the pig to the crossing point.

distance = ____________

[6]

For Examiner's Use

5 (a) State the two conditions for equilibrium.

....

.... [2]

(b) Fig. 5.1 shows a builder's arm holding a brick.

Fig. 5.1

On **Fig. 5.1**, use arrows to show the points and lines of action of the forces which keep the arm in equilibrium. [3]

For Examiner's Use

2 (a) State the two conditions for equilibrium.

____

____ [2]

(b) **Fig. 2.1** shows a builder's arm holding a brick.

Fig. 2.1

On **Fig. 2.1**, use arrows to show the points and lines of action of the forces which keep the arm in equilibrium. [4]

3 (a) (i) Define *simple harmonic motion*.

(ii) **Fig. 3.1** shows the variation of energy of an oscillating simple pendulum with its displacement.

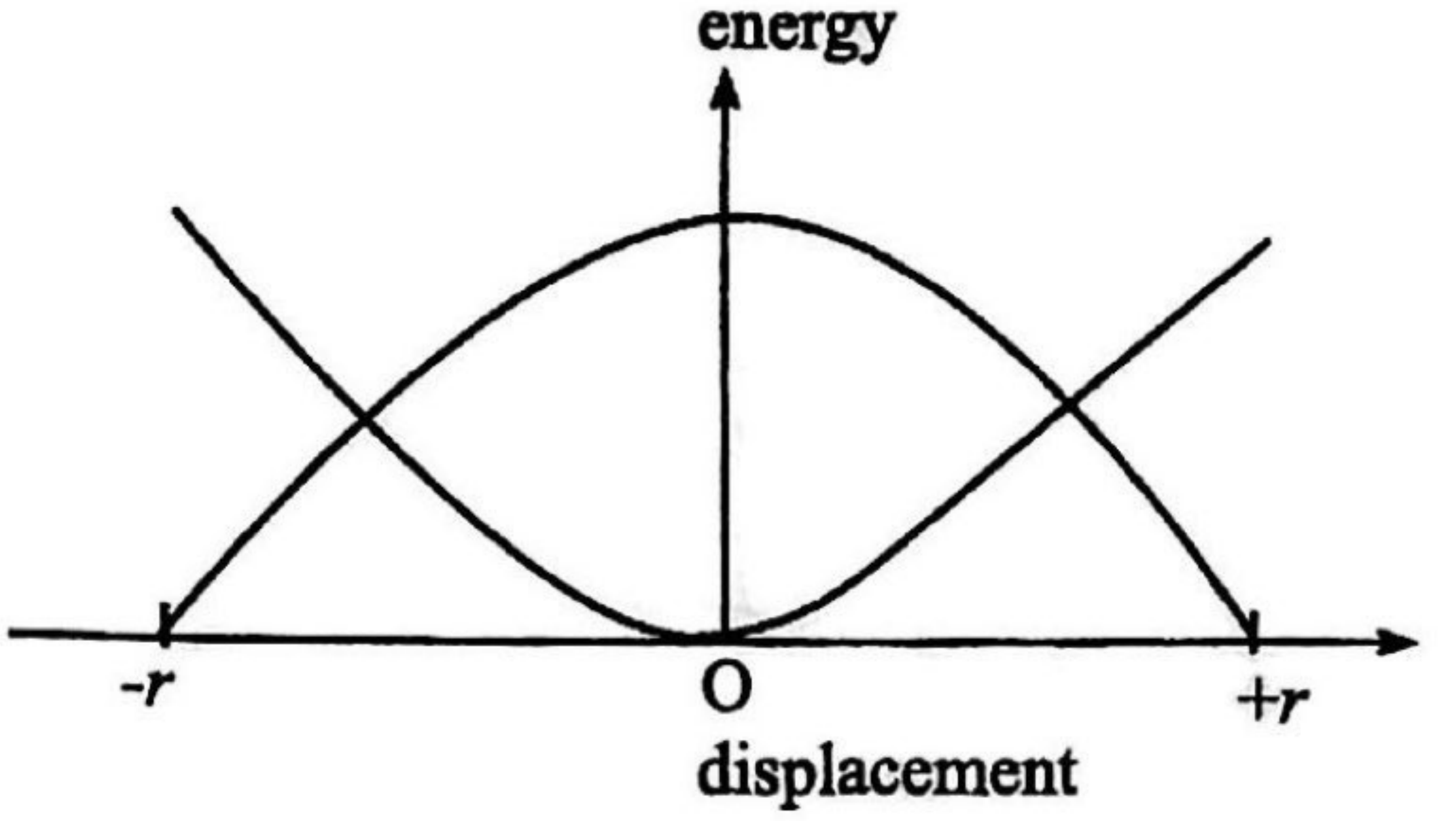


Fig. 3.1

On **Fig. 3.1** label the curve for potential energy, E_p, and that for kinetic energy, E_k.

[4]

(b) (i) Sketch displacement-time graphs to distinguish between light damping, heavy damping and critical damping.

(ii) Give **one** practical example where oscillations which are critically damped are observed.

[4]

For Examiner's Use

4 Coherent sources of light produce an observable interference pattern.

(a) Explain the term *coherent sources*.

____

____

____ [1]

(b) A plane diffraction grating having k lines per unit length is illuminated normally by a source of monochromatic light of wavelength λ.

Given the grating equation as $\sin\theta = nk\lambda$, state the significance of

(i) n,

____

____

(ii) θ.

____

____ [2]

5 (a) Define

(i) *electric field strength,*

____

____

____

(ii) *electric potential.*

____

____

____

[3]

(b) Two electric charges Q_1 and Q_2 of charges +10 nC and –5 nC respectively are placed 50 mm apart.

Calculate the combined electric field strength, E, at their mid-point.

E = ____________________ [3]

For Examiner's Use

6 (a) Define

(i) *capacitance*,

____

____

____

(ii) *the farad.*

____

____

______________________________ [2]

(b) If a student was given two 4 μF capacitors, draw diagrams to show how the capacitors could be connected in order to give a combined capacitance of

(i) 2 μF,

(ii) 8 μF.

[2]

[Turn over

For Examiner's Use

(c) A capacitor of capacitance, C, is fully charged by a 200 V battery. It is then discharged through a small coil of resistance wire embedded in a thermally insulated block of specific heat capacity $2.5 \times 10^{-2}\,\text{Jkg}^{-1}\text{K}^{-1}$ and mass 0.1 kg.

If the temperature of the block rises by 0.4 K, find the value of C.

$C =$ ____________ [3]

For Examiner's Use

7 (a) Define *root mean square value of an alternating current.*

____

____ [1]

(b) **Fig. 7.1 shows a voltage wave on a cathode ray oscilloscope. The time-base and the y-gain are set at 5 ms/cm and 0.2 V/cm respectively.**

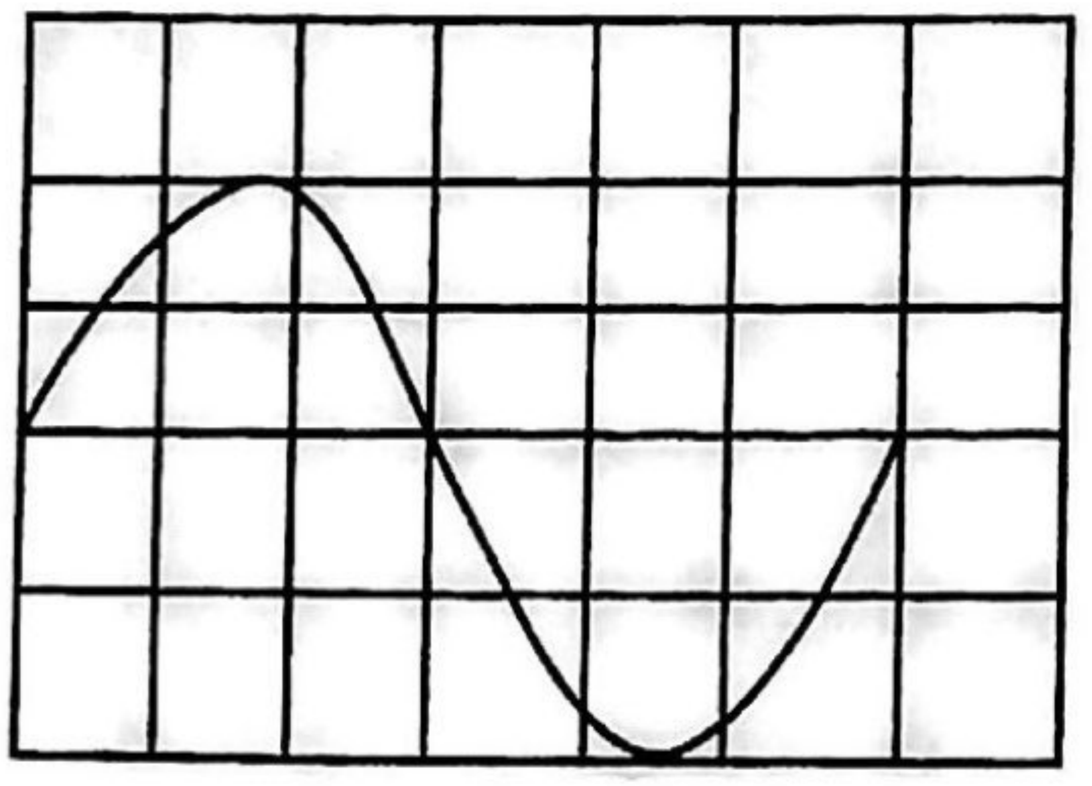


Fig. 7.1

Determine

(i) the peak-to-peak voltage,

____

(ii) the root mean square voltage,

____

(iii) the mean power developed in a 30 Ω resistor.

____ [5]

[Turn over

For Examiner's Use

8 Fig. 8.1(a) and (b) show electric circuits.

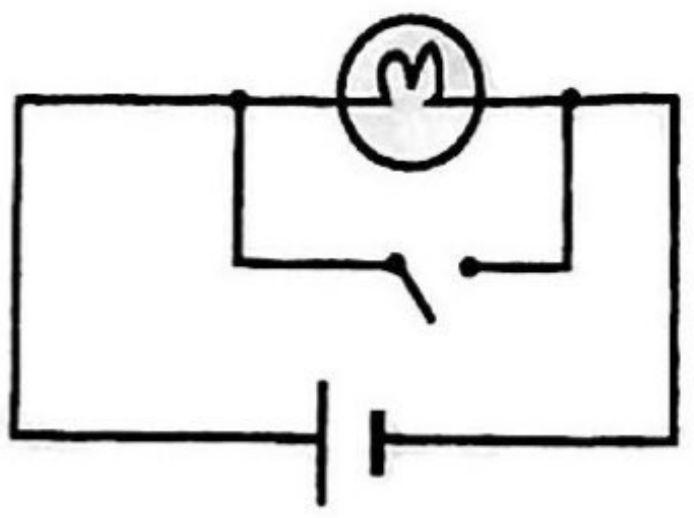


Fig. 8.1(a)

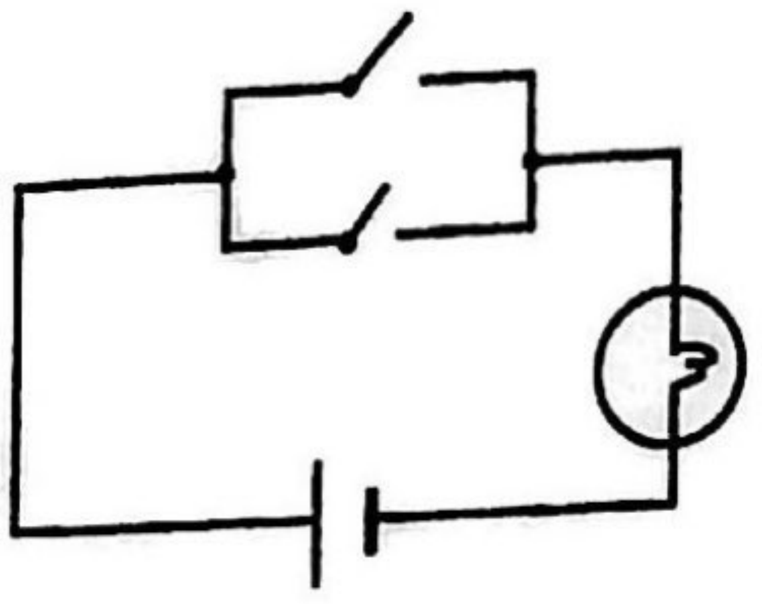


Fig. 8.1(b)

(a) Identify logic gates that operate in the same way as the circuits.

(i) Fig. 8.1(a), ______________________________

(ii) Fig. 8.1(b). ______________________________ [2]

(b) Fig. 8.2 shows an op-amp circuit.

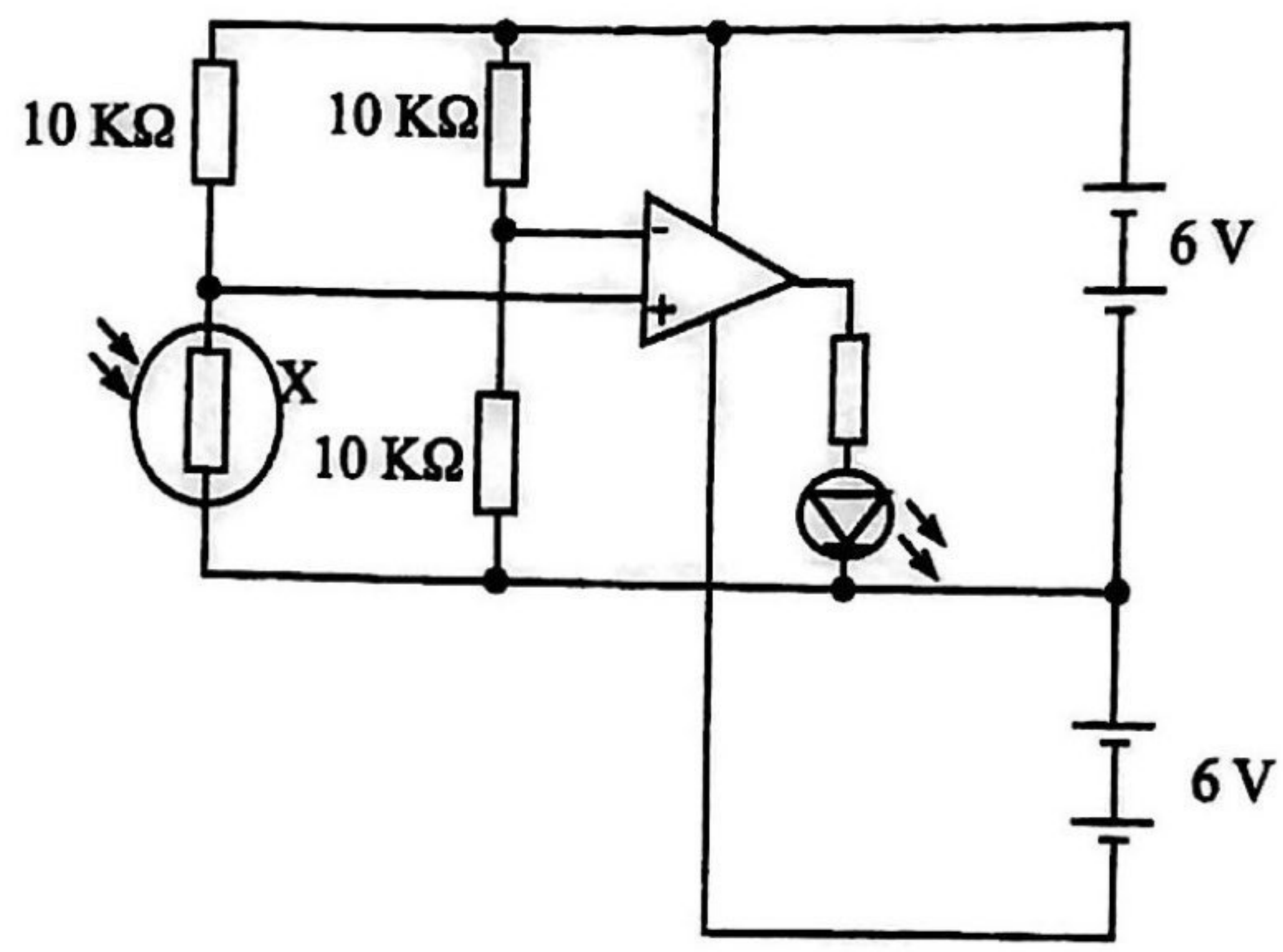


Fig. 8.2

(i) Identify component X. ______________________________

(ii) Describe how the circuit operates.

____

____

____

____

____

______________________________ [5]

For Examiner's Use

9 **(a)** Distinguish between elastic and plastic deformation of a material.

____

____

____

____ [2]

(b) **Fig. 9.1** shows a force-extension graph of a spring.

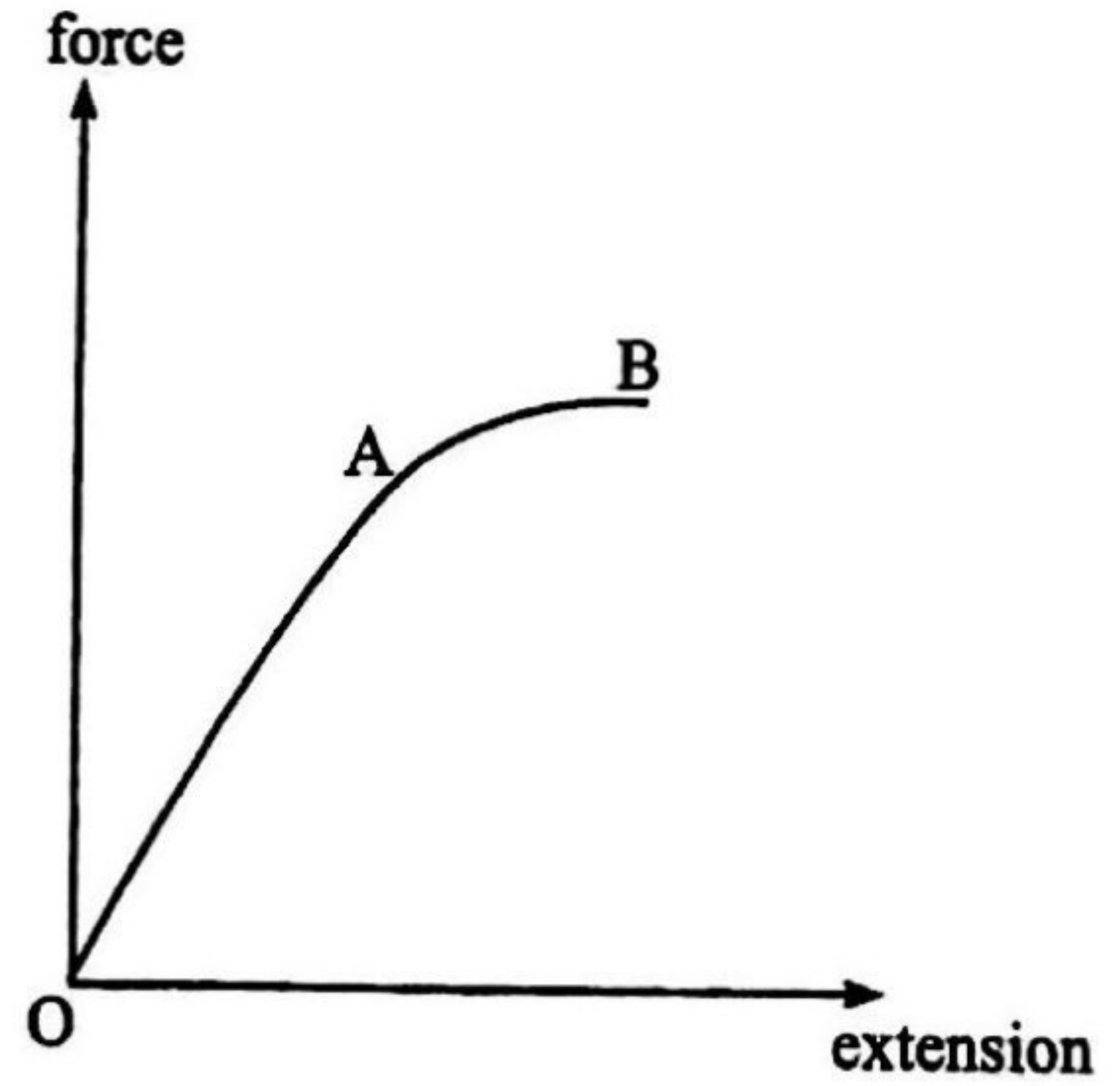


Fig. 9.1

(i) State the part of the graph which shows

1. plastic deformation,

____

____

2. elastic deformation of the spring.

____

____

(ii) On **Fig. 9.1** draw the graph obtained as the spring is unloaded. [3]

10 (a) The terms *work function* and *threshold wavelength* are used in the description of the photoelectric effect.

Define

(i) *work function,*

____

____

____

(ii) *threshold wavelength.*

____

____

____

[2]

(b) In an α-scattering experiment using gold foil, the α-particles have an energy of 5.6 MeV.

Given that the mass of the α-particle is 6.7×10^{-27} kg and its charge is $+3.2 \times 10^{-19}$ C, calculate

(i) the velocity of the α-particles,

velocity = ______________

(ii) the distance of closest approach between the centres of a gold nucleus and an α-particle. (proton number of gold = 79).

distance = ______________

[4]

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

MARKING SCHEME

NOVEMBER 2014

PHYSICS 9188/2

1 (i) $t = \frac{d}{v} = \frac{5}{2{,}5}$ C1

$= 2\text{s}$ A1

(ii) $t = \frac{2}{2{,}5}$

$= 0{,}8\text{s}$ A1

(iii) $0{,}5\text{s}$ A1

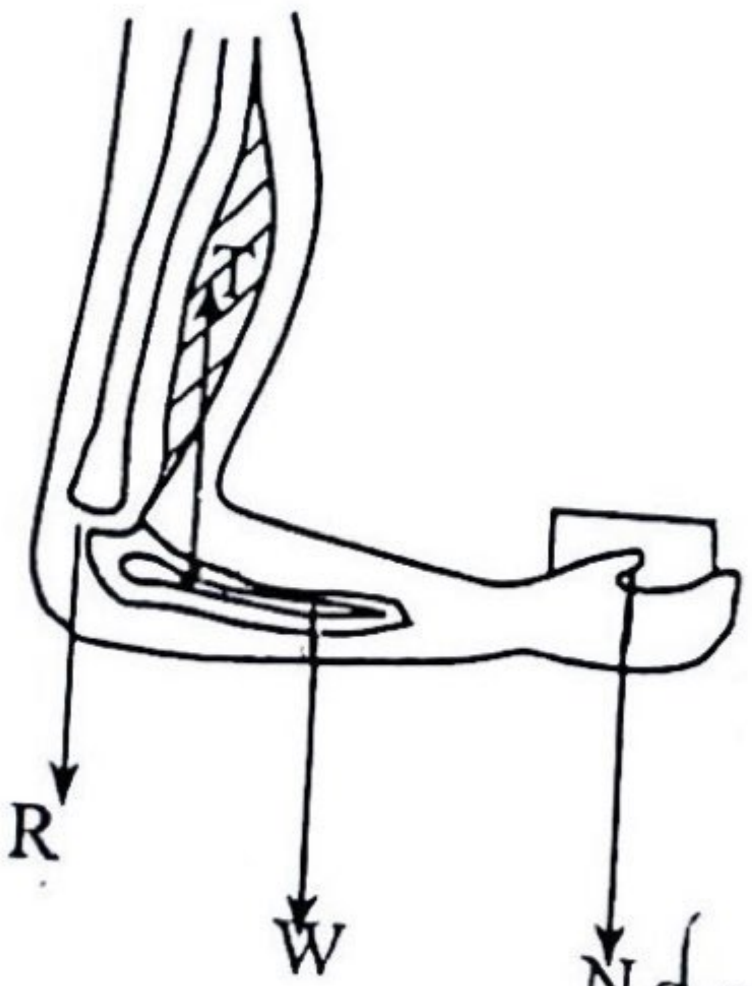
(iv) $(40 \times 0{,}5) + 10 = 20 + 10$ C1

$= 30\text{ m}$ A1 [6]

2 (a) Resultant force = 0 Reject Total forces = 0

Sum of clockwise moments about any point = sum of anticlockwise moments about that point. B1 [2]

(b) B1



B1
B1
B1
B1

N from hand back!

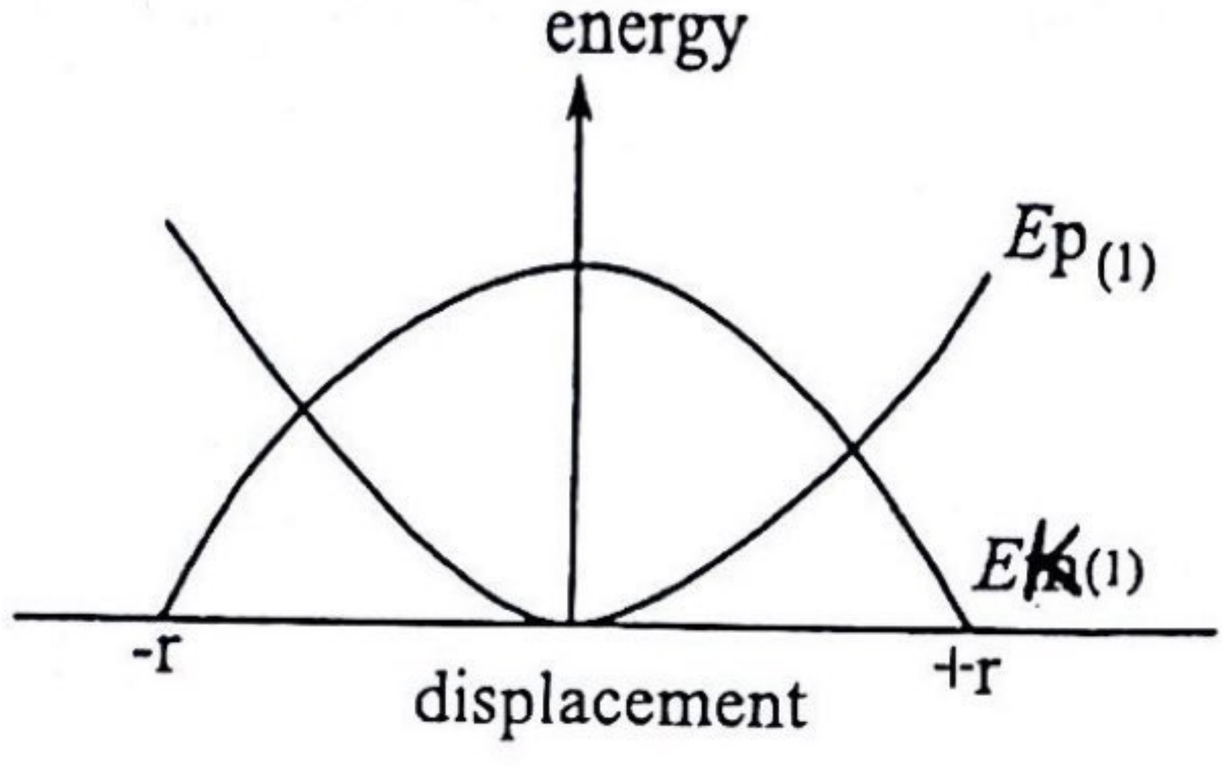
N – from inside the hand
W – anywhere inside the bone
T – must touch the bone.

Scanned by CamScanner

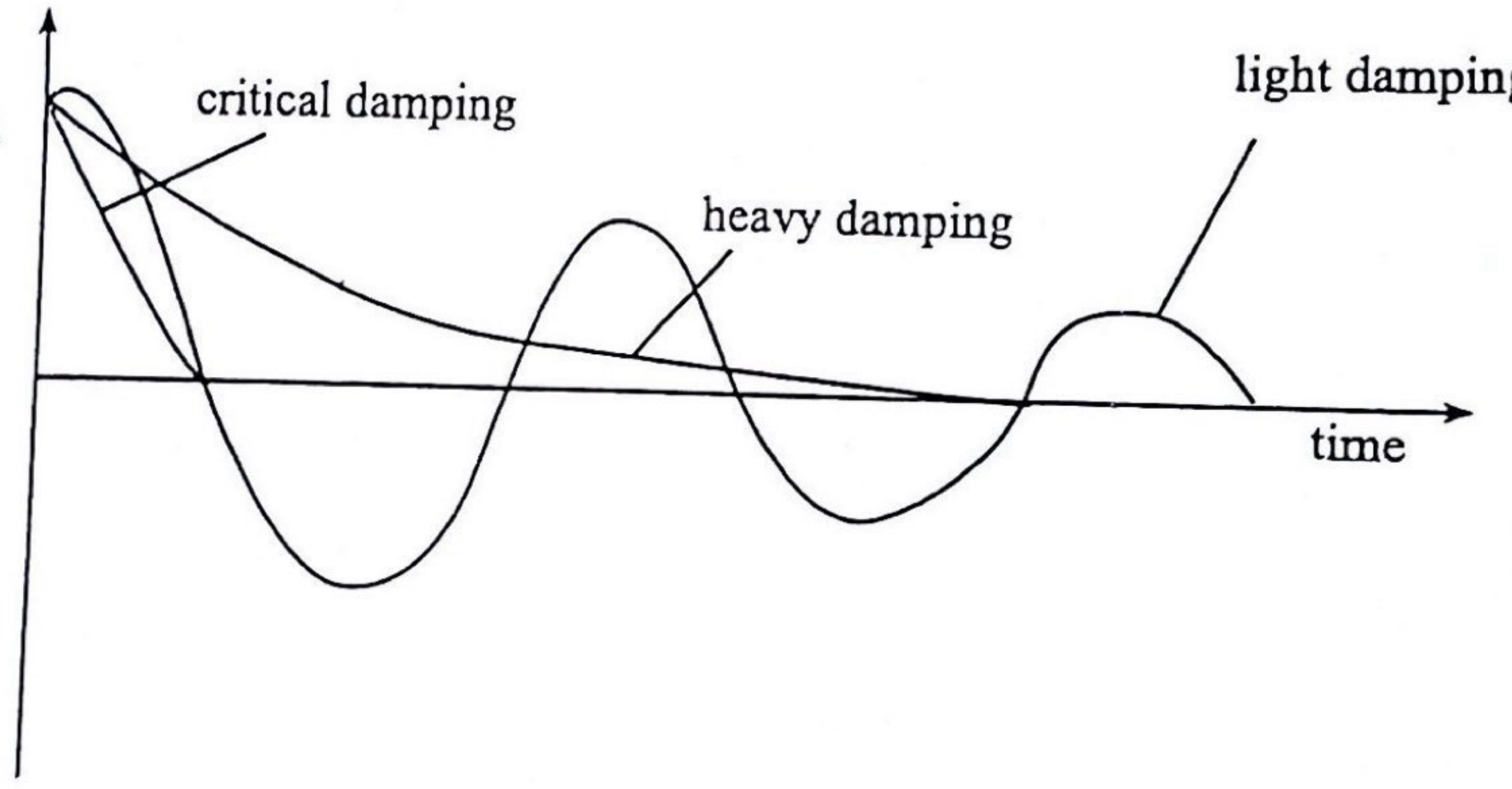
3 (a) (i) Simple harmonic motion is a periodic oscillation whose acceleration is directly proportional to the displacement and is always directed to the equilibrium position B1

B1

(ii) B2



(b) (i)



B1
B1
B1

(ii) moving coil meters/car suspension

B1B1

Max B1

4 (a) coherent sources have a constant phase difference/have the same frequency. B1
/ in phase

θ - angle of diffraction of the (nth order)
n – order number of (beam)

B1
B1

Ro

5 (a) (i) The electric field strength at a point in an electric field is the force per unit (positive) charge placed in an electric field. / F/Q terms explained — B1

(ii) The electric potential at a point in an electric field is the work done (1) per unit positive charge; in bringing the unit positive charge from infinity to that point; (1) — B2

(b)

$$E = \frac{Q}{4\pi\varepsilon_0 r^2}$$

$$E_1 = \frac{10 \times 10^{-9}}{4\pi 8{,}85 \times 10^{-12}\left(\frac{50}{2} \times 10^{-3}\right)^2} = 1.44 \times 10^5 (Vm^{-1})$$ C1

$$E_2 = \frac{-5 \times 10^{-9}}{4\pi \times 8{,}85 \times 10^{-12}\left(\frac{50}{2} \times 10^{-3}\right)^2} = -7.19 \times 10^4 (Vm^{-1})$$ C1

$$E = E_1 + E_2 = 1.44 \times 10^5 + 7.19 \times 10^4$$

$= ~~[crossed out]~~$ / $2{,}16 \times 10^5\ Vm^{-1}$ — accept 2/3 sf — A1

6 (a) (i) Ratio of charge to p.d between the plates/ a/w

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

C	-	capacitance
Q	-	charge
V	-	p.d.

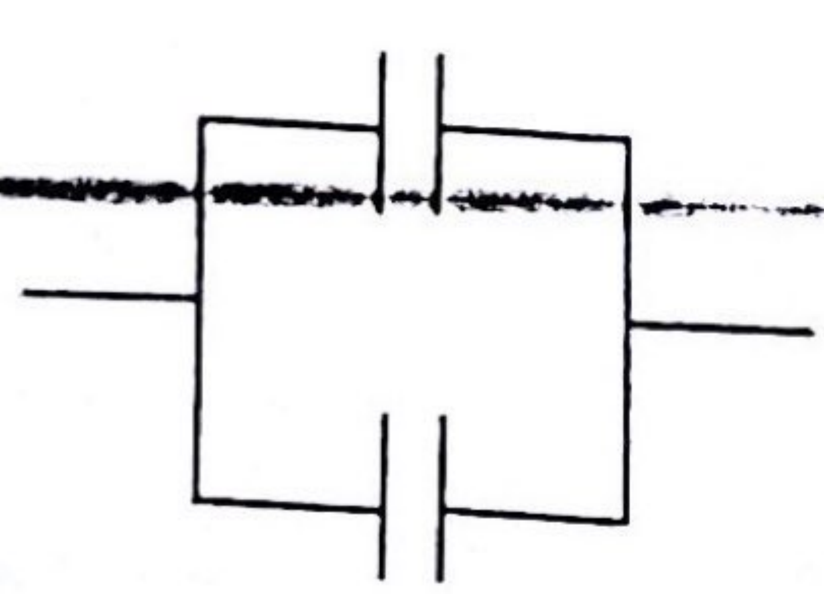
B1

(ii) One Qulomb per volt $1F = \frac{1C}{1V}$ / a/w — B1

(b) (i)

B1

(ii)



B1

Candidate Name | Centre Number | Candidate Number

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

PHYSICS

PAPER 2 Theory

9188/2

JUNE 2015 SESSION 1 hour 15 minutes

Candidates answer on the question paper.

Additional materials:

Scientific calculator and/or Mathematical tables

TIME 1 hour 15 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

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INFORMATION FOR CANDIDATES

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FOR EXAMINATION'S USE	
1	
2	
3	
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TOTAL	

This question paper consists of 11 printed pages and 1 blank page.

[Turn over

Data

speed of light in free space,	$c = 3.00 \times 10^{8}\ \mathrm{m\,s^{-1}}$
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Reynolds' number,	$R_e = \frac{\rho v r}{\eta}$
drag force in turbulent flow,	$F = Br^2\rho v^2$

For Examiner's Use

*Answer **all** questions.*

1 **(a)** **(i)** Distinguish between *precision* and *accuracy*.

____

____ [2]

(ii) **Fig.1.1** and **Fig 1.2** show the distribution of measurements taken, for a constantan wire of diameter 0.43± 0.01 mm by two students.

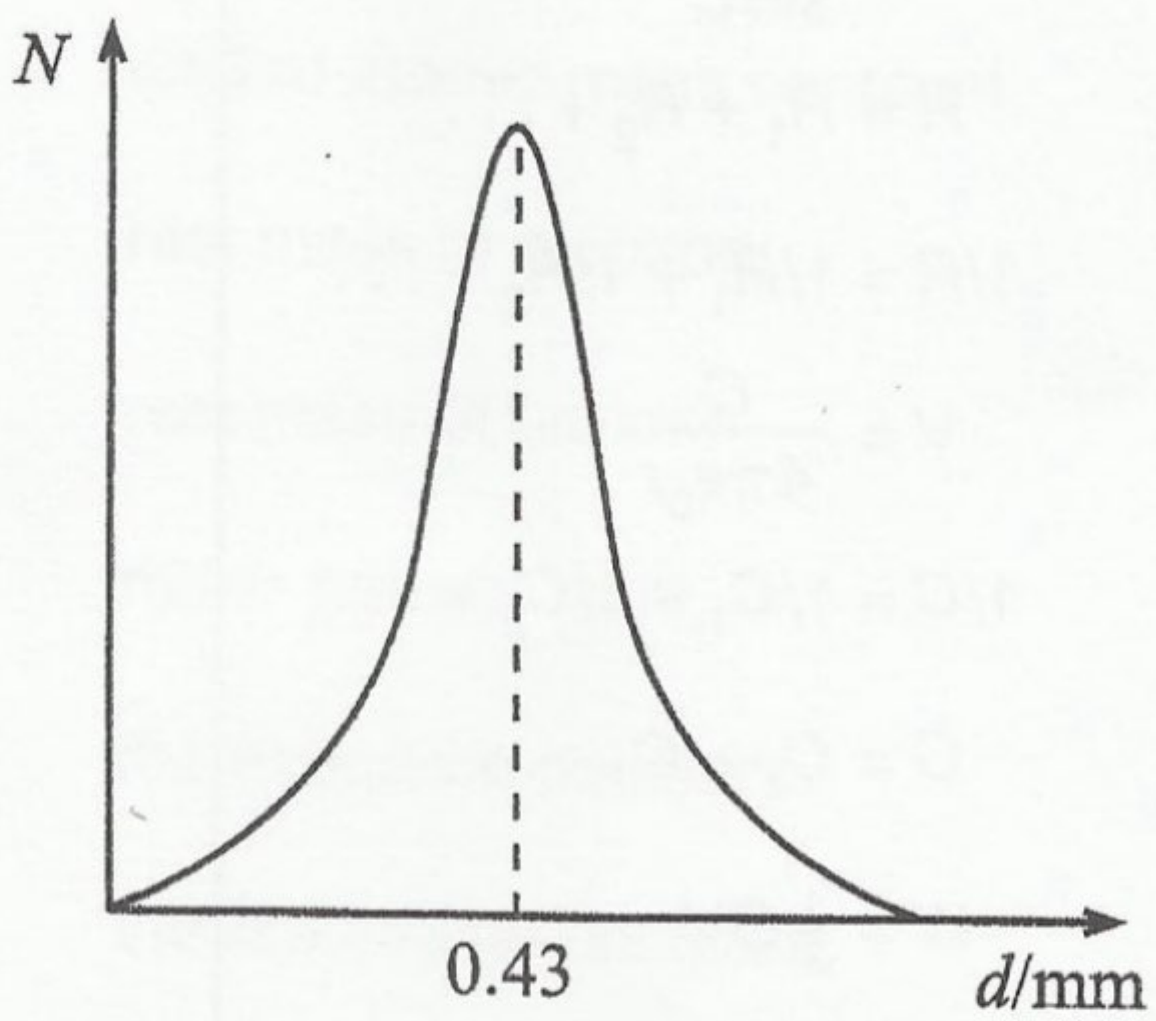

Fig.1.1

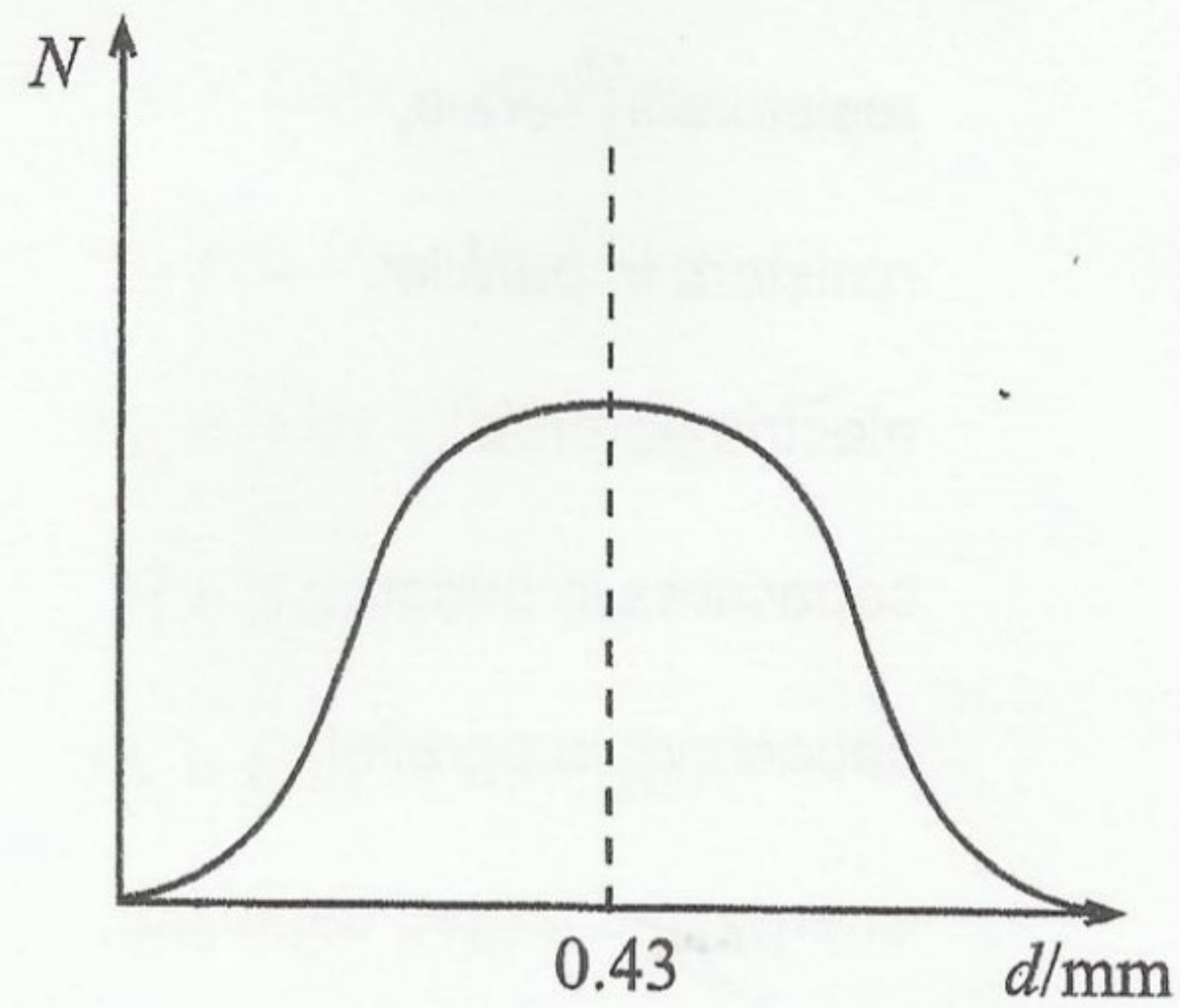

Fig 1.2

Comment on the precision and accuracy of the measurements.

Fig.1.1 ____

____

Fig.1.2 ____

____ [4]

(b) Give **one** advantage of repeated measurements over single measurements.

____

____ [1]

For Examiner's Use

2 **(a)** State **two** quantities that are conserved in any collision where no external forces are acting.

1. ______________________________

2. ______________________________

[2]

(b) A tennis racket hits a tennis ball with a constant force of 60 N. The mass of the ball is 68 g and is in contact with the racket for a time of 0.12 s.

(i) Calculate for the ball:

1. its change in momentum

change in momentum ______________

2. its acceleration

acceleration ______________

(ii) State, with a reason, if it is possible to apply a constant force to the ball in the 0.12 s.

____

____

____

[5]

For Examiner's Use

3 (a) Explain the term *centre of gravity of an object*.

______

______

______ [2]

(b) A uniform beam, AB, 2 m long and of weight 80 N, is in equilibrium. It has a 70 N load placed 0.20 m from end B and an unknown load of weight, *W*, placed 0.3 m from end A. P is the pivot 0.50 m from end A.

(i) State **two** conditions required for the beam to be in equilibrium.

1. ______

2. ______

(ii) Determine the weight of the load, *W*.

$W =$ ______ [4]

4 (a) Define *gravitational field strength*.

______

______ [1]

(b) The Earth is considered to be a uniform sphere of radius 6.40×10^6 m.

Calculate the mass of the Earth.

mass of Earth ______ [2]

For Examiner's Use

(c) A satellite is placed in a geostationary orbit around the Earth.

Determine the

(i) angular speed of the satellite,

angular speed = ______________________

(ii) radius of orbit of the satellite.

radius = ______________________

[4]

5 (a) **Fig. 5.1** shows two resistors, R_1 and R_2, connected in series with a cell of negligible internal resistance.

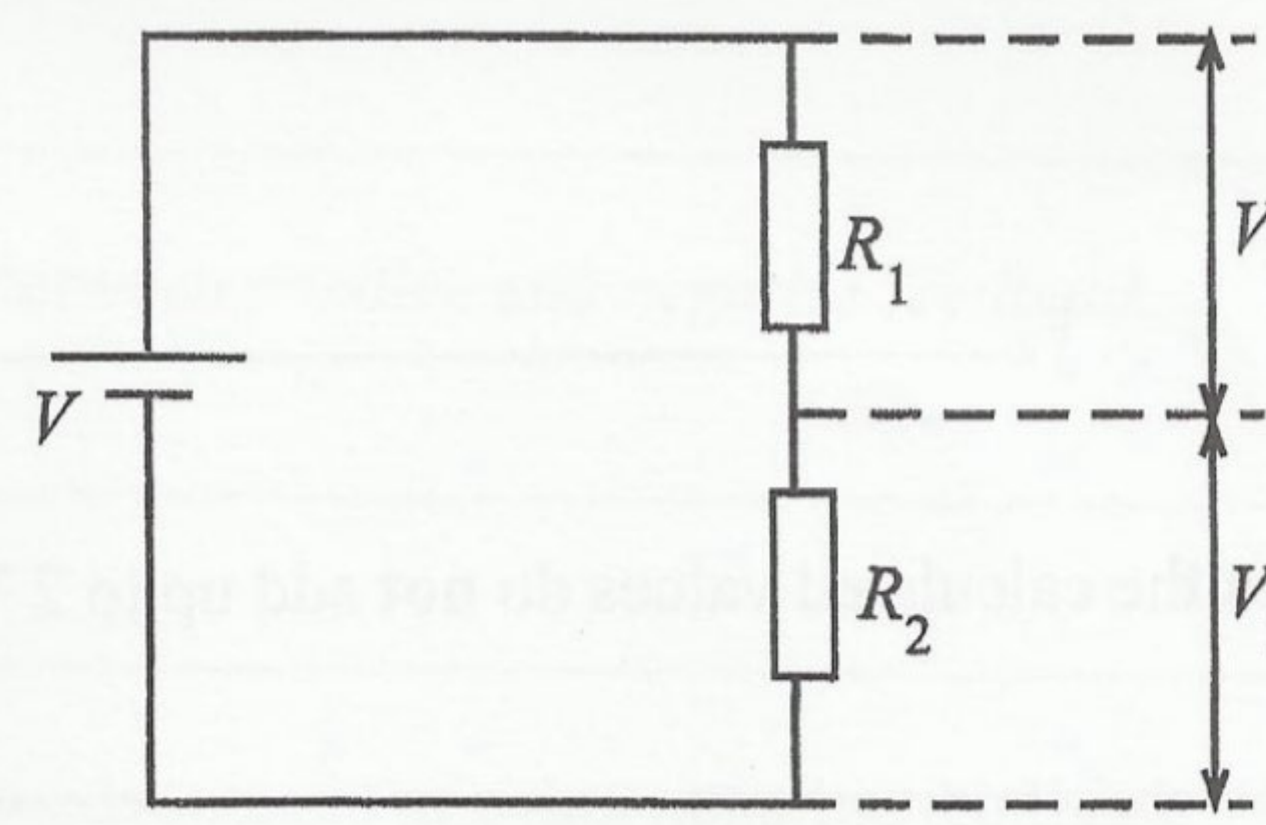

Fig. 5.1

Deduce the respective expressions for V_1 and V_2 when a moving coil voltmeter of resistance, R, is connected

(i) across R_1,

[Turn over

For Examiner's Use

(ii) across R_2.

[2]

(b) Calculate the readings on the voltmeter if $V = 2$ V, $R_1 = R_2 = 1\times10^3\ \Omega$ and $R = 4\times10^2\ \Omega$.

1. V_1

V_1 ____________________

2. V_2

V_2 ____________________

[3]

(c) Comment on the fact that the calculated values do **not** add up to 2 V.

____

____

____

____ [2]

6 (a) Define *magnetic flux.*

____

____ [1]

For Examiner's Use

(b) A 5.0 cm long copper wire carrying a current of 2.0 A is placed in a magnetic field. The wire experiences a force of 4.0×10^{-4} N when inclined at 50° to the field.

Calculate the magnetic flux density, B, of the field.

$B =$ ______________ [2]

(c) Describe how a calibrated Hall probe can be used to measure flux density.

____

____

____

____

____

____ [3]

7 **(a)** Distinguish between *positive* and *negative feedback.*

____

____ [2]

(b) State any **two** advantages of using negative feedback.

1. ____

2. ____

[2]

For Examiner's Use

(c) Fig.7.1 shows an operational amplifier and a potential divider comprising a Schmitt trigger circuit.

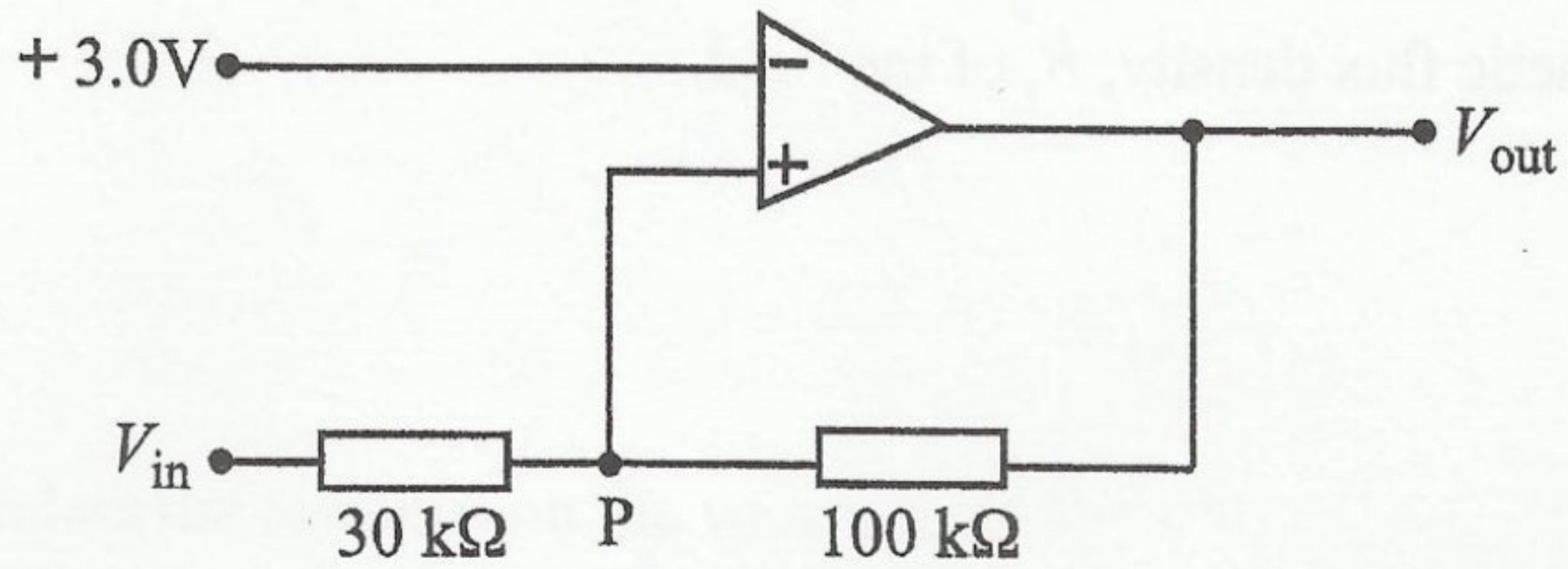

Fig.7.1

The inverting input is held at +3.0 V as shown. Initially the input voltage V_{in} and the output voltage V_{out} are 0 V and –15 V respectively.

Calculate the

(i) voltage at point, P, under the stated conditions,

voltage = ________________

(ii) voltage to which V_{in} must be raised for V_{out} to change in value.

V_{in} = ________________ [4]

Scanned with CamScanner

For Examiner's Use

8 Complete **Table 8.1** to compare and contrast a thermocouple thermometer and a platinum resistance thermometer.

Table 8.1

type of thermometer	**thermometric property**	**advantage**	**disadvantage**
platinum resistance			
thermocouple			

[6]

9 **(a)** Define, in words, the term

(i) *photon,*

____

____

(ii) *work function,*

____

____

(iii) *threshold frequency,*

____

____

(iv) *photoelectric emission.*

____

____

[4]

(b) Calculate the energy of a photon of light of wavelength 5.89×10^{-7} m.

energy = ______________________ [2]

37

Candidate Name | Centre Number | Candidate Number

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

PHYSICS

PAPER 2

9188/2

NOVEMBER 2015 SESSION 1 hour 15 minutes

Candidates answer on the question paper.
Additional materials:
Electronic calculator and/or Mathematical tables

TIME 1 hour 15 minutes

INSTRUCTIONS TO CANDIDATES

FOR EXAMINER'S USE

Write your name, Centre number and candidate number in the spaces at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided on the question paper.
For numerical answers, **all** working should be shown.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

FOR EXAMINATION'S USE	
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	

This question paper consists of 12 printed pages.

[Turn over

Data

speed of light in free space,	$c = 3.00 \times 10^{8}\ \mathrm{m\,s^{-1}}$
permeability of free space,	$\mu_0 = 4\pi \times 10^{-7}\ \mathrm{H\,m^{-1}}$
permittivity of free space,	$\epsilon_0 = 8.85 \times 10^{-12}\ \mathrm{F\,m^{-1}}$
elementary charge,	$e = 1.60 \times 10^{-19}\ \mathrm{C}$
the Planck constant,	$h = 6.63 \times 10^{-34}\ \mathrm{J\,s}$
unified atomic mass constant,	$u = 1.66 \times 10^{-27}\ \mathrm{kg}$
rest mass of electron,	$m_e = 9.11 \times 10^{-31}\ \mathrm{kg}$
rest mass of proton,	$m_p = 1.67 \times 10^{-27}\ \mathrm{kg}$
molar gas constant,	$R = 8.31\ \mathrm{J\,K^{-1}\,mol^{-1}}$
the Avogadro constant,	$N_A = 6.02 \times 10^{23}\ \mathrm{mol^{-1}}$
the Boltzmann constant,	$k = 1.38 \times 10^{-23}\ \mathrm{J\,K^{-1}}$
gravitational constant,	$G = 6.67 \times 10^{-11}\ \mathrm{N\,m^2\,kg^{-2}}$
acceleration of free fall,	$g = 9.81\ \mathrm{m\,s^{-2}}$

Formulae

uniformly accelerated motion,	$s = ut + \frac{1}{2}at^2$ $v^2 = u^2 + 2as$
work done on/by a gas,	$W = p\Delta V$
gravitational potential,	$\phi = -\frac{Gm}{r}$
refractive index,	$n = \frac{1}{\sin C}$
resistors in series,	$R = R_1 + R_2 + \ldots$
resistors in parallel,	$1/R = 1/R_1 + 1/R_2 + \ldots$
electric potential,	$V = \frac{Q}{4\pi\epsilon_0 r}$
capacitors in series,	$1/C = 1/C_1 + 1/C_2 + \ldots$
capacitors in parallel,	$C = C_1 + C_2 + \ldots$
energy of charged capacitor,	$W = \frac{1}{2}QV$
alternating current/voltage,	$x = x_0 \sin \omega t$
hydrostatic pressure,	$p = \rho g h$
pressure of an ideal gas,	$p = \frac{1}{3}\frac{Nm}{V}\langle c^2\rangle$
radioactive decay,	$x = x_0 \exp(-\lambda t)$
decay constant,	$\lambda = \frac{0.693}{t_{\frac{1}{2}}}$
critical density of matter in the Universe,	$\rho_0 = \frac{3H_0^2}{8\pi G}$
equation of continuity,	$Av = \text{constant}$
Bernoulli equation (simplified),	$p_1 + \frac{1}{2}\rho v_1^2 = p_2 + \frac{1}{2}\rho v_2^2$
Stokes' law,	$F = Ar\eta v$
Reynolds' number,	$R_e = \frac{\rho v r}{\eta}$
drag force in turbulent flow,	$F = Br^2\rho v^2$

[Turn over

*Answer **all** questions.*

For Examiner's Use

1 **(a)** Distinguish between *precision* and *accuracy*.

____

____

____

____ [2]

(b) The speed, V, of ocean waves is given by $V = k\sqrt{g\lambda}$, where k is a constant, λ is the wavelength and g is acceleration of free fall.

Determine the base units for k.

base units for k = ________________________ [2]

(c) In a simple pendulum experiment to determine the period, T, the equation used is $T = 2\pi\sqrt{\frac{l}{g}}$ where T is found to be (2.16 ± 0.01) s and the length, l, of pendulum is (1.15 ± 0.005) m.

Calculate the value of g and its uncertainty.

g = __________________ ± ____________________ [3]

For Examiner's Use

2 (a) Define *acceleration.*

____

____ [1]

(b) A ball of mass 50.0 g is thrown vertically downwards with a velocity of 3.25 ms^{-1}. It hits the ground after 1.62 s.

(i) Assuming air resistance to be negligible, calculate the

1. speed of the ball when it hits the ground,

speed ____________________________

2. distance travelled by the ball to the ground.

distance ____________________________

(ii) The ball makes contact with the ground for 15 ms and rebounds with an upward velocity of 15.2 ms^{-1}.

Calculate the

1. average force acting on the ball on impact with the ground,

average force ____________________________

For Examiner's Use

2. maximum height the ball reaches after hitting the ground.

maximum height ____________

[8]

3 (i) Explain the origin of the upthrust acting on a body in a fluid.

____

____

____________ [2]

(ii) **Fig.3.1** shows a steel ball of diameter 8.2 mm falling through oil at a steady speed.

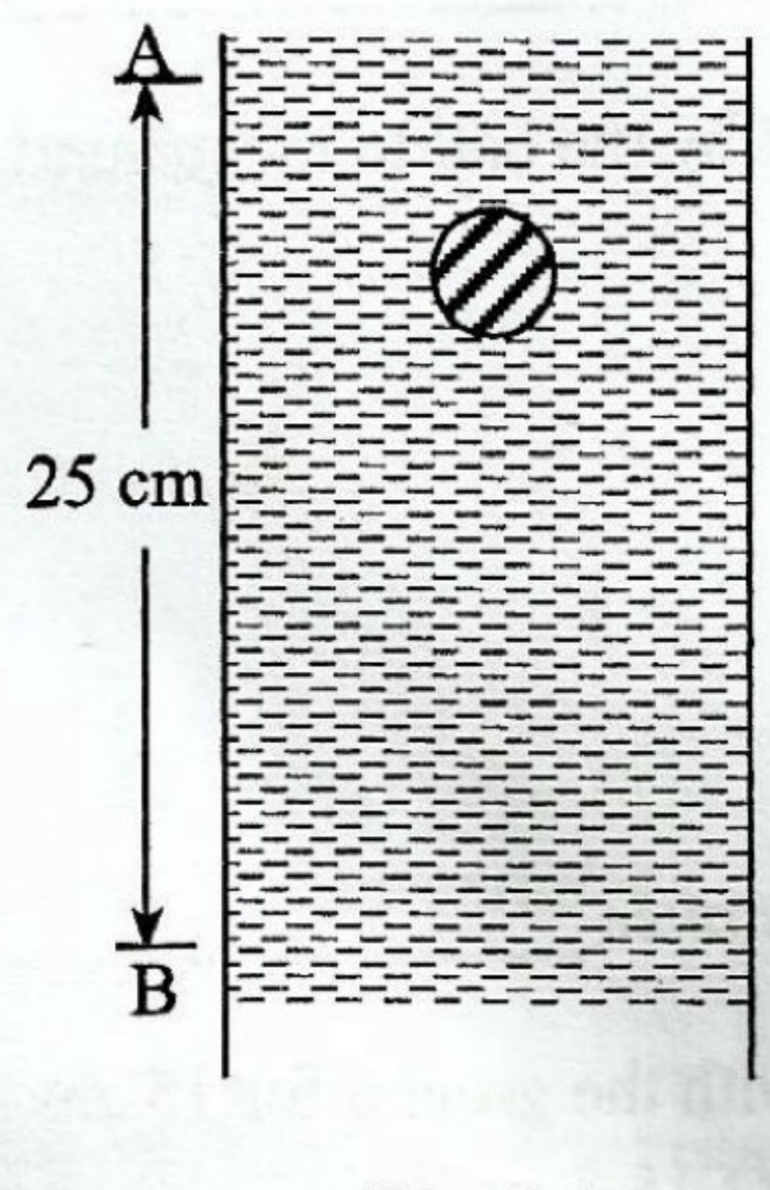

Fig. 3.1

The ball moves from A to B in 0.60 s.

Assuming the density of steel and oil to be 7 800 kgm^{-3} and 900 kgm^{-3} respectively, calculate the

1. weight of the ball,

weight ____________

For Examiner's Use

2. upthrust on the ball,

upthrust ________________

3. terminal velocity of the ball.

terminal velocity ________________ [5]

4 **(a)** Explain the term *total internal reflection.*

____

____

________________________________ [2]

(b) Give **four** advantages of fibre optic cables over metal cables.

1. ________________________________

____

2. ________________________________

____

3. ________________________________

____

4. ________________________________

________________________________ [4]

5 (a) Define *electric potential.*

____

____ [2]

(b) Equal and opposite $5\,\mu C$ charges are situated at the vertices X and Y of an equilateral triangle XYZ where XY = 10 cm.

Calculate the

(i) magnitude of the electric field strength at Z,

field strength = ____________________

(ii) electric potential at *Z*.

electric potential = ____________________ [4]

(c) Describe how dust can be extracted electrostatically from a chimney of a factory.

____

____

____

____ [3]

For Examiner's Use

6 (a) Describe the principle of operation of an ideal transformer.

____

____

____ [3]

(b) The primary coil of an ideal transformer has 480 turns and is connected to a 120 V (r.m.s), 60 Hz sinusoidal supply. The secondary coil has 40 turns and is connected to a resistor of resistance 4.0 Ω as shown in **Fig. 6.1.**

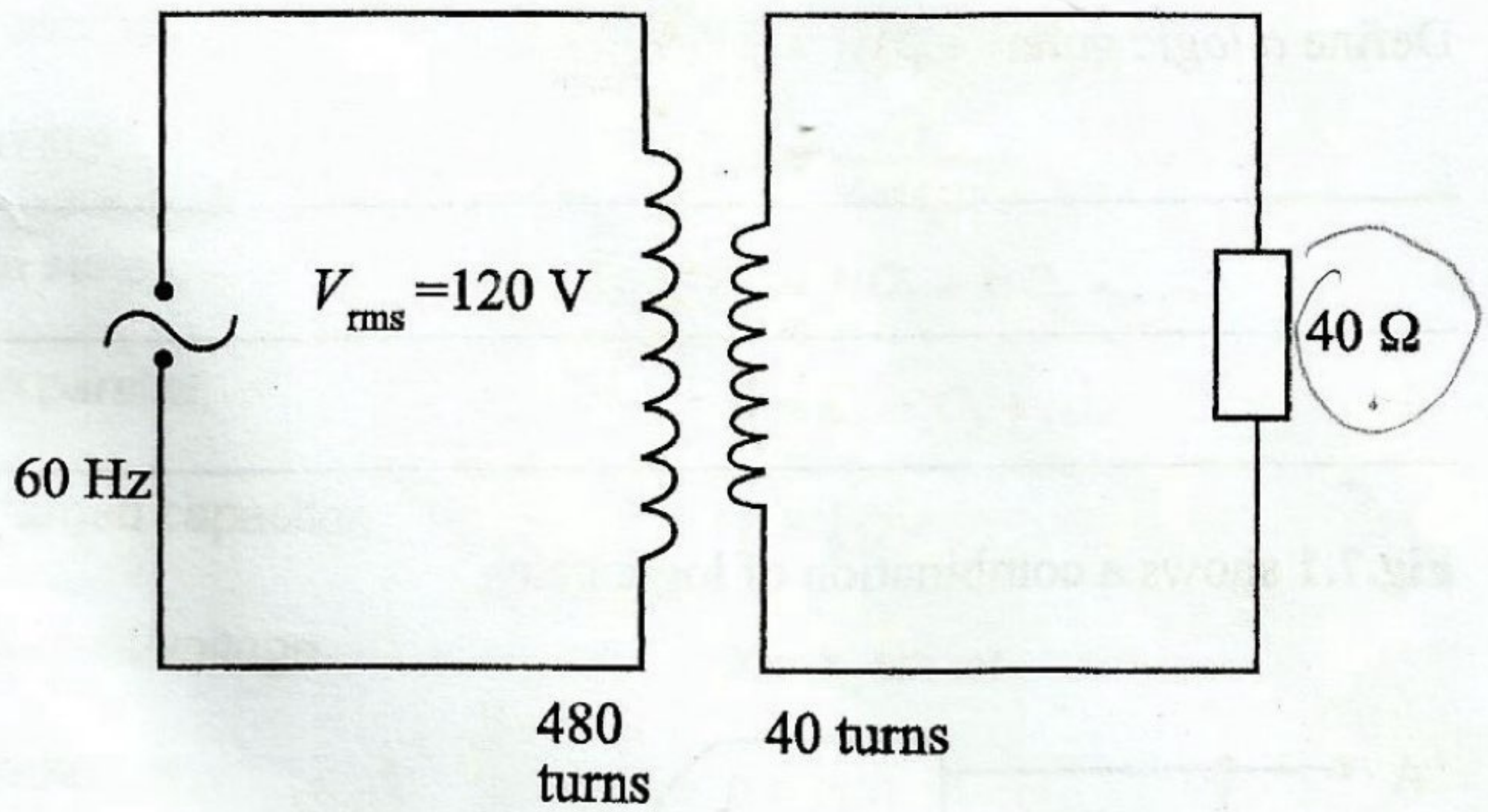

Fig.6.1.

Calculate

(i) V_{rms} across the resistor,

V_{rms} = ______________________

[Turn over

For Examiner's Use

(ii) peak power dissipated by the resistor.

peak power ______________________________ [4]

7 (a) Define *a logic gate.*

____

____

______________________________ [1]

(b) Fig.7.1 shows a combination of logic gates.

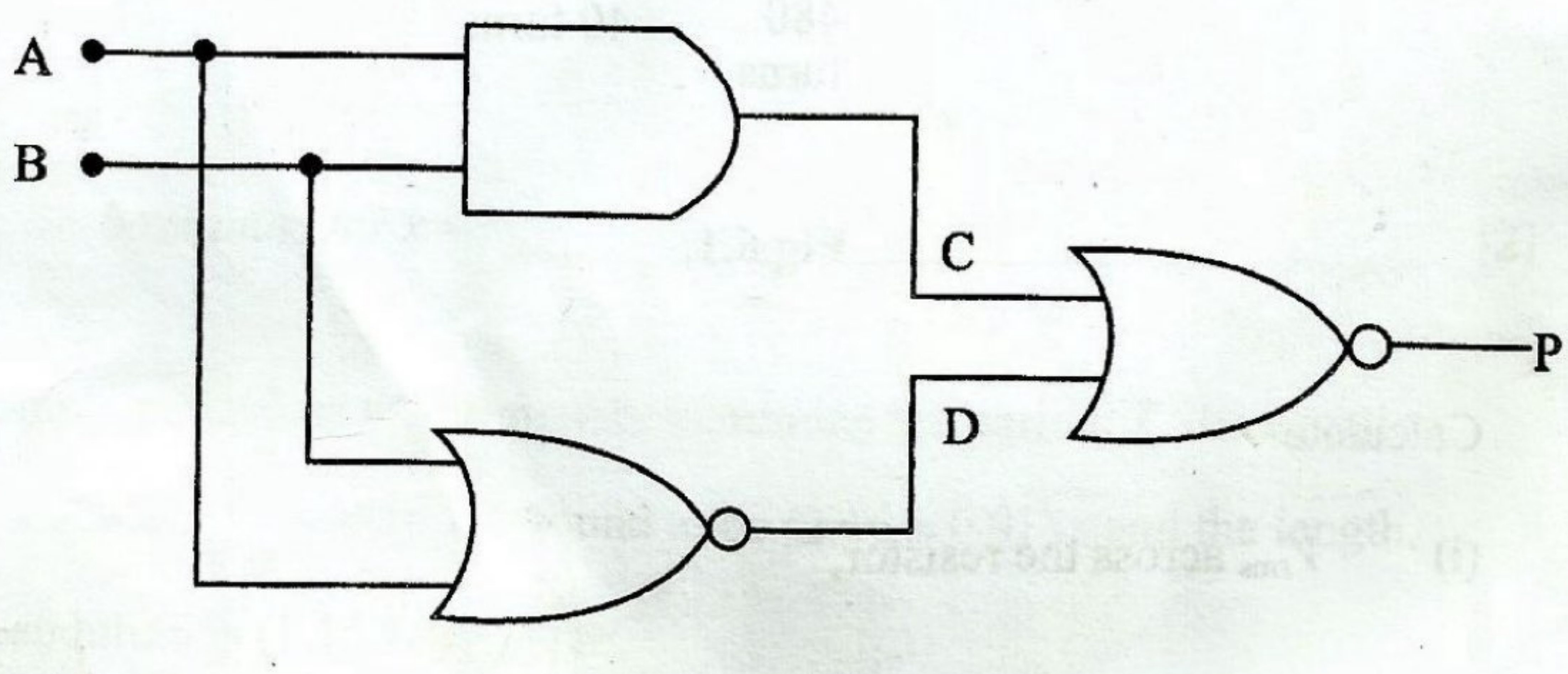

Fig.7.1

For Examiner's Use

(i) Construct a truth table for the combination.

(ii) State the logical function for the combination.

______________________________ [4]

8 Different types of thermometers have different thermometric properties and advantages.

Complete **Table 8.1** to distinguish between the two types of thermometers given.

Table 8.1

type of thermometer	**thermometric property**	**advantages**
liquid in glass		
thermocouple		

[4]

For Examiner's Use

9 **(a)** Radioactive decay is *random* and *spontaneous.*

Define the terms in italics.

spontaneous ______________________

____

random ______________________

______________________ [2]

(b) Radium-226 has a decay constant of 1.8×10^{-6} s and an initial decay rate of $5.2 \times 10^{10}\ s^{-1}$

Calculate the

(i) initial number of radioactive atoms present,

number of atoms = ______________________

(ii) time taken for the activity to fall to a quarter of its initial value.

time = ______________________

[4]

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

MARKING SCHEME

November 2015

PHYSICS

9188/2

(ii) precision : the measurements concentrated about the mean value — B1

accuracy : measurements are scattered about the true value — B1

(b) $k = \frac{v}{\sqrt{gL}}$

$$[k] = \frac{ms^{-1}}{\sqrt{ms^{-2}m}}$$ C1

$$= \frac{ms^{-1}}{ms^{-1}}$$

$$= 1$$

∴ k is dimensionless/ has no units — A1

(c) $T = 2\pi\sqrt{\frac{L}{g}}$

$$T^2 = 4\pi^2\frac{L}{g}$$

$$g = \frac{4\pi^2 L}{T^2} = \frac{(4\pi^2)(1.15)}{(2.16)^2}$$

$$= 9.73 \text{ ms}^{-2}$$ C1

$$\frac{\Delta g}{g} = \frac{\Delta L}{L} + 2\frac{\Delta T}{T}$$

$$= \frac{0.005}{1.15} + 2\left(\frac{0.01}{2.16}\right)$$

$$\Delta g = 0.1 \text{ ms}^{-2}$$ C1

$$g = (9.7 \pm 0.1) \text{ ms}^{-2}$$

B1

(a) rate of change of velocity

(b) (i) $v = u + at$

$= 3.25 + (9.81 \times 1.62)$ C1

$= 19.14\ ms^{-1}$ / 19.1 m s⁻¹ 3/4 s.f. A1

(ii) $s = ut + \frac{1}{2} + at^2$

$= (3.25 \times 1.62) + \frac{1}{2} \times (9.81 \times 1.62^2)$ C1

$= 18.13\ m$ | 18.1 m 3/4 s.f. A1

(c) (i) $f = m\left(\frac{v - u}{t}\right)$

$= \frac{50 \times 10^{-3} \times [15.2 - (-19.14)]}{15 \times 10^{-3}}$ C1

$= 114.47\ N$ A1

(ii) $v^2 = u^2 + 2as$

$0 = 15.2^2 - (2 \times 9.81\ s)$ C1

$\therefore s = 11.78\ m$ 3/4 s.f. A1

(a) (i) pressure in a fluid increases with depth. AO

pressure at lower surface of a submerged object is greater than at its upper surface, hence resultant upward force upthrust B1 B1

(ii) 1. $V = \frac{4\pi}{3}r^3 = \frac{4\pi}{3}\left(\frac{8.2 \times 10^{-3}}{2}\right)^3$

$W = \rho v g$

$= \frac{4\pi}{3}\left(\frac{8.2 \times 10^{-3}}{2}\right)^3 \times 7\ 800 \times 9.81$ C1

2. U = weight of displaced fluid

$= \rho_{oil} Vg$

$= \frac{4\pi}{3}\left(\frac{8.2\times10^{-3}}{2}\right)^3 \times 900 \times 9.81$ C1

$= 0.0025$ N A1

3. terminal velocity $= \frac{l}{t}$

$= \frac{0.25}{0.6}$

$= 0.42$ m/s A1

4 (a) - Light moves from *optically dense* medium to less *optically dense* medium B1
- Light reflected back into the denser medium B1
- Incident angle > critical angle B1 max 2

(b) - very cheap B1
- very light – easy transportation/ installation B1
- less vulnerable to vandalism due to its cost and underground laying B1
- very large information carrying capacity B1
- very low attenuation B1
- no interference hence noiseless reception B1
- no cross talk between fibres hence more security of information B1 max 4

5 (a) - Work done per unit charge in moving the charge from infinity to the point B1 B1

(b) (i) $E_1 = \frac{Q}{4\pi \in_0 r^2} = \frac{5\times10^{-6}\times9\times10^9}{(0.1)^2}$ C1

$= 4.5\times10^6$ NC^{-1}

$E_2 = \frac{-5\times10^{-6}\times9\times10^9}{(0.1)^2} = 4.5\times10^6$ NC^{-1}

(ii) $V = = \frac{}{4\pi \epsilon_0 r} - \frac{}{0.1} - \frac{}{0.1}$

$= 0 V$ A1

(c) - electric field between the electrodes ionizes the dust particles B1

- ionized dust particles get attracted to electrodes B1

- dust particle are tapped off regularly B1

6 (a) - alternating current in the primary coil produces an alternating magnetic flux B1
- transferred to the secondary coil (through the core) B1
- alternating magnetic flux will cut the secondary coil B1
- producing an alternating e.m.f. in the secondary coil B1 max 3

(b) (i) $\frac{V_p}{V_s} = \frac{N_p}{N_s}$

$V_s = \frac{V_p N_s}{N_p} = \frac{120 \times 40}{480}$ C1

$= 10 \text{ V}$

; V_{rms} across the resistor $= 10 \text{ V}$ A1

(ii) $P = 2\frac{V_{rms}^2}{R} = \frac{2 \times 10^2}{40}$ C1

$= 5.0 \text{ W}$ A1

7 (a) An electronically operated switch which has one or more inputs and one output. B1

(b) (i)

A	B	C	D	E
0	0	0	1	0
0	1	0	0	1
1	0	0	0	1
1	1	1	0	0

B2
A1

(ii) Output is high if and only if $A \neq B$. B1

OR

$A + \bar{B} = 1$ (reject just "ex-OR Gate" only)

type of thermometer	*thermometric property*	*advantages*
liquid in glass	length of liquid B1	portable B1
thermocouple	e.m.f. of a thermocouple B1	Measure rapidly changing temperatures B1

9 (a) random - unpredictable i.e. at any time it might happen without any pattern B1

spontaneous - process which is governed from within rather than by external factors/ natural and without effort B1

(b) (i) $\frac{dN}{dt} = \lambda N$

$\frac{5.2\times10^{10}}{1.8\times10^{-6}} = N$ C1

$N = 2.89\times10^{16}$ A1

(ii) $t_{\frac{1}{2}} = \frac{\ln 2}{\lambda}$

$= \frac{\ln 2}{1.8\times10^{-6}}$ C1

$= 3.85\times10^{5} s$

$t = 3.85\times10^{5}\times2$

$= 7.7\times10^{5} s$ A1

OR

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

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

$$\frac{1}{4} = e^{-\lambda t}$$

$$\ln 4 = \lambda t$$

$$t = 7.7 \times 10^{5} s$$

Candidate Name	Centre Number	Candidate Number

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

For Performance Measurement

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

PHYSICS

9188/2

PAPER 2

JUNE 2016 SESSION

1 hour 15 minutes

Candidates answer on the question paper.
Additional materials:
Electronic calculator and/or Mathematical tables

TIME 1 hour 15 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided on the question paper.
For numerical answers, **all** working should be shown.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

FOR EXAMINER'S USE	
1	
2	
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TOTAL	

This question paper consists of 12 printed pages.

Formulae

uniformly accelerated motion,	$s = ut + \frac{1}{2}at^2$ $v^2 = u^2 + 2as$
work done on/by a gas,	$W = p\Delta V$
gravitational potential,	$\phi = -\frac{Gm}{r}$
refractive index,	$n = \frac{1}{\sin C}$
resistors in series,	$R = R_1 + R_2 + \ldots$
resistors in parallel,	$1/R = 1/R_1 + 1/R_2 + \ldots$
electric potential,	$V = \frac{Q}{4\pi\epsilon_0 r}$
capacitors in series,	$1/C = 1/C_1 + 1/C_2 + \ldots$
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energy of charged capacitor,	$W = \frac{1}{2}QV$
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hydrostatic pressure,	$p = \rho gh$
pressure of an ideal gas,	$p = \frac{1}{3}\frac{Nm}{V}<c^2>$
radioactive decay,	$x = x_0 \exp(-\lambda t)$
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Stokes' law,	$F = Ar\eta v$
Reynolds' number,	$R_e = \frac{\rho vr}{\eta}$
drag force in turbulent flow,	$F = Br^2\rho v^2$

Data

speed of light in free space,	$c = 3.00 \times 10^{8}\ \mathrm{m\,s^{-1}}$
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the Boltzmann constant,	$k = 1.38 \times 10^{-23}\ \mathrm{J\,K^{-1}}$
gravitational constant,	$G = 6.67 \times 10^{-11}\ \mathrm{N\,m^2\,kg^{-2}}$
acceleration of free fall,	$g = 9.81\ \mathrm{m\,s^{-2}}$

Answer ***all*** *questions.*

For Examiner's Use

1 **(a)** Define the term *base unit.*

____

____ [1]

(b) The drag force, D, on an object of cross-sectional area, A, moving with speed, v, through a fluid of density, ρ, is given by

$$D = \frac{1}{2}C\rho A v^2,$$

where C is a drag constant .

(i) Show that C has no units.

(ii) The following measurements were obtained for a liquid of constant density 990 kgm^{-3} and drag constant 0.30.

$A = 12.1 \pm 0.3$ cm^2
$v = 10.0 \pm 0.2$ ms^{-1}

Calculate the drag force and its uncertainty.

drag force = ________ ± ______ N [6]

For Examiner's Use

2 (a) (i) State the principle of conservation of momentum.

____

____

(ii) A car of mass 1200 kg travelling at 40 ms^{-1} rams into the back of an unloaded lorry of mass 3000 kg travelling at 25 ms^{-1} and they coalesce.

Calculate the velocity of the vehicles after collision.

velocity = ______________ [4]

(b) Explain how seat belts in vehicles reduce injuries.

____

____

____

____ [2]

3 A car of mass 900 kg moves with a uniform speed of 15 ms^{-1} in a circular path of radius 90 m on a horizontal surface.

(i) State how the centripetal force, F, is produced.

____

____

(ii) Determine the magnitude and direction of F.

F = ______________ N

direction ______________

____

For Examiner's Use

(iii) Explain why roads are banked at the corners, considering all the forces acting on the car when it moves round a curve.

____

____

____

____

____

____

____ [6]

4 **(a)** State *the principle of superposition.*

____

____

____ [2]

(b) Give any three conditions necessary for two-source interference fringes to be observed.

1.____

2.____

3.____ [3]

(c) In a Young's double-slit experiment, the distance between the slits and the screen is 1.60 m. Using light of wavelength 5.89×10^{-7} m, the distance between the centre of the interference pattern and the fourth bright fringe on either side is found to be 16.0 mm.

Calculate the slit separation.

slit separation = ______________________ [3]

For Examiner's Use

5 **(a)** Define *the farad.*

____

____ [1]

(b) **Fig. 5.1** shows a 15 μF capacitor connected in series with 1600 Ω resistor and 20 V supply of negligible internal resistance.

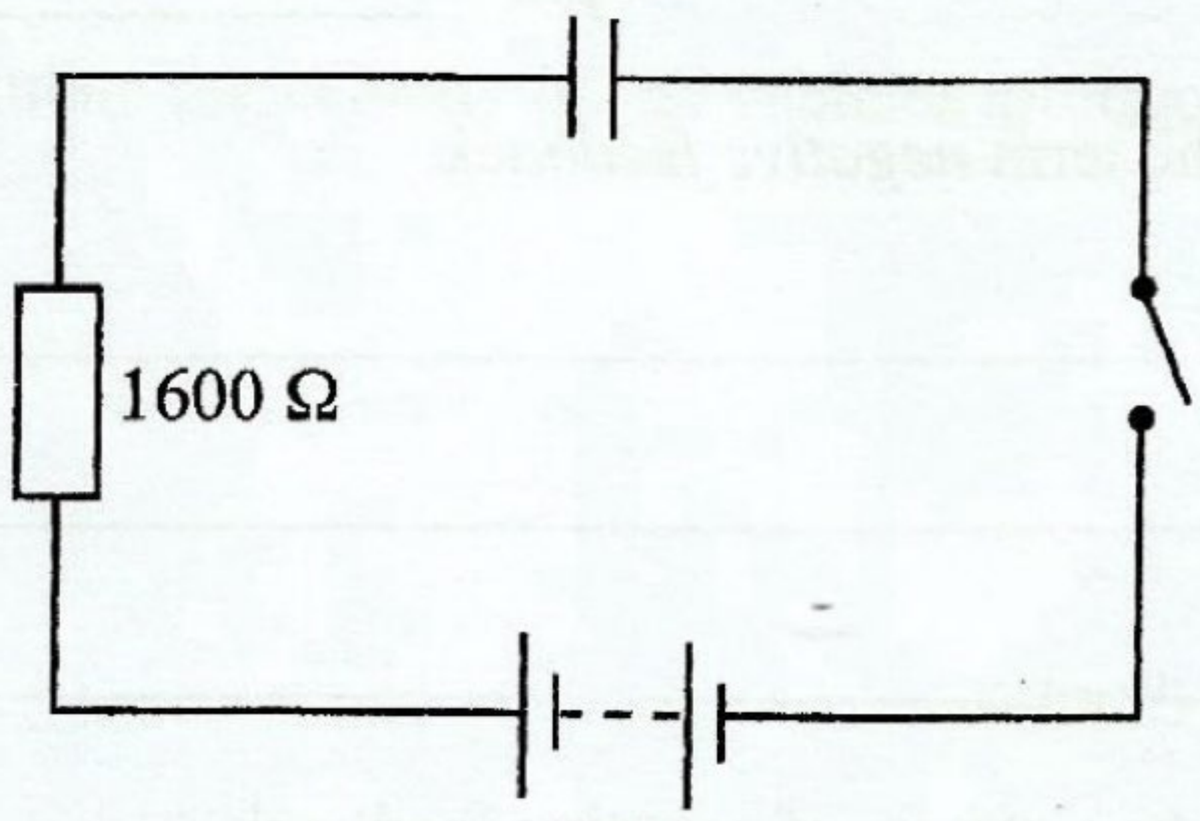

Fig. 5.1

The capacitor is initially uncharged.

Calculate the

(i) current in the circuit immediately after the switch is closed,

current = ______________

(ii) final charge on the capacitor.

charge = ______________

[3]

[Turn over

For Examiner's Use

(c) The capacitor in **(b)** is then connected in parallel with an uncharged 18.0 μF capacitor.

Calculate the p.d across the 18 μF capacitor.

p.d = ______________________ [2]

6 **(a)** **(i)** Explain the term *negative feedback*.

____

____

____

(ii) State any **two** effects of negative feedback.

1. ______________________

2. ______________________

[3]

(b) **Fig. 6.1** shows an op-amp circuit.

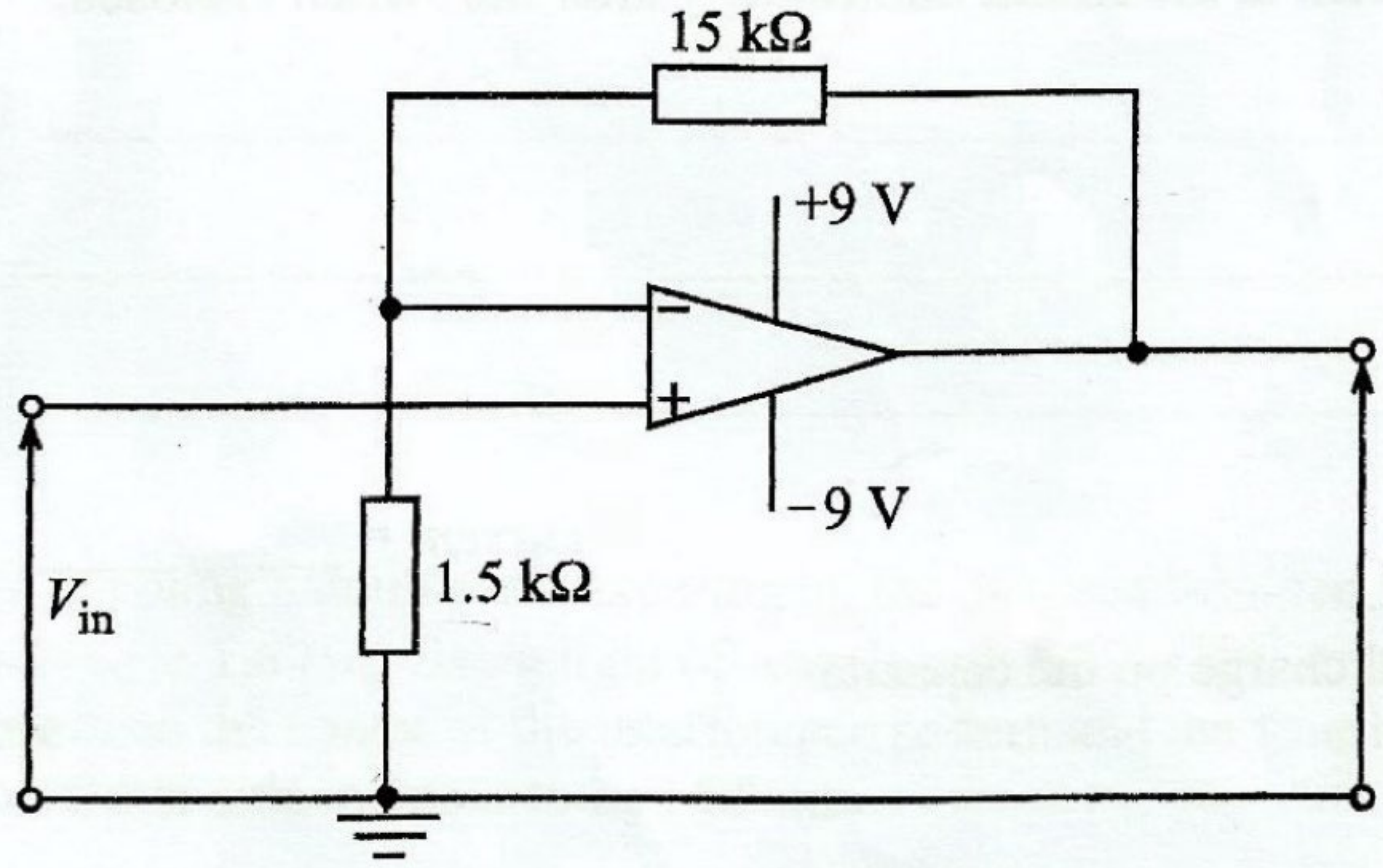

Fig. 6.1

(i) Identify the op-amp circuit.

____

For Examiner's Use

(ii) Calculate the gain of the amplifier.

gain = ______________

(iii) Determine the value of the output voltage of the amplifier for input voltages of

1. 0.08 V,

output = ______________

2. 0.95 V.

output = ______________ [5]

7 (a) Distinguish between *evaporation* and *boiling*.

____

____

____

____ [2]

For Examiner's Use

(b) Explain why a wet person standing in a windy place feels cold.

[3]

8 **(a)** **(i)** State any **two** assumptions of the kinetic theory of gases.

1.

2.

(ii) Explain the term *internal energy of an ideal gas.*

[4]

(b) Deduce, by comparing $PV = \frac{1}{3}Nm < c^2 >$ with $PV = NkT$, that the average translational kinetic energy of a molecule is proportional to T.

[2]

For Examiner's Use

(c) A sealed flask of volume 100 cm^3 contains argon gas at a pressure of 10 kPa and temperature of 30 °C. Molar mass of argon is 0.018 kg.

Calculate the r.m.s speed of the molecules in the flask.

r.m.s speed = ______________ [2]

9 **(a)** The decay of a radioactive isotope is said to be *random* and *spontaneous*.

Explain what is meant by a *spontaneous process*.

____

____

____

____ [1]

(b) Thorium-231, $^{231}_{90}Th$ decays to form Protactinum-231, $^{231}_{91}Pa$.

(i) Write down the nuclear equation representing this decay.

____

(ii) During this decay, a β- particle and an X-ray photon are emitted with energies of 5.32 MeV and 0.50 MeV respectively.

Calculate the

1. mass equivalence of the energy released during the decay,

mass = ____________

For Examiner's Use

2. wavelength of the emitted X-ray photon.

wavelength = ____________

[5]

Candidate Name	Centre Number	Candidate Number

ZIMSEC For Performance Measurement

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

PHYSICS **9188/2**

PAPER 2 Theory

NOVEMBER 2016 SESSION 1 hour 15 minutes

Candidates answer on the question paper.
Additional materials:
Electronic calculator and/or Mathematical tables

TIME 1 hour 15 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.
Write your answers in the spaces provided on the question paper.
For numerical answers, **all** working should be shown.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

FOR EXAMINER'S USE	
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	

This question paper consists of 12 printed pages.

[Turn over

*Answer **all** questions.*

1 **(a)** Distinguish between a *vector quantity* and a *scalar quantity*.

____

____

____

____ [1]

(b) **Fig. 1.1** shows a system of forces acting at a point.

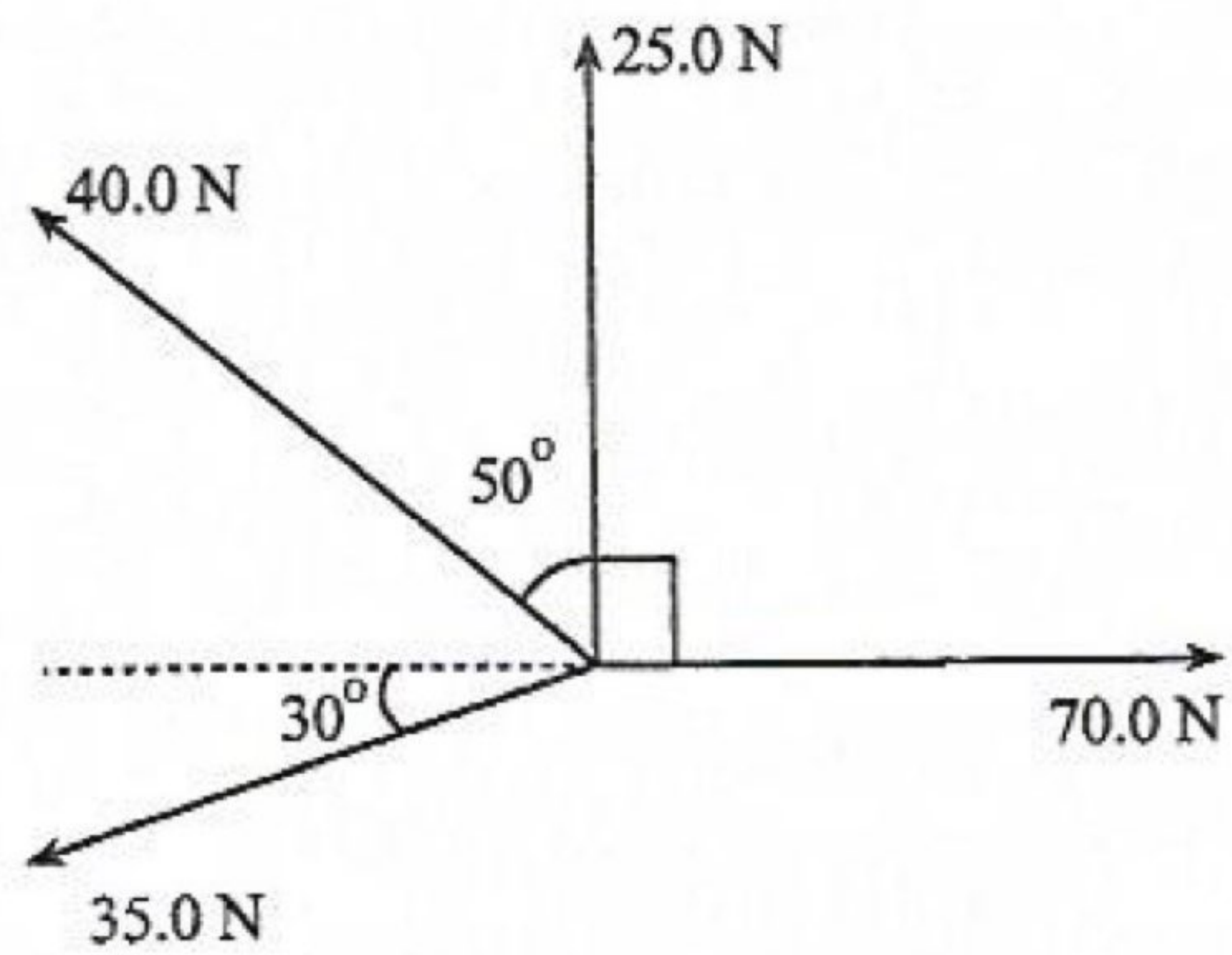

Fig. 1.1

Calculate the magnitude of the resultant force.

magnitude of resultant force = ______________ [3]

2 (a) State the principle of conservation of momentum.

____

____ [2]

(b) **Fig. 2.1** shows a snooker ball of mass 0.40 kg travelling at 2.0 m/s colliding head on with another identical ball travelling at 1.0 m/s. After the collision, the first snooker ball bounces back at 0.50 m/s.

Fig. 2.1

(i) Show that the second ball bounces back as well.

(ii) Determine whether the collision is elastic or inelastic.

____ [5]

Exa

(c) Explain why a child jumping off a wall should bend knees on landing.

____

____ [2]

3 (i) State the **two** conditions that must be satisfied for a satellite to be in a geostationary orbit.

1.____

____

2.____

____

(ii) The mass and the radius of the earth are 6.02×10^{24} kg and 6.4×10^{6} m respectively.

Calculate the height above the earth's surface of the satellite in **(i)**.

height of satellite = ____________________ [5]

4 (a) Define *electric field strength.*

______________________________ [1]

(b) An oil drop of weight of 3.04×10^{-14} N is held stationary between metal plates 4.0 mm apart when the potential difference applied is 380 V.

(i) Calculate the

1. electric field strength, E, between the plates,

$E =$ ______________

2. magnitude of the charge on the oil drop.

charge = ____________

(ii) Hence show that the charge is quantized.

[6]

5 (a) Explain the terms with reference to an op-amp:

(i) *infinite slew-rate*

(ii) *infinite bandwidth*

(iii) *infinite input impedance*

(iv) *zero output impedance*

[4]

(b) Fig. 5.1 shows an inverting amplifier.

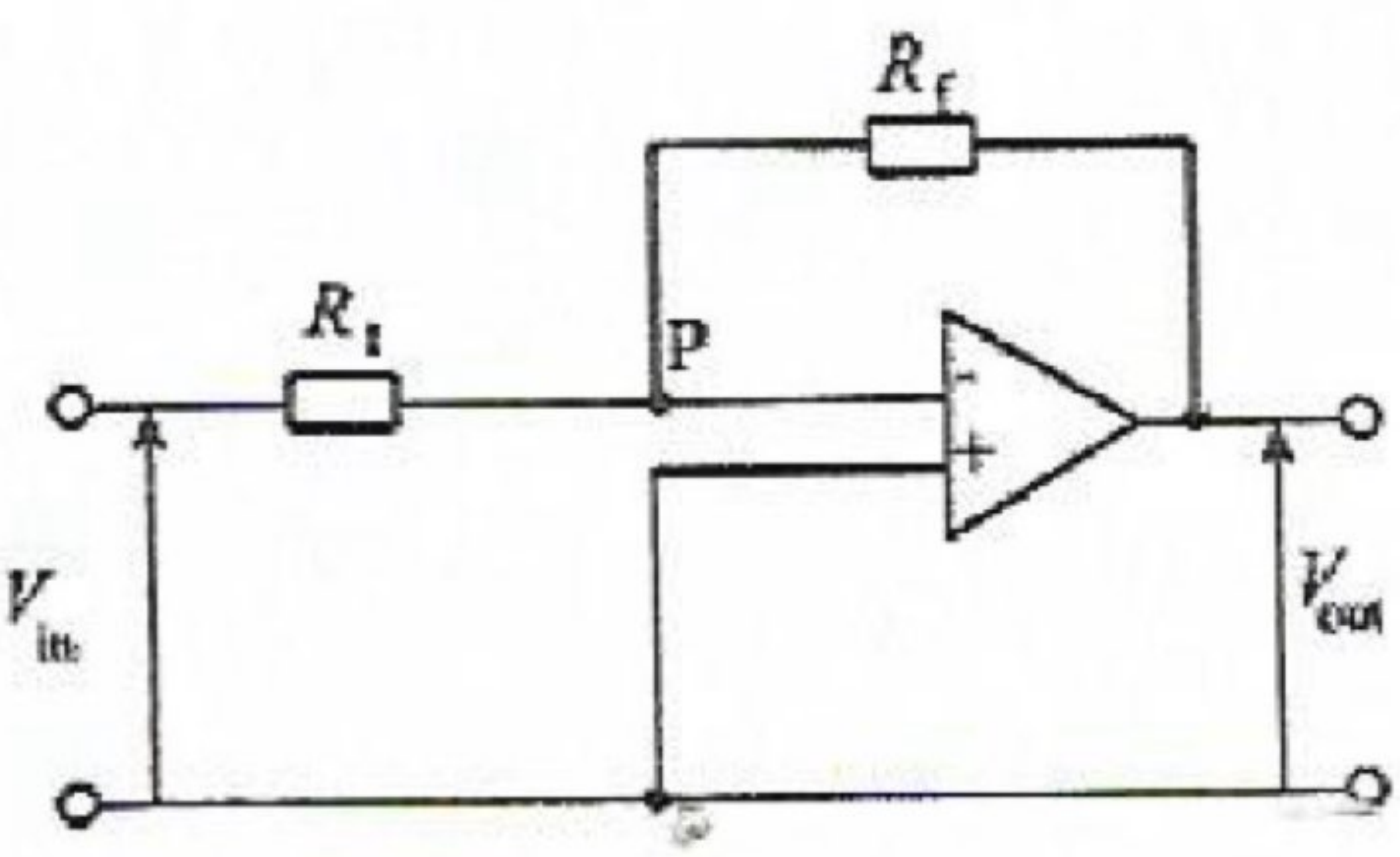

Fig. 5.1

Derive an expression for the gain, A, of the amplifier.

[2]

6 (a) Define

(i) *yield point*,

(ii) *ultimate tensile strength*.

[2]

(b) In an experiment to measure the Young Modulus of a wire, the wire is long and thin.

Explain why the wire should be

(i) *long*,

(ii) *thin*.

[2]

(c) When a load of 40.0 N is applied to a wire of cross-sectional area 1.50×10^{-7} m^2 and length 2.00 m, it causes an extension of 1.00 mm.

Determine the

(i) stress in the wire,

(ii) energy stored in the wire.

[3]

For Examiner's Use

7 (a) (i) Define *thermal equilibrium.*

(ii) Explain the importance of thermal equilibrium.

[3]

(b) A resistance thermometer has resistances of 37.3 Ω and 48.1 Ω at ice and steam points respectively.

Calculate the temperature corresponding to 18.2 Ω.

temperature = ______________ [2]

8 (a) State the ideal gas equation.

[1]

(b) The density of nitrogen at standard temperature and pressure (s.t.p) is 1.25 kgm^{-3}. The s.t.p values are 1.01×10^5 Pa and 273 K.

Calculate the r.m.s speed, $c_{r.m.s}$, of nitrogen molecules at 298 K.

$c_{r.m.s}$ = ______________ [3]

(c) Explain how an increase in internal energy of an ideal gas is related to a rise in temperature of the ideal gas.

___

___

___ [2]

9 (a) Given the photoelectric equation:

$$hf = \phi + E_k$$

State the physical quantity represented by

(i) hf, ___

(ii) ϕ, ___

(iii) E_k. ___

[3]

(b) A metal surface of threshold wavelength 550 nm is irradiated with blue light of wavelength 450 nm.

Calculate the

(i) maximum kinetic energy of the emitted photoelectrons,

(ii) reverse voltage required to stop the emitted photoelectrons from reaching the anode.

[4]

[Turn over

(c) State, with a reason, the effect on the quantity calculated in **b(ii)** of doubling the

(i) intensity of incident light, ________________________________

____

____

____

(ii) wavelength. ____

____

____ [4]

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL
General Certificate of Education Advanced Level

MARKING SCHEME

NOVEMBER 2016

PHYSICS 9188/2

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General Certificate of Education Advanced Level

MARKING SCHEME

NOVEMBER 2016

PHYSICS 9188/2

1 (a) Vector - quantity with both magnitude and direction, scalar - is quantity with magnitude /size only — B1

(b) total upward force = $25 + 40\sin 40 - 35\sin 30 = 33.21$ N

total horizontal force = $70 - 40\cos - 35\cos 30 = 9.05$ N — C1

Therefore $R = \sqrt{33.21^2 + 9.05^2}$ — C1

= 34.4 N — A1

A.H accept

2 (a) Total momentum before = total momentum after; — B1

provided it's a closed system; — B1

(b) (i) momentum before = momentum after

$(0.40 \times 2) - (0.40 \times 1.0) = (0.40 \times (-0.50)) + 0.40V$ — C1

V = 1.5 m/s — A1

Take note of signs

Accept right as -ve

Therefore second ball bounces back — A0

(ii) KE before = $\left(\frac{1}{2} \times 0.40 \times 2.0^2\right) + \left(\frac{1}{2} \times 0.40 \times 1.0^2\right) = 1.0$ J

0.8   0.2

or relative speed before

KE after = $\left(\frac{1}{2} \times 0.40 \times 0.50^2\right) + \left(\frac{1}{2} \times 0.40 \times 1.5^2\right)$ — C1

relative speed after

= 0.50 J — C1

Therefore Inelastic, 1.0 J > 0.50 J — A1

relative speed of approach/separation

(c) Increase duration of impact with the ground, — B1

reduces force of impact — B1

~~(a)~~ (i) period of 24 hours / 1 of Earth's rotation B1
moving from west to east above the equator / rotation in the same direction as the Earth. B1

(ii) $T^2 = \frac{4\pi r^3}{GM}$

$r^3 = \frac{(24 \times 3600)^2 \times 6.67 \times 10^{-11} \times 6.02 \times 10^{24}}{4\pi^2}$ C1

$r^3 = 7.59 \times 10^{22}$ C1

$\therefore \ r = 4.23 \times 10^7$ m

$h = 4.23 \times 10^7 - 6.4 \times 10^6$

$= \quad 3.60 \times 10^7$ m 2/3 s.f. A1

3.59

4 (a) Force per unit charge A. all formulae with +B B1

(b) (i) I. $E = \frac{V}{d}$

$= \quad \frac{380}{4.0 \times 10^{-3}}$ C1

$= \quad 9.5 \times 10^4$ NC^{-1} 2/3 s.f. / 95 000 A1
V/m

b 2 $q = \frac{mg}{E}$

$= \quad \frac{3.04 \times 10^{-14}}{9.5 \times 10^4}$ C1

$= \quad 3.20 \times 10^{-19}$ C A1

(ii) $n = \frac{q}{e} = \frac{3.20 \times 10^{-19}}{1.6 \times 10^{-19}}$ 2/3 s.f. C1

$= \quad 2$ A1

$\therefore$ charge is quantised

30+42+34+55+38+30

5 (a) (i) if the input suddenly changes, the output changes in step; A.H. **B1**

(ii) it amplifies all frequencies by the same amount; Constant gain for all frequencies. **B1**

(iii) no current flows into either of the two inputs; **B1**

(iv) the amplifier can provide the correct current for any load (no matter how small its resistance) **B1**

(b) $\frac{V_{in} - 0}{R_1} = \frac{0 - V_{out}}{Rf}$; **M1**

$\therefore A = \frac{V_{out}}{V_{in}} = -\frac{Rf}{R_1}$; **A1**

6 (a) (i) yield point – is a point on (stress-strain graph) beyond which the material undergoes plastic deformation or remarkable extension **B1**

(ii) is the maximum stress or force / greatest (idea of maximum). **B1**

(b) (i) long – to produce measurable extension A.H. (large extension) **B1**

(ii) thin – so that a large tensile stress can be produced (to produce a measurable extension) **B1**

(c) (i) $\frac{F}{A}$ $\frac{40.0}{1.50 \times 10^{-7}} = 2.67 \times 10^{8}$ Pa / 267 MPa **A1**

(ii) $\frac{1}{2}Fx = \frac{1}{2} \times 40 \times 1.0 \times 10^{-3}$ **C1**

$= 2.00 \times 10^{-2}$ J 3/4 s.f. **A1**

7 (a) (i) If two or more bodies are in contact and (same temperature) **B1**
there is no (net) heat transfer. **B1**

(ii) enables temperature measurement **B1**

(b) $\theta = \frac{18.2 - 37.3}{48.1 - 37.3} \times 100$ °C **C1**

$=$ -176.9 °C / -177 **A1**

96.1 K

$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$

(a) PV = nRT with terms defined B1

(b) $P = \frac{1}{3}\rho \overline{c^{2}}$

$1.01 \times 10^{5} = \frac{1}{3} \times 1.25 \times \overline{c^{2}}$

$\sqrt{\overline{c^{2}}} = \sqrt{\frac{1.01 \times 10^{5}}{\frac{1}{3} \times 1.25}}$ C1

$= 492.3$

$E_K = \frac{3}{2}KT$

∴ r.m.s speed at 298 K

$= \sqrt{\frac{298}{273}} \times 492.3$ C1

$= 514.3$ m/s A1

(c) Internal energy is wholly kinetic B1
kinetic energy ∝ temp B1

9 (a) (i) hf – energy of photon B1

(ii) ϕ - work function of metal B1

(iii) E_K – max kinetic energy of photo electrons B1

(b) (i) $E_K = hf - hf_o$

$= 6.63 \times 10^{-34} \times 3 \times 10^{8}\left(\frac{1}{450 \times 10^{-9}} - \frac{1}{550 \times 10^{-9}}\right)$ C1

$= 8.04 \times 10^{-20}$ J A1

(ii) $E_K = eV$

$V = \frac{8.04 \times 10^{-20}}{1.6 \times 10^{-19}}$ C1

$= 0.502$ V A1

(a) $PV = nRT$ with terms defined $PV = NkT$ [formulae] — B1

(b) $P = \frac{1}{3}\rho \overline{c}^{2}$

$1.01 \times 10^5 = \frac{1}{3} \times 1.25 \times \overline{c}^{2}$

$\sqrt{\overline{c}^{2}} = \sqrt{\frac{1.01 \times 10^5}{\frac{1}{3} \times 1.25}}$ — C1

$= \quad 492.3$

$E_K = \frac{3}{2}KT$

$\therefore$ r.m.s speed at 298 K

$= \quad \sqrt{\frac{298}{273}} \times 492.3$ — C1

$= \quad 514.3$ m/s 3/4 s.f. — A1

(c) Internal energy is wholly kinetic A.H. (4 = 0) — B1
kinetic energy $\propto$ temp — B1

9 (a) (i) hf – energy of photon / Photon Energy — B1

(ii) ϕ - work function of metal — B1

(iii) E_K – max kinetic energy of photo electrons (idea of maximum). — B1

(b) (i) $E_K = hf - hf_o$

$= 6.63 \times 10^{-34} \times 3 \times 10^{8}\left(\frac{1}{450 \times 10^{-9}} - \frac{1}{550 \times 10^{-9}}\right)$ — C1

$= 8.04 \times 10^{-20}$ J ~~3/4 s.f.~~ 2/3 s.f. — A1

(ii) $E_K = eV$

$V = \frac{8.04 \times 10^{-20}}{1.6 \times 10^{-19}}$ — C1

E.C.F.

$= \quad 0.502$ V — A1

s.f. 3/4

0.5025

0.502

(c)	(i)	will not change,	B1
		V_s is independent of intensity / E_{Kmax} is independent of intensity	B1
	(ii)	V_s decreases [redacted]	B1
		V_s is inversely proportional to λ	B1

V_s decreases when λ increases

No emission occurs —— B1

V_s is zero —— B1

2 – 1 – 1

$\varphi = m\Delta T$

$\varphi_1 = mL$

$\varphi_2 = mL$

$C = \frac{\varphi}{T}$

Candidate Name	Centre Number	Candidate Number

For Performance Measurement

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL
General Certificate of Education Advanced Level

PHYSICS — 9188/2
PAPER 2

JUNE 2017 SESSION — 1 hour 15 minutes

Candidates answer on the question paper.
Additional materials:
Electronic calculator and/or Mathematical tables

TIME 1 hour 15 minutes

INSTRUCTIONS TO CANDIDATES

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FOR EXAMINER'S USE	
1	
2	
3	
4	
5	
6	
7	
8	
TOTAL	

This question paper consists of 12 printed pages.

[Turn over

Formulae

uniformly accelerated motion,	$s = ut + \frac{1}{2}at^2$
	$v^2 = u^2 + 2as$
work done on/by a gas,	$W = p\Delta V$
gravitational potential,	$\phi = -\dfrac{Gm}{r}$
refractive index,	$n = \dfrac{1}{\sin C}$
resistors in series,	$R = R_1 + R_2 + \ldots$
resistors in parallel,	$1/R = 1/R_1 + 1/R_2 + \ldots$
electric potential,	$V = \dfrac{Q}{4\pi\epsilon_0 r}$
capacitors in series,	$1/C = 1/C_1 + 1/C_2 + \ldots$
capacitors in parallel,	$C = C_1 + C_2 + \ldots$
energy of charged capacitor,	$W = \frac{1}{2}QV$
alternating current/voltage,	$x = x_0 \sin \omega t$
hydrostatic pressure,	$p = \rho g h$
pressure of an ideal gas,	$p = \frac{1}{3}\dfrac{Nm}{V}\langle c^2 \rangle$
radioactive decay,	$x = x_0 \exp(-\lambda t)$
decay constant,	$\lambda = \dfrac{0.693}{t_{\frac{1}{2}}}$
critical density of matter in the Universe,	$\rho_0 = \dfrac{3H_0^2}{8\pi G}$
equation of continuity,	$Av = \text{constant}$
Bernoulli equation (simplified),	$p_1 + \frac{1}{2}\rho v_1^2 = p_2 + \frac{1}{2}\rho v_2^2$
Stokes' law,	$F = Ar\eta v$
Reynolds' number,	$R_e = \dfrac{\rho v r}{\eta}$
drag force in turbulent flow,	$F = Br^2\rho v^2$

Data

speed of light in free space,	$c = 3.00 \times 10^{8}\ \mathrm{m\,s^{-1}}$
permeability of free space,	$\mu_0 = 4\pi \times 10^{-7}\ \mathrm{H\,m^{-1}}$
permittivity of free space,	$\epsilon_0 = 8.85 \times 10^{-12}\ \mathrm{F\,m^{-1}}$
elementary charge,	$e = 1.60 \times 10^{-19}\ \mathrm{C}$
the Planck constant,	$h = 6.63 \times 10^{-34}\ \mathrm{J\,s}$
unified atomic mass constant,	$u = 1.66 \times 10^{-27}\ \mathrm{kg}$
rest mass of electron,	$m_e = 9.11 \times 10^{-31}\ \mathrm{kg}$
rest mass of proton,	$m_p = 1.67 \times 10^{-27}\ \mathrm{kg}$
molar gas constant,	$R = 8.31\ \mathrm{J\,K^{-1}\,mol^{-1}}$
the Avogadro constant,	$N_A = 6.02 \times 10^{23}\ \mathrm{mol^{-1}}$
the Boltzmann constant,	$k = 1.38 \times 10^{-23}\ \mathrm{J\,K^{-1}}$
gravitational constant,	$G = 6.67 \times 10^{-11}\ \mathrm{N\,m^{2}\,kg^{-2}}$
acceleration of free fall,	$g = 9.81\ \mathrm{m\,s^{-2}}$

*Answer **all** questions.*

For Examiner's Use

1 **(a)** Explain how an accurate value of the diameter of a thin wire is measured.

____

____

____ [2]

(b) The diameter, d, and length l, of a piece of wire are given as:

$d = (0.84 \pm 0.04)$ mm
$l = (755 \pm 4)$ mm

The volume, V, of the wire is given by $V = \frac{1}{4}\lambda d^2 l$, where λ is a constant.

Calculate the percentage uncertainty in the measurement of the

(i) diameter,

uncertainty = ______________%

(ii) length,

uncertainty = ______________%

(iii) volume.

uncertainty = ______________%

[4]

For Examiner's Use

2 (a) (i) Explain the meaning of the following terms:

1. *free oscillations*

____

____

2. *simple harmonic motion*

____

____

____

(ii) Explain why in practice the amplitude of a free oscillation is not constant.

____

____

____

[4]

(b) The position of an object undergoing simple harmonic motion is given by $x = x_0 \sin 0.5t$.

Sketch on the same axis the graphs showing the variation with time of the object's

(i) speed,

(ii) acceleration.

[3]

For Examiner's Use

3 (a) State any **two** basic assumptions of the kinetic theory of gases.

____

____

____

____ [2]

(b) The pressure, p, of an ideal gas of density ρ, is given by

$$p = \frac{1}{3}\rho < c^2 >.$$

(i) State the meaning of the symbol $<c^2>$.

____

(ii) Show that the average kinetic energy of the molecules is proportional to the thermodynamic temperature, T.

[4]

For Examiner's Use

4 **(a)** A cell has <u>an e.m.f. of 3V</u>.

Explain the underlined phrase.

____

____

____ [1]

(b) **Fig. 4.1** shows a connection of resistors of 5 kΩ each.

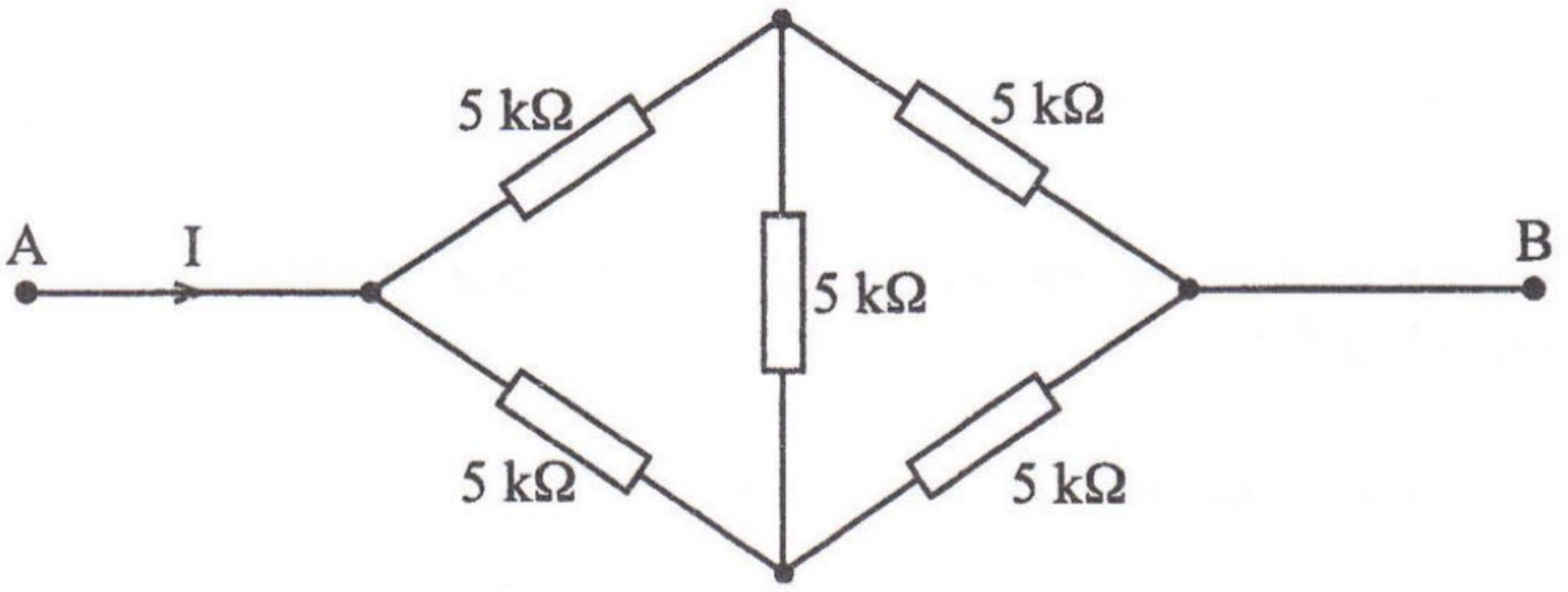

Fig. 4.1

The *p.d* across A and B is 3 V.

Determine the

(i) total resistance between A and B,

resistance = ______________

(ii) current, I, in the circuit.

current = ______________

[5]

For Examiner's Use

5 (a) Define

(i) *electric field strength,*

____

____

(ii) *electric potential.*

____

____ [2]

(b) An electron at rest, A, is moved in a vacuum by an electric field to B as shown in **Fig. 5.1**.

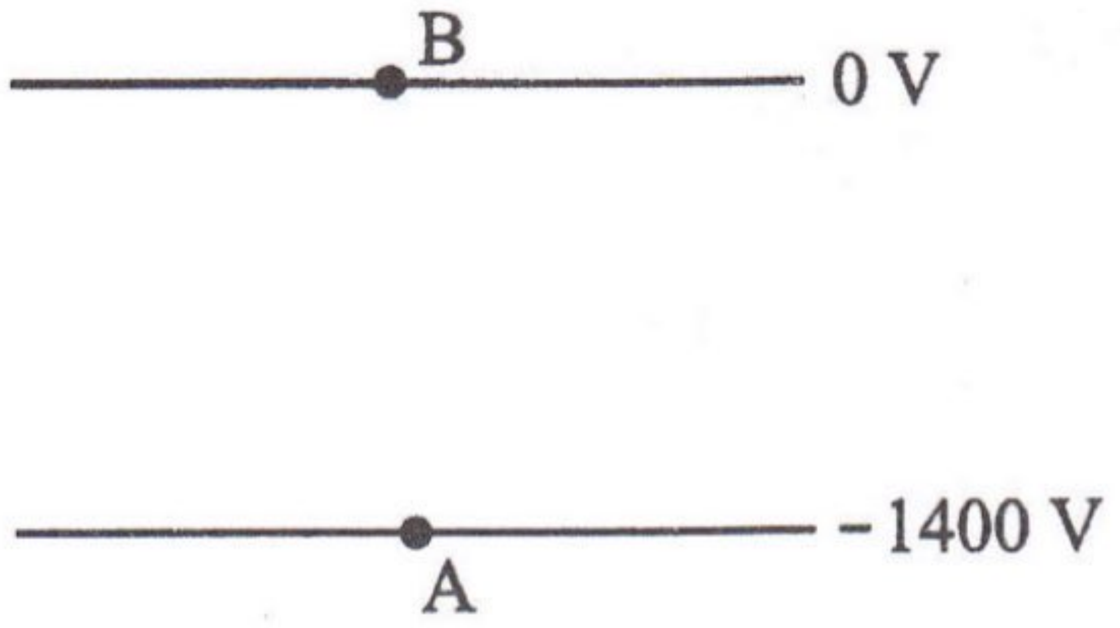

Fig. 5.1

(i) Show, on **Fig. 5.1**, the direction of the electric field.

(ii) Determine the

1. gain in electric potential by the electron,

gain in electric potential = ______________

2. loss in electric potential energy by the electron,

loss in electric potential = ______________

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For Examiner's Use

3. velocity of the electron at B.

velocity = __________

[6]

6 **Fig. 6.1** shows an opamp.

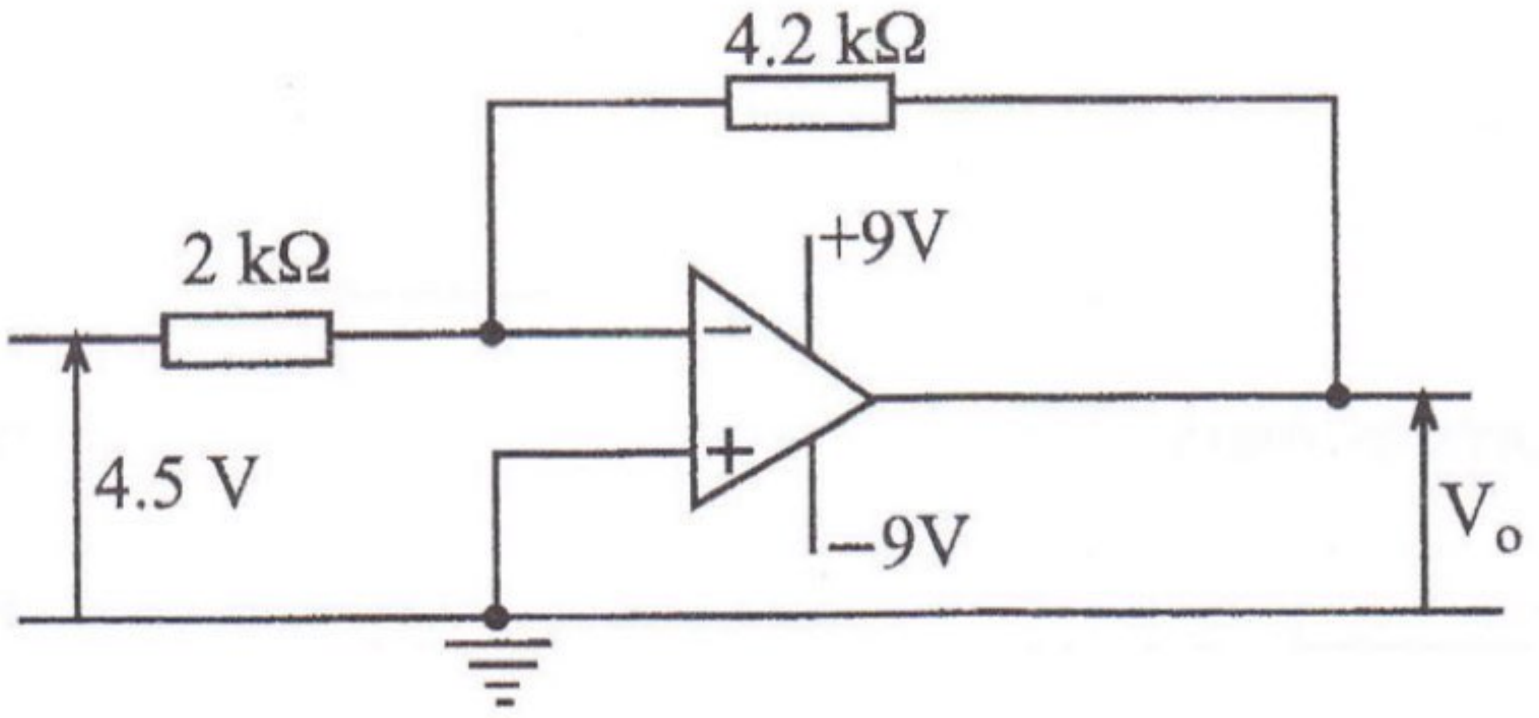


Fig. 6.1

(i) Mark with a letter X, the virtual earth on **Fig. 6.1**.

(ii) State

1. the type of amplifier shown in **Fig. 6.1**,

____

2. what is meant by negative feedback.

____

____

For Examiner's Use

(iii) Calculate the output voltage.

output voltage = __________

[6]

7 **(a)** Explain the following terms:

(i) *photon*

____

____

____

(ii) *wave particle duality*

____

____

____ [2]

(b) The photoelectric effect provides evidence for the particulate nature of electromagnetic radiation.

State **three** experimental observations that support this conclusion.

1. ____

____

2. ____

____

3. ____

____ [3]

For Examiner's Use

(c) Calculate the wavelength of a beam of electrons which was accelerated through a potential difference of 3 600 V.

wavelength = ___________ [3]

(d) **Fig. 7.1** shows sunlight rays directed to an enclosed hydrogen gas.

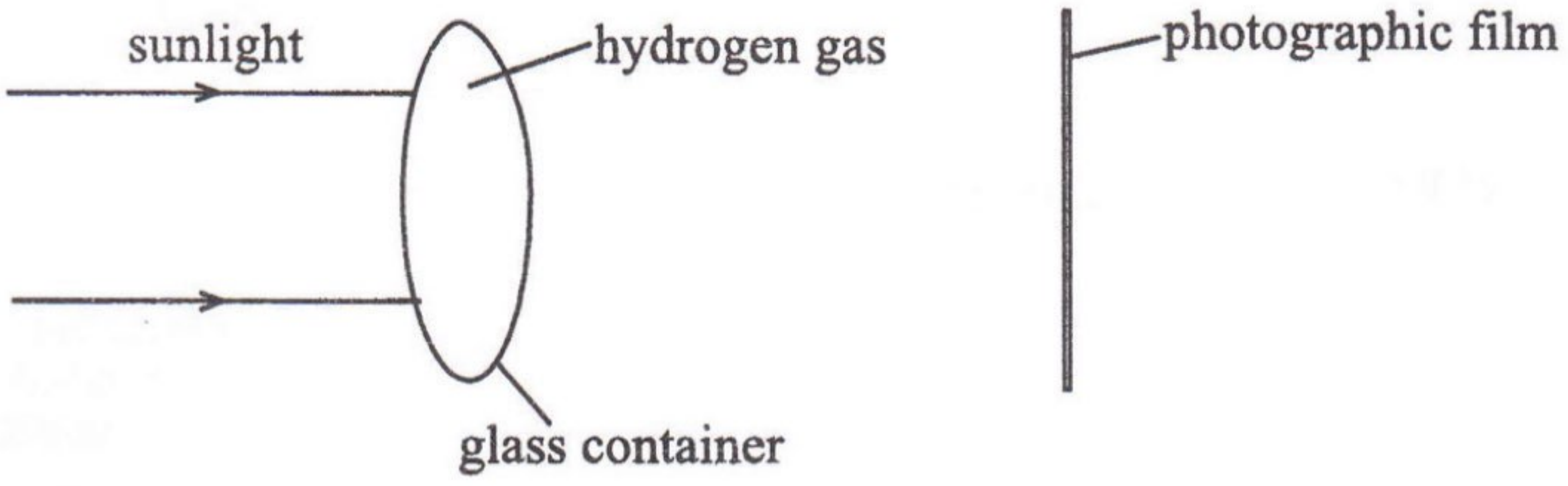


Fig. 7.1

(i) State the type of spectrum observed on the photographic film.

____

(ii) Explain, with a reason, how the spectrum in **(i)** is produced.

____

____

______________________________ [3]

8 **(a)** Radioactive decay is said to be <u>spontaneous</u> and <u>random</u>.

Explain the underlined terms.

1. spontaneous ______________________________

____

2. random ______________________________

______________________________ [2]

For Examiner's Use

(b) A sample of cobalt-60 has 3.72×10^{21} particles. Cobalt-60 has a decay constant of $1.83 \times 10^{-9} s^{-1}$.

Calculate the

(i) mass of cobalt-60 present,

mass = ______________

(ii) half life, $t_{\frac{1}{2}}$, of the source,

$t_{\frac{1}{2}}$ = ______________

(iii) number, *N*, of undecayed particles after 1 year.

N = ______________

[6]

(c) Explain why high energy α-particles are not suitable for bombarding atoms to cause nuclear reactions.

____

____

____

____ [2]

MARKING SCHEME

JUNE 2017

PHYSICS 9188/2

1 (a) Use of micrometer screw gauge (choice of suitable instrument B1
measure diameter on a number of points along the wire, and finding the average B2
repeat & average
max B2

(b) (i) $\frac{\Delta d}{d} \times 100\% = \frac{0.04}{0.84} \times 100\% = 4.76\%$ A1

(ii) $\frac{\Delta l}{l} \times 100\% = \frac{4}{755} \times 100\% = 0.53\%$ A1

(iii) $\frac{\Delta V}{V} \times 100\% \left(\frac{2\Delta d}{d} + \frac{\Delta l}{l}\right) \times 100\%$ C1

$= 2(4.76\%) + 0.53\%$

$= 10.05\%$ A1

2 (a) (i) 1. These are oscillations where no external forces are applied to sustain the oscillations a/w B1

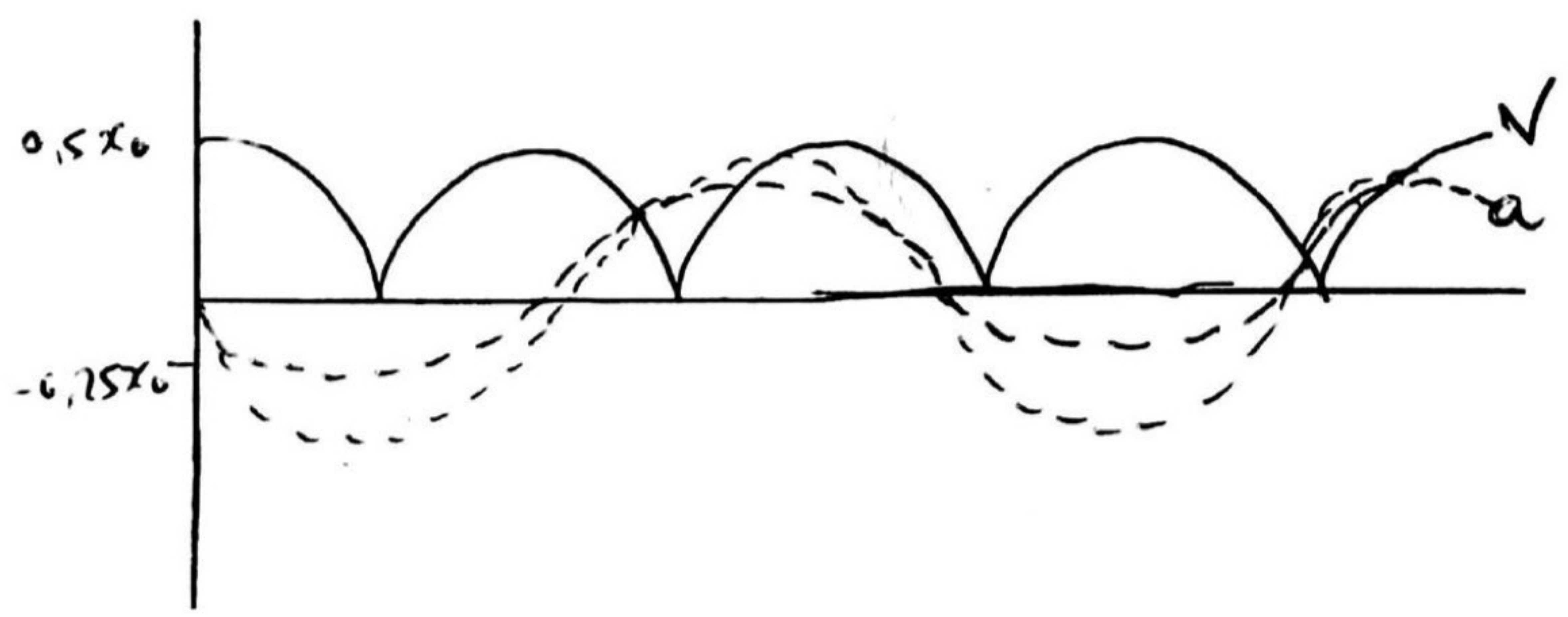
2. acceleration directed towards a fixed point and acceleration proportional to distance from fixed point B1 B1

or motion which satisfies $a = -w^2x$ with terms defined

(ii) energy is lost through work done against air resistance A/w B1

hence amplitude would gradually die down/decrease B0

(b)



Correct speed graph B1
Correct acceleration graph B1
Amplitude of acceleration < amplitude of velocity B1

award mark for amplitude comparison for candidates who label separate graphs.

3 (a) There are no intermolecular forces between the particles A/ω B1

The volume of the molecules is negligible compared to the volume occupied by the gas A/ω . B1

Collisions (between the gas molecules) are perfectly elastic B1

(time during collisions)
The duration of collisions is negligible compared with the time between collisions B1

There are many ~~number of~~ particles (large number of particles) B1

Particles are in random motion B1
newtonian mechanics apply Max B2

(b) (i) mean square speed/velocity B1

(ii) $\rho = \frac{Nm}{V}$ } B1 ~~B1~~

$PV = \frac{1}{3}Nm.<c^2>$ ~~PV = nRT~~ ~~B1~~

PV = NkT / PV = nRT B1

∴ average kinetic energy = $\frac{1}{2}m<c^2>$

$= \frac{3}{2}kT$ / $\frac{3}{2}NkT$ B1

4 (a) 3 J of chemical energy converted to electrical energy when ~~3 Joules of energy is required to drive~~ a unit positive charge moves round complete circuit. B1

(b) (i) $\frac{1}{R1} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$ $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$ B1

$\frac{1}{10} = \frac{1}{10} + \frac{1}{5} = \frac{4}{10}$ $\frac{1}{R_T} = \frac{1}{10} + \frac{1}{10}$ C1

$R_T = 2.5\ k\Omega$ $R_T = 5\ k\Omega$ A1

(ii) $I = \frac{V}{R} = \frac{3}{2500} =$ ~~1.2mA~~ 0,6 mA ecf – for R C1 A1

1 or 2 s.f.

5 (a) (i) Force acting per unit positive charge placed at a point in an electric field — B1

(ii) Work done per unit positive charge in bringing the charge from infinity to the point — B1

(b) (i) arrow(s) pointing downwards — B1

(ii) 1. gain in electric potential = 0 – (–1 400 V)

= 1 400 V — A1

2. loss in electric potential energy

= $eV = 1400 \times 1.6 \times 10^{-19}$ — C1

= 2.24×10^{-16} J (ignore signs) 3 or 4 s.f. — A1

3. loss in potential energy = gain in kinetic energy — C1

$$\frac{1}{2}mv^2 = 2.24 \times 10^{-16}$$

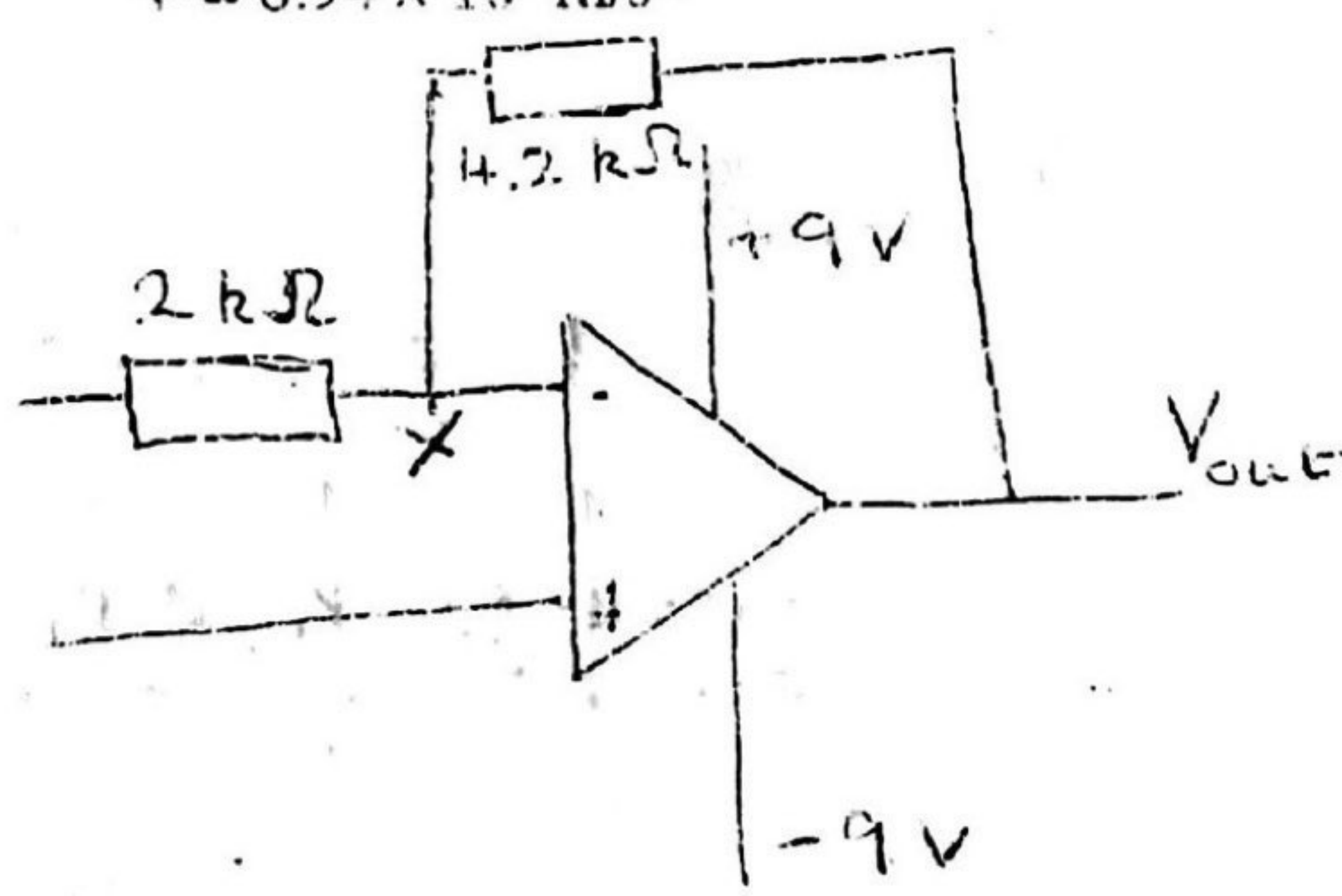
$$\frac{1}{2} \times 9.11 \times 10^{-31} v^2 = 2.24 \times 10^{-16}$$

$v^2 = 4.92 \times 10^{14}$

2.22×10^{7} ms^{-1} 3 or 4 s.f.

~~$v = 6.94 \times 10^{8}$ m/s~~ — A1

6 (a) (i)



B1

(ii) 1. Inverting amplifier — B1

2. is when part or all of the output is fed back to the inverting/negative input — B1

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(iii) $V_{out} = \frac{-R_f}{R_{in}} V_{in}$ C1

$= \frac{-4.2}{2} \times 4.5$ C1

$= -9.45$ V ~~C1~~

opamp has saturated hence output = −9V A1

7 (a) (i) A photon is a discrete packet of an electromagnetic radiation A/w B1

(ii) refers to the particle-like behaviour of waves and wave-like behaviour of particles B1

(b) instantaneous emission of photoelectrons A/w B1
existence of threshold frequency A/w B1
intensity directly proportional to the number of photoelectrons emitted per unit time B1 A/w

maximum kinetic energy of photoelectrons is determined by the frequency of the incident radiation B1
max KE is independant of intensity Max B3

(c) $E = eV = 1.6 \times 10^{-19} \times 3600 = 5.7 \times 10^{-16}$ J C1

$$\lambda = \frac{h}{\sqrt{2mE}} = \frac{6.63 \times 10^{-34}}{\sqrt{2 \times 9.11 \times 10^{-31} \times 5.76 \times 10^{-16}}}$$

$= 2.06 \times 10^{-11}$ m (9.02) A1

(d) (i) absorption spectrum B1

(ii) the atoms absorb photons whose freq/wavelength energies match those in their emission spectrum / A/w B1

They then re-emit photons of those energies; but in all directions
So the intensity in the (forward) direction is reduced for those wavelength B1
spectrum is white light minus absorbed spectrum/light

8 (a) Random

We cannot predict which atom will decay next/unpredictable/no order B1

Spontaneous

Is not affected by physical conditions such as temperature and pressure B1

(b) (i) mass $= \frac{3{,}72 \times 10^{21}}{6{,}02 \times 10^{23}} \times 60$ C1

$= 0{,}371$ g acc 2 or 3 s.f. A1

(ii) $t_{\frac{1}{2}} = \frac{\ln 2}{\lambda} = \frac{\ln 2}{1{,}83 \times 10^{-9}}$ C1

$= 3{,}79 \times 10^{8}$s A1

(iii) $N = N0e^{-\lambda t}$

$= 3{,}72 \times 10^{-21} e^{-1{,}83 \times 10^{-9}} \times 3{,}16 \times 16 \times 10^{7}$ C1

$= 3.51 \times 10^{21}$ acc 2 or 3 s.f. A1

(c) not suitable

α-particles are positively charged and therefore are repelled by any other nucleus B2

hence cannot penetrate the nucleus of other particles B1

Max B2

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9188/2 J2017

1(a) - use a micrometre screw gauge
- repeat and average readings
- avoid parallax error

b(i) $\frac{0.04}{0.84} \times 100 = 4.76 = 5\%$ (1.s.f)

(ii) $\frac{4}{755} \times 100 = 0.529 = 0.5\%$ (1.s.f)

(iii) $\frac{\Delta V}{V} \times 100 = \left(2\left[\frac{\Delta d}{d}\right] + \frac{\Delta l}{l}\right) \times 100$

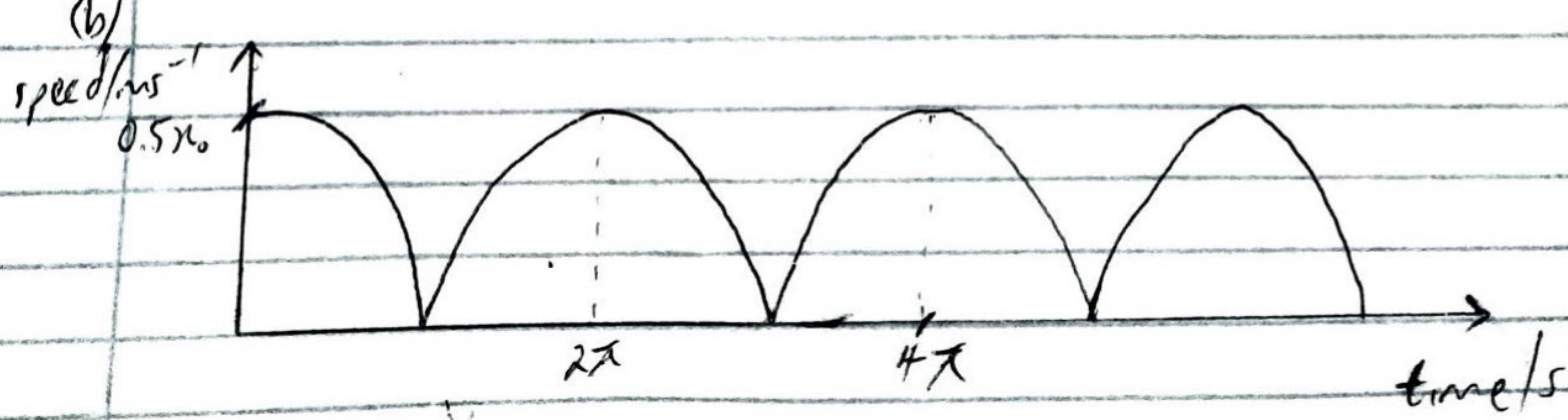
$= 2\left[4.76\right] + 0.529 = \underline{\underline{10\%}}$

2a(i) Motion with no external forces /constant amplitude

(2) Motion where acceleration is proportional to displacement from a fixed point and is directed towards that point.

(ii) Some energy is lost as work done against resistance. (air resistance)

(b)

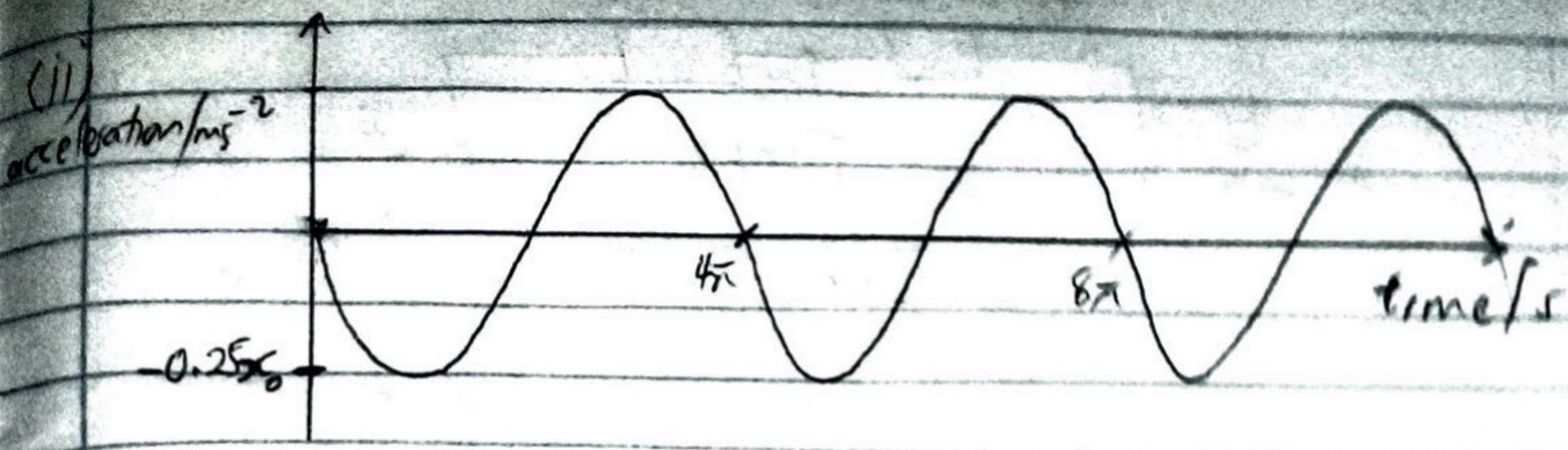


(ii) accelera

3(a)

b

(ii)



3(a) - no intermolecular forces
- random motion of particles
- number of particles large
- perfectly elastic collisions etc

b(i) mean square speed.

(ii) $P = \frac{1}{3} \rho \langle c^2 \rangle = \frac{1}{3} \frac{Nm \langle c^2 \rangle}{V}$

$PV = \frac{Nm \langle c^2 \rangle}{3} = NkT$

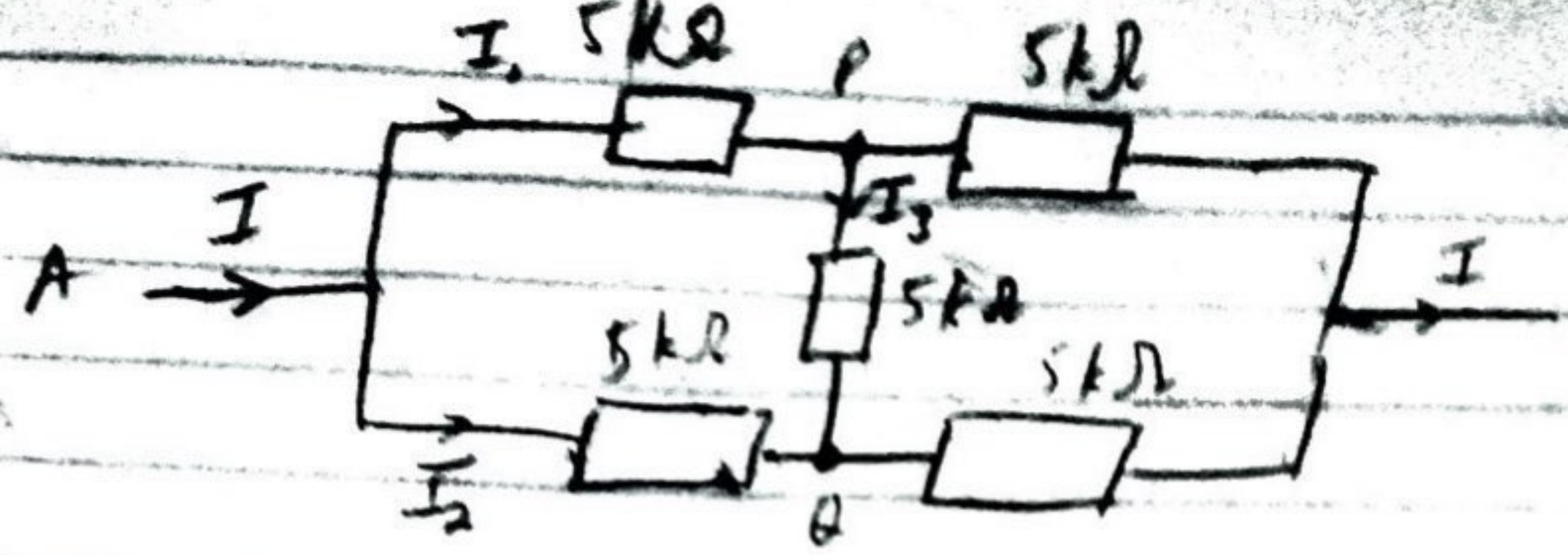
$= m \langle c^2 \rangle = 3kT$

$KE = \frac{1}{2} m \langle c^2 \rangle = \frac{3}{2} kT$ shown

(accept the use of nRT)

4(a) 3J of electrical energy is produced from other forms of energy (chemical of the battery) for every 1C of charge (the battery can drive)

(i) $R_T = \frac{(5+5) \times (5+5)}{(5+5) + (5+5)} = 5k\Omega$



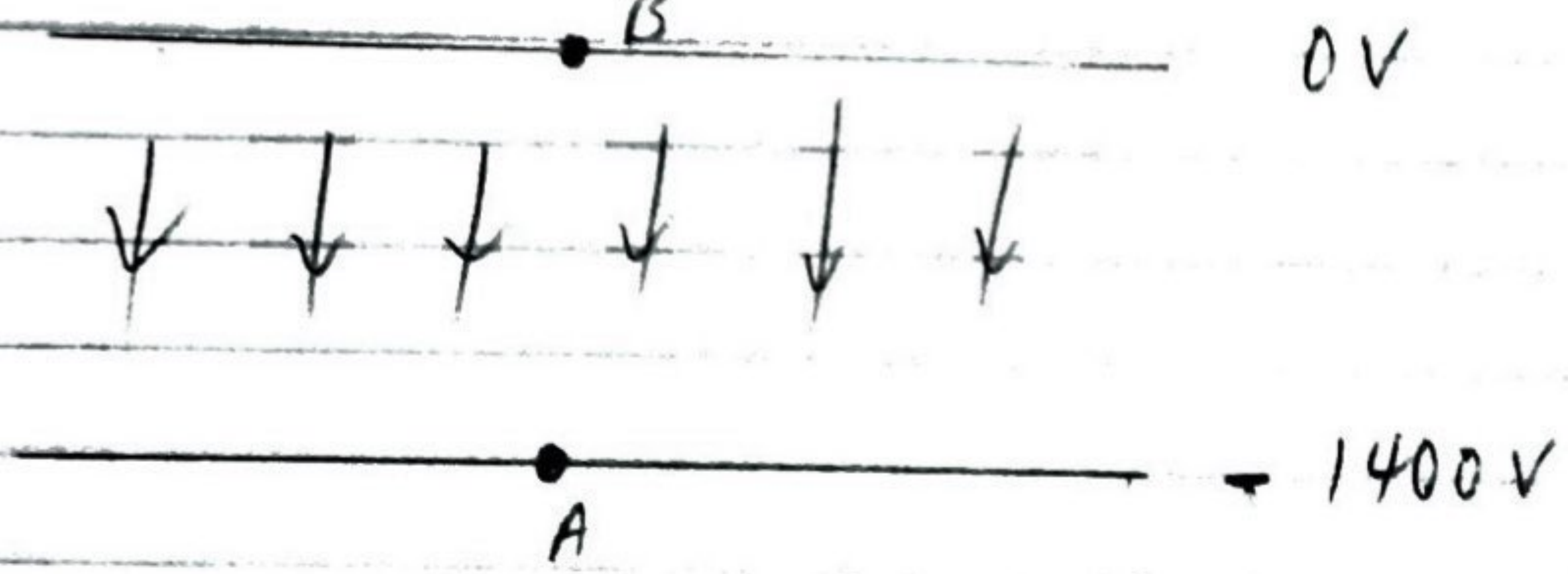
$I_3 = 0$ because potential at $P = Q$

(ii) $I = \frac{V}{R_T} = \frac{3}{5\times10^3} = \underline{6\times10^{-4}\,A}$

5 a(i) Electric force acting per unit positive charge

(ii) Work done in moving a positive charge from infinity to a point in field.

(b)



(ii) 1 $\Delta V = 0 - (-1400) = \underline{1400V}$

(2) $1 = eV = \underline{1400\,eV / 2.24\times10^{-16}\,J}$

(3) $eV = \frac{1}{2}mv^2$

$$v = \sqrt{\frac{2eV}{m}} = \sqrt{\frac{2\times2.24\times10^{-16}}{9.11\times10^{-31}}}$$

$$= \underline{2.22\times10^{7}\,ms^{-1}}$$

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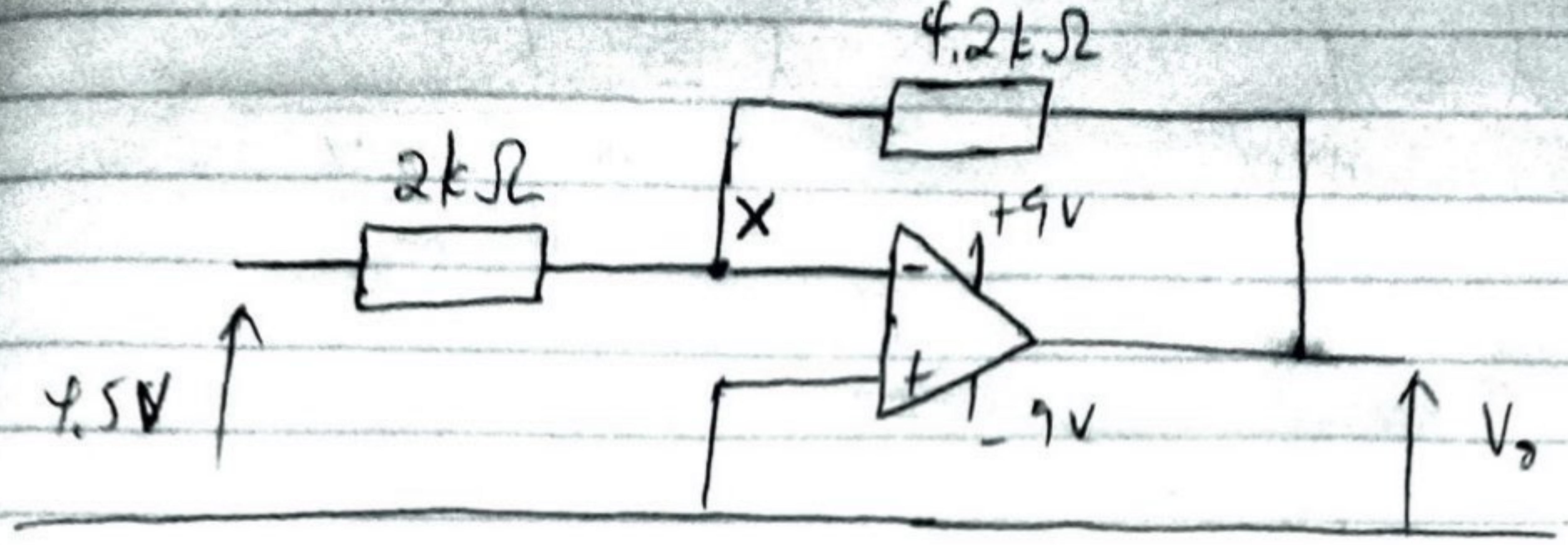
6(i)



(ii). (1) Inverting with negative feedback
2. Part or all of output voltage is fed to inverting input

(iii) $\frac{V_o}{V_{in}} = \frac{-R_f}{R_{in}}$

$V_o = \frac{-R_f}{R_{in}}(V_{in}) = -\frac{4.2\times10^3}{2\times10^3}\times 4.5$

$= \underline{-9.45V}$

7(a)(i) A discrete packet of energy from electromagnetic radiation
(ii) waves show particle behavior and particles show wave behavior

(b) 1. Existance of a threshold frequency
2. Instantaneous ejection of electrons
(3) Photoelectric current directly proportional to intensity of illumination

(c) $\frac{1}{2}mv^2 = eV$ $\qquad v = \sqrt{\frac{2eV}{m}}$

$$\lambda = \frac{h}{mv} \therefore \lambda = \frac{h}{m\sqrt{\frac{2eV}{m}}}$$

$$= \frac{h}{\sqrt{2meV}} =$$

$$= \frac{6.63 \times 10^{-34}}{\sqrt{2 \times 9.11 \times 10^{-31} \times 1.6 \times 10^{-19} \times 3600}}$$

$$= \underline{\underline{2 \times 10^{-11} m}}$$

d (i) absorption spectrum

(ii) Existance of dark lines is due to photons in sunlight being absorbed by hydrogen atoms. The photons have the same frequencies as characteristic lines of the hydrogen spectrum

8 a(1) process governed from within (self inducing) unaffected by external factors

(2) unpredictable ie at any time it might happen without any pattern

(b) $\frac{M}{Mr} = \frac{N}{L} \therefore M = \frac{N}{L} \times Mr$

$$= \frac{3.72 \times 10^{21} \times 60}{6.02 \times 10^{23}} = \underline{\underline{0.37g}}$$

BY SIR ALOIS

(ii) $t_{\frac{1}{2}} = \frac{0.693}{\lambda} = \frac{0.693}{1.83\times10^{-9}}$

$= 3.7868\times10^{8}$

$= \underline{3.8\times10^{8}\,s}$

1 year $= 365\times24\times3600$

$n = \frac{365\times24\times3600}{3.8\times10^{8}} = 8.3\times10^{-2}$

$n\,t_{\frac{1}{2}} = \frac{1}{2^{n}} N_0$

$N = \frac{1}{2^{0.083}} \times 3.72\times10^{21}$

$= \underline{3.5\times10^{21}\text{ particles}}$

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

$= 3.72\times10^{21}\, e^{-(1.83\times10^{-9})(365\times24\times3600)}$

$= \underline{3.5\times10^{21}}$

(c) α particles are positively charged therefore they are repelled by positively charged nucleus.

BY SIR ALOIS CHIPFURUTSE
0771 320 978 / 0713 702273

Candidate Name	Centre Number	Candidate Number

For Performance Measurement

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

PHYSICS — 9188/2

PAPER 2

NOVEMBER 2017 SESSION 1 hour 15 minutes

Candidates answer on the question paper.
Additional materials:
Electronic calculator and/or Mathematical tables

TIME 1 hour 15 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided on the question paper.
For numerical answers, **all** working should be shown.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

FOR EXAMINER'S USE	
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	

This question paper consists of 12 printed pages.

[Turn over

Formulae

uniformly accelerated motion,	$s = ut + \frac{1}{2}at^2$ $v^2 = u^2 + 2as$
work done on/by a gas,	$W = p\Delta V$
gravitational potential,	$\phi = -\frac{Gm}{r}$
refractive index,	$n = \frac{1}{\sin C}$
resistors in series,	$R = R_1 + R_2 + \ldots$
resistors in parallel,	$1/R = 1/R_1 + 1/R_2 + \ldots$
electric potential,	$V = \frac{Q}{4\pi\epsilon_0 r}$
capacitors in series,	$1/C = 1/C_1 + 1/C_2 + \ldots$
capacitors in parallel,	$C = C_1 + C_2 + \ldots$
energy of charged capacitor,	$W = \frac{1}{2}QV$
alternating current/voltage,	$x = x_0 \sin \omega t$
hydrostatic pressure,	$p = \rho g h$
pressure of an ideal gas,	$p = \frac{1}{3}\frac{Nm}{V}\langle c^2 \rangle$
radioactive decay,	$x = x_0 \exp(-\lambda t)$
decay constant,	$\lambda = \frac{0.693}{t_{\frac{1}{2}}}$
critical density of matter in the Universe,	$\rho_0 = \frac{3H_0^2}{8\pi G}$
equation of continuity,	$Av = \text{constant}$
Bernoulli equation (simplified),	$p_1 + \frac{1}{2}\rho v_1^2 = p_2 + \frac{1}{2}\rho v_2^2$
Stokes' law,	$F = Ar\eta v$
Reynolds' number,	$R_e = \frac{\rho v r}{\eta}$
drag force in turbulent flow,	$F = Br^2\rho v^2$

Data

speed of light in free space,	$c = 3.00 \times 10^8 \text{ m s}^{-1}$
permeability of free space,	$\mu_0 = 4\pi \times 10^{-7} \text{ H m}^{-1}$
permittivity of free space,	$\epsilon_0 = 8.85 \times 10^{-12} \text{ F m}^{-1}$
elementary charge,	$e = 1.60 \times 10^{-19} \text{ C}$
the Planck constant,	$h = 6.63 \times 10^{-34} \text{ J s}$
unified atomic mass constant,	$u = 1.66 \times 10^{-27} \text{ kg}$
rest mass of electron,	$m_e = 9.11 \times 10^{-31} \text{ kg}$
rest mass of proton,	$m_p = 1.67 \times 10^{-27} \text{ kg}$
molar gas constant,	$R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$
the Avogadro constant,	$N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$
the Boltzmann constant,	$k = 1.38 \times 10^{-23} \text{ J K}^{-1}$
gravitational constant,	$G = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$
acceleration of free fall,	$g = 9.81 \text{ m s}^{-2}$

*Answer **all** questions.*

For Examiner's Use

1 **(a)** Define a *systematic error*.

____

____

____ [1]

(b) Distinguish between *accurate* and *precise* measurements.

accurate measurements,

____

____

____

____

precise measurements.

____

____

____

____ [2]

(c) In an experiment to measure the density of a ball bearing the following readings were obtained

mass = (5.03 ± 0.02) g
diameter = (11.02 ± 0.04) mm

Calculate the percentage error in the density of the ball bearing.

percentage error = ______________ [3]

For Examiner's Use

2 (a) State Newton's third law of motion.

____

____

____ [1]

(b) A boy of mass 40.0 kg rests on the floor of a lift.

Calculate the force, **S**, exerted on the boy by the floor when the lift

(i) has an upward acceleration of 1.5 ms^{-2},

(ii) is moving down with a constant velocity of 15.0 m/s.

[4]

(c) Suggest, with a reason, the value of the force, **S**, on the boy when the lift falls freely.

____

____

____

____ [2]

For Examiner's Use

3 **(a)** Distinguish between a *progressive wave* and a *stationary wave* with reference to

(i) maximum kinetic energy,

____

____

____

(ii) frequency of particles.

____

____

____ [2]

(b) In a Young's double slit experiment, sodium light of wavelength 0.59×10^{-6} m is used to illuminate a double slit with separation of 0.36 mm. The fringes are observed at a distance of 30 cm from the double slits.

Calculate the fringe separation.

[2]

(c) Explain why two identical filament lamps close to each other cannot produce interference fringes.

____

____

____

____ [2]

For Examiner's Use

4 **(a)** State Kirchhoff's **two** laws for an electric circuit.

1. ____

____

2. ____

____ [2]

(b) **Fig. 4.1** shows a circuit diagram.

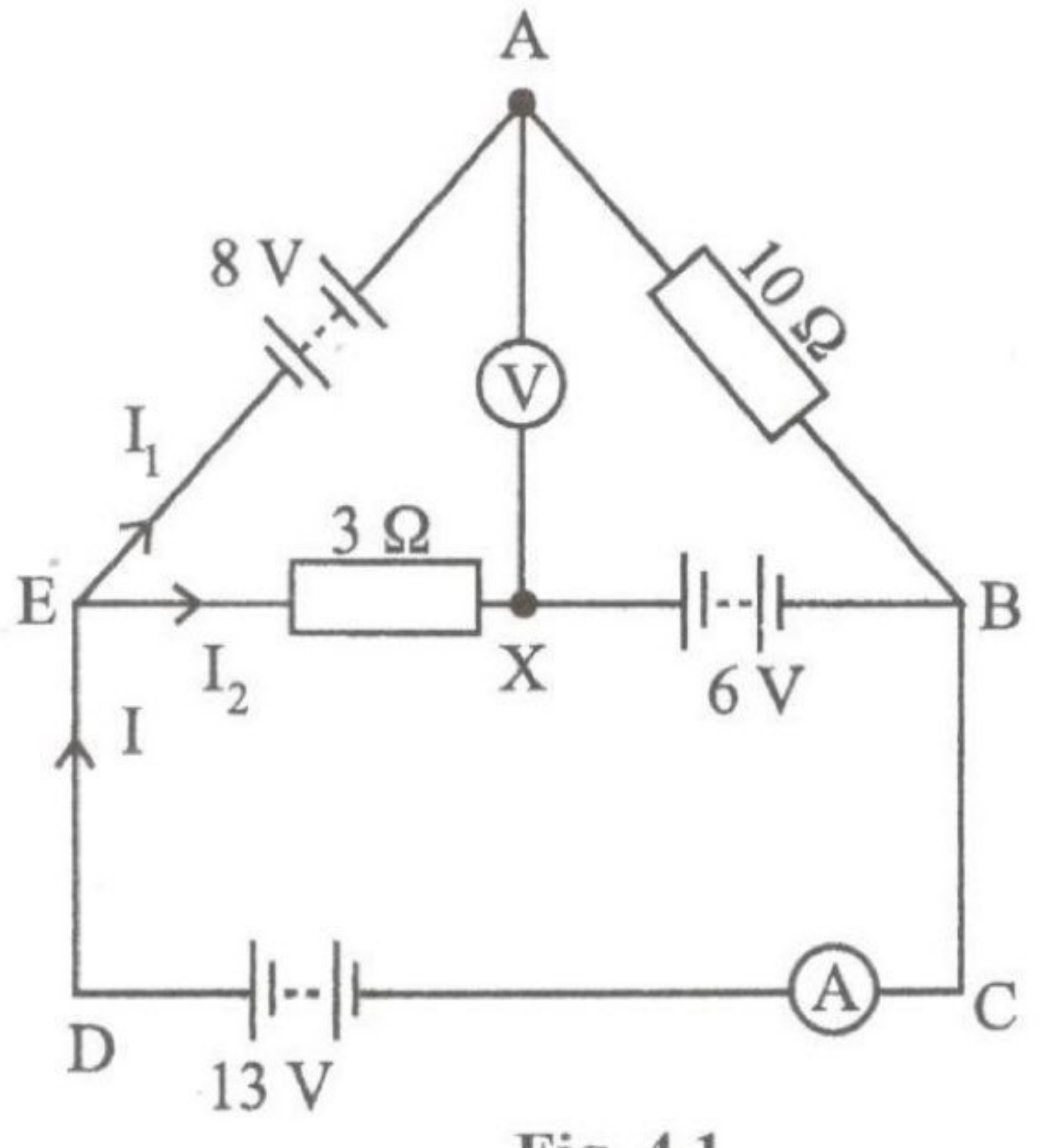


Fig. 4.1

Calculate the

(i) *ammeter reading,*

(ii) *voltmeter reading.*

[4]

[Turn over

(c) Suggest assumptions you have made about each meter in the calculations in **(b)**.

ammeter ______________________________

____

____

voltmeter ______________________________

____

______________________________ [2]

5 **(a)** State any **two** properties of an ideal operational amplifier.

1. ______________________________

____

2. ______________________________

______________________________ [2]

(b) **Fig. 5.1** shows the variation of the output voltage, V_o, with input voltage, V_1, for an amplifier.

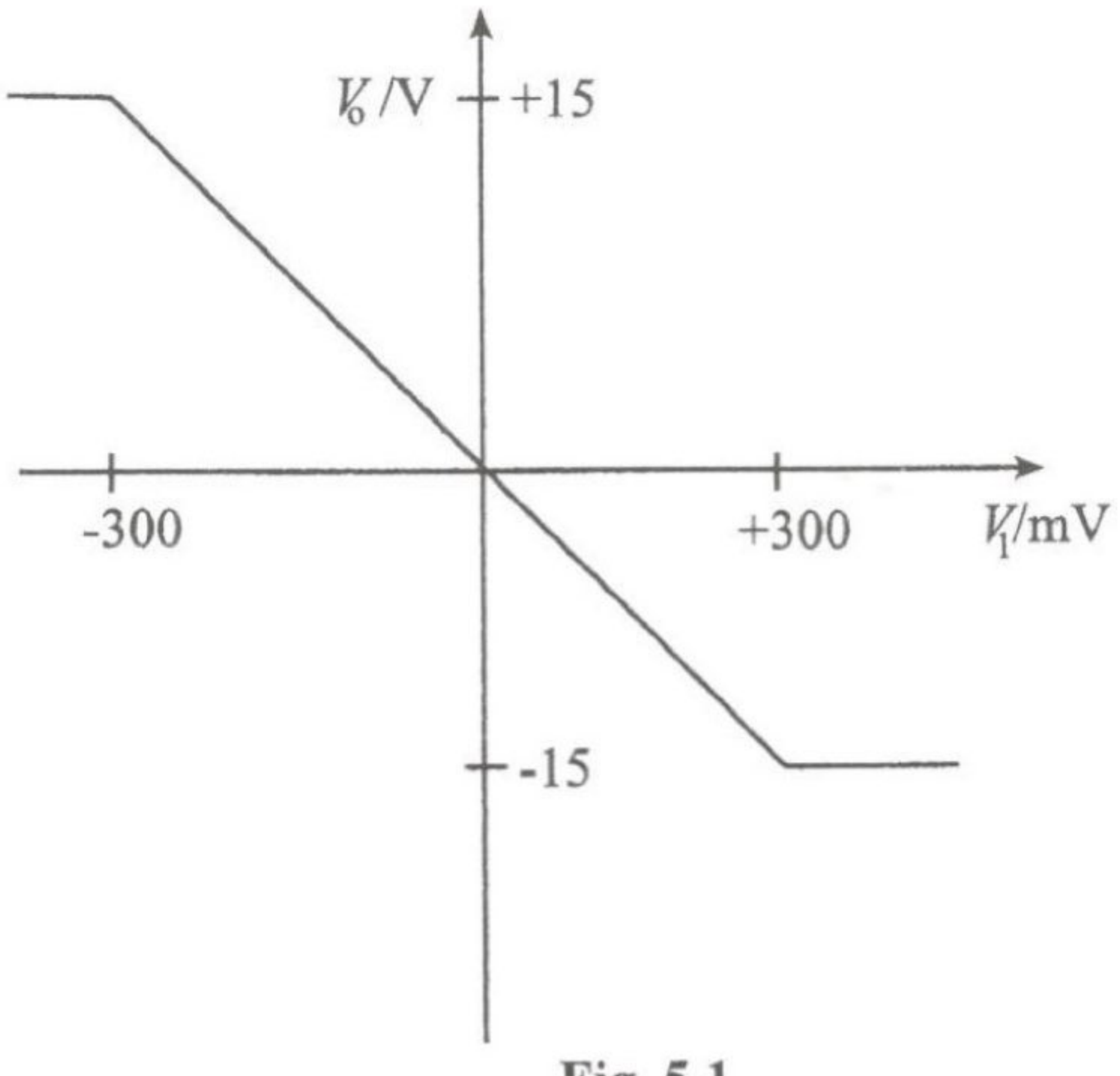


Fig. 5.1

(i) State with a reason, the mode of the opamp in **Fig. 5.1**.

____

____

____

For Examiner's Use

(ii) Determine the gain of the opamp.

[3]

(c) Suggest any **two** advantages of using an opamp in the mode shown in **Fig. 5.1**.

____

____

____

____ [2]

6 (a) Define *root mean square current*.

____

____ [1]

(b) An electric heater is rated 240 V, 3000 W.

Calculate the

(i) 1. *root mean square current* in the heater,

2. *peak current* in the heater.

For Examiner's Use

(ii) Fuses labelled **10 A**, **13 A** and **15 A** are available.

State, with a reason, the most suitable fuse for the heater in **(b)**.

____

____

____

____ [4]

7 (a) State any **two** physical properties measured to determine temperature.

____

____

____

____ [2]

(b) A platinum resistance thermometer is calibrated in ice and steam. It is then used to find the temperature of an oil bath. The values of its resistance are:

at ice point	=	25.60 Ω
at steam point	=	35.60 Ω
at temperature of oil bath	=	45.35 Ω

Calculate the temperature of the oil bath in °C.

[2]

(c) Practical thermometers only agree at fixed points and often disagree at all other temperatures.

Explain.

____

____

____

____ [2]

For Examiner's Use

8 The work function for potassium is 3.54×10^{-19} J. Monochromatic light of wavelength 4.00×10^{-7} m is used to illuminate potassium.

(a) Define *work function.*

____

____ [1]

(b) Calculate the maximum

(i) wavelength of light that can cause photo emission,

(ii) speed of photoelectrons emitted from potassium as a result of the monochromatic light given.

[5]

(c) Suggest the effect of using red light of wavelength 6.70×10^{-7} m on potassium.

____

____

____

____ [2]

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL
General Certificate of Education Advanced Level

MARKING SCHEME

NOVEMBER 2017

PHYSICS 9188/2

(A1) include units

- person consistently making the same mistake
- Accept that cause of an error

2

1 (a) error that causes shift of values from the true value by a constant factor. | a shift of values in one dirctn. B1

(b) (i) measurements are close to the true value | low systematic error
closeness of values to the true value – reject B1

(ii) all measurements are close to the mean value | close to each other | low random error
closeness of values to their mean value. (R) B1

(c) $\frac{\Delta\rho}{\rho} \times 100\% = \left(\frac{\Delta m}{m} + \frac{3\Delta d}{d}\right) \times 100\%$ C1

$= \left(\frac{0.02}{5.03} + \frac{3(0.04)}{11.02}\right) \times 100\%$ C1

$= 1.49\%$ accept ≥ 2 s.f A1

2 (a) If body A exerts a force on body B, then body B exerts an equal but opposite force on body A. | AW B1

(b) (i) $S - mg = ma$

$S = mg + ma$

$= 40(9.81 + 1.5)$ C1

$= 452$ N | ~~450N~~ ≥ 2 s.f A1

(ii) $S - mg = ma$

but $a = 0$

$S = mg$

$= 40 \times 9.81$ C1

$= 392$ N ≥ 3 s.f A1

(c) - S force = 0 B1

- the boy exert no force on the floor and the floor of the lift would exert no upward push on the boy. Newton's 3rd Law | weightlessness B1

/ hence the boy would not have the sensation of weight.

3 (a) Progressive wave | Stationary wave

	Progressive wave	Stationary wave	
(i)	kinetic energy is ~~maximum at rest positions and minimum at maximum displacement~~ the same for all ptcles	~~at~~ nodes kinetic energy is ~~zero~~ in antinodes kinetic energy is maximum / AW	B1
(ii)	constant frequency / same frequency	same frequency between nodes / zero frequency at nodes. accept idea of different frequencies.	B1

(b) $y = \frac{\lambda D}{a}$

$= \frac{0.59 \times 10^{-6} \times 0.3}{3.6 \times 10^{-4}}$ C1

$= 4.92 \times 10^{-4}$ m ≥ 2 s.f A1

(c) - not coherent sources / no constant phase difference. B1
- light ~~emitted is random / separate sources~~ does not have same amplitude B1

(a) - Total current entering a junction is equal to current leaving the junction / AW
accept eqtn with defined terms / diagram.

$\sum emf = \sum IR$ in a (closed) loop B1

(b) (i) $13 - 6 = 3I_2$ (1) C1

$7 = 3I_2$

$I_2 = 2.33$ A

$14 = 10I_1 - 3I_2$ (2)

$= 10I_1 - 3\left(\frac{7}{3}\right)$ C1

$I_1 = 2.1$ A

$I = I_1 + I_2$ (3)

$2.1 + 2.33$

$= 4.43$ A ≥ 1 s.f A1

(iii) V = 3(2.33) + 8 or 10(2.1) – 6 ecf.

= 15 V ignore sign A1

(c) - ammeter has zero resistance | ideal ammeter | AW very low resistance. reject very low resistance. B1
- voltmeter has infinite resistance | ideal | draws no current B1

reject very high resistance

5 (a) infinite slew rate (zero processing time) B1
zero output ~~importance~~ impedance (supply correct current) B1
infinite input impedance, infinite open loop gain, infinite bandwidth. } take the 1st 2 points only.

(b) (i) inverting mode with a, B1
negative gradient / AW – V_{in} and V_o are not in phase B1
V_{in} +ve when V_o is –ve.

(ii) gain = gradient

$$= \frac{15-(-15)}{(-300-300)\times10^{-3}}$$ C1

= –50 reject with units A1

(c) - greater operational stability | constant B1
- less distortion B1
- increased bandwidth. ~~Ecf from (b)(i)~~
- gain is predictable | more stable | achievable.

6 (a) $I_{rms} = \frac{I_0}{\sqrt{2}}$ where I_{rms} is the root main square current and I_0 is the peak current – reject B1
a d.c equivalent for an a.c | d.c which produces same heating effect as the a.c

(b) (i) P = $I_{rms} . V_{rms}$

I_{rms} = $\frac{P}{V_{rms}}$

= $\frac{3000}{240}$

= 13 | 12.5 A accept 10 A | s.f or more A1

(ii) I_0 = $\sqrt{2}\times12.5$ ecf

= 17.7 A accept ≥1 s.f. A1

(c) 13 A fuse ecf A1

- a fuse labelled slightly more (above/close) than the r.m.s current should be used B1

7 (a) - length
- resistance B1 B1

resistance, colour/spectral radiant, pressure, emf — reject voltage/volume (1st 2 points)

(b) $\theta°C = \frac{X_\theta - X_0}{X_{100} - X_0} \times 100°C$

$= \frac{45.35 - 25.60}{35.60 - 25.60} \times 100°C$ C1

$= 197.5°C$ ≥ 4 s.f A1

(c) - calibrated from same fixed points / AW B1
- use different thermometric properties B1

8 (a) - minimum energy required for an electron to be ejected from the metal (cold) surface | accept eqtn $\frac{hc}{\lambda_0}$, λ_0 is mxm wavelength, or hf_0; f_0 is the minimum frequency B1

(b) (i) $\lambda_{max} = \frac{6.63 \times 10^{-34} \times 3 \times 10^{8}}{3.54 \times 10^{-19}}$ C1

$= 5.62 \times 10^{-7} m$ ≥ 3 s.f. A1

(ii) $E_{max} = \frac{hc}{\lambda} - W$ $E = \frac{hc}{\lambda} = \frac{6.63 \times 10^{-34} \times 3 \times 10^{8}}{4.00 \times 10^{-7}} = 4.973 \times 10^{-19}$

$= \frac{6.63 \times 10^{-34} \times 3 \times 10^{8}}{~~5.62 \times 10^{-7}~~ \; 4.00 \times 10^{-7}} - 3.54 \times 10^{-19}$ C1

$=$ ~~1.189 × 10⁻²¹ J~~ 1.433×10^{-19}

$E_{max} = \frac{1}{2} m_e v^2 max$

$\frac{1}{2} m_e v^2 max =$ ~~1.18 × 10⁻²¹~~ 1.433×10^{-19}

$$V_{max} = \sqrt{\frac{2 \times \sout{1.18 \times 10^{-21}}\ 1.433 \times 10^{-19}}{9.11 \times 10^{-31}}}$$ C1

$= \sout{5.04 \times 10^4 \text{ m/s}}$ A1

5.61×10^5 m/s ≥ 3 s.f

(c) $\lambda_{max} < \lambda_{red}$ | $E_{red} < \phi$ B1

so no photoemission occurs B1

9 (a) (i) can occur at any time | idea of unpredictable | each nucleus has an equal chance of decay B1

(ii) not influenced by any external factors | physical conditions independence. B1

(b) (i) $\lambda = \frac{0.693}{5.03}$

$= 0.138 \text{ hr}^{-1}$ | $3.83 \times 10^{-5} \text{ s}^{-1}$ | $2.30 \times 10^{-3} \text{ min}^{-1}$ ≥ 3 s.f A1

(ii) $N = \frac{A}{\lambda}$ → represent N for $N = N_0 e^{-\lambda t}$

$= \frac{3.8 \times 10^8 \times 3600}{0.13777}$ e.c.f ~~C1~~

award credit

$= 9.93 \times 10^{12}$ atoms | 9.92×10^{12} atoms. A1

(c) - has a short half life | stays for a short while in the body B1

- it emits gamma rays which have a high penetrating power | [illegible] B1

| least ionising | no harm to cells

Scanned by CamScanner

Candidate Name	Centre Number	Candidate Number

For Performance Measurement

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

PHYSICS — 9188/2

PAPER 2

JUNE 2018 SESSION 1 hour 15 minutes

Candidates answer on the question paper.
Additional materials:
Electronic calculator and/or Mathematical tables

TIME 1 hour 15 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the spaces at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided on the question paper.
For numerical answers, **all** working should be shown.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

FOR EXAMINER'S USE	
1	
2	
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8	
TOTAL	

This question paper consists of 14 printed pages and 2 blank pages.

[Turn over

Data

speed of light in free space,	$c = 3.00 \times 10^{8}\ \mathrm{m\,s^{-1}}$
permeability of free space,	$\mu_0 = 4\pi \times 10^{-7}\ \mathrm{H\,m^{-1}}$
permittivity of free space,	$\epsilon_0 = 8.85 \times 10^{-12}\ \mathrm{F\,m^{-1}}$
elementary charge,	$e = 1.60 \times 10^{-19}\ \mathrm{C}$
the Planck constant,	$h = 6.63 \times 10^{-34}\ \mathrm{J\,s}$
unified atomic mass constant,	$u = 1.66 \times 10^{-27}\ \mathrm{kg}$
rest mass of electron,	$m_e = 9.11 \times 10^{-31}\ \mathrm{kg}$
rest mass of proton,	$m_p = 1.67 \times 10^{-27}\ \mathrm{kg}$
molar gas constant,	$R = 8.31\ \mathrm{J\,K^{-1}\,mol^{-1}}$
the Avogadro constant,	$N_A = 6.02 \times 10^{23}\ \mathrm{mol^{-1}}$
the Boltzmann constant,	$k = 1.38 \times 10^{-23}\ \mathrm{J\,K^{-1}}$
gravitational constant,	$G = 6.67 \times 10^{-11}\ \mathrm{N\,m^{2}\,kg^{-2}}$
acceleration of free fall,	$g = 9.81\ \mathrm{m\,s^{-2}}$

Formulae

uniformly accelerated motion,	$s = ut + \frac{1}{2}at^2$ $v^2 = u^2 + 2as$
work done on/by a gas,	$W = p\Delta V$
gravitational potential,	$\phi = -\frac{Gm}{r}$
refractive index,	$n = \frac{1}{\sin C}$
resistors in series,	$R = R_1 + R_2 + \ldots$
resistors in parallel,	$1/R = 1/R_1 + 1/R_2 + \ldots$
electric potential,	$V = \frac{Q}{4\pi\epsilon_0 r}$
capacitors in series,	$1/C = 1/C_1 + 1/C_2 + \ldots$
capacitors in parallel,	$C = C_1 + C_2 + \ldots$
energy of charged capacitor,	$W = \frac{1}{2}QV$
alternating current/voltage,	$x = x_0 \sin \omega t$
hydrostatic pressure,	$p = \rho gh$
pressure of an ideal gas,	$p = \frac{1}{3}\frac{Nm}{V}<c^2>$
radioactive decay,	$x = x_0 \exp(-\lambda t)$
decay constant,	$\lambda = \frac{0.693}{t_{\frac{1}{2}}}$
critical density of matter in the Universe,	$\rho_0 = \frac{3H_0^2}{8\pi G}$
equation of continuity,	$Av = \text{constant}$
Bernoulli equation (simplified),	$p_1 + \frac{1}{2}\rho v_1^2 = p_2 + \frac{1}{2}\rho v_2^2$
Stokes' law,	$F = Ar\eta v$
Reynolds' number,	$R_e = \frac{\rho vr}{\eta}$
drag force in turbulent flow,	$F = Br^2\rho v^2$

Answer all questions.

For Examiner's Use

1 **(a)** Define the term *displacement*.

____

____ [1]

(b) An aeroplane is travelling at a steady speed of 40 ms^{-1} at an altitude of 250 m. A metal sphere is released from the aeroplane directly above a point on the level ground.

[Neglect air resistance]

Calculate the

(i) time of flight of the sphere,

time of flight = ______________________________

(ii) speed on impact of the sphere,

speed on impact = ______________________________

(iii) distance from the point the sphere is released to the point of impact.

distance = ______________________________ [6]

For Examiner's Use

2 (a) Define *linear momentum*

____ [1]

(b) A trolley, *x*, of mass 3 kg is moving with a velocity of 5 m/s. The trolley collides head on with another trolley, *y*, of mass 2 kg moving in the opposite direction with a velocity of 6 m/s as shown in **Fig.2.1**.

Fig.2.1

After the collision, the two trollies couple and move with a common velocity, *v*.

(i) Calculate the total momentum before the collision.

total momentum before the collision = ____________________

(ii) Determine the common velocity, *v*.

common velocity, v = ____________________

[4]

For Examiner's Use

3 (a) State the origin of *upthrust*.

____

____

____ [1]

(b) A spherical steel ball of diameter 9.00 mm and density 7.8 gcm^{-3} falls through oil of density 9.0 gcm^{-3} at a steady speed.

(i) Identify a force other than upthrust, that is acting on the ball.

____

(ii) Calculate the upthrust on the ball.

upthrust = ______________________ [3]

(c) (i) State two conditions for a system of forces to be in equilibrium.

1.____

2.____

For Examiner's Use

(ii) **Fig. 3.1** shows a ladder of length 12.0 m and weight 500 N propped up against a smooth vertical wall. The lower end is on rough horizontal ground at a distance of 4.0 m from the wall. The upper end is 11.3 m above ground level.

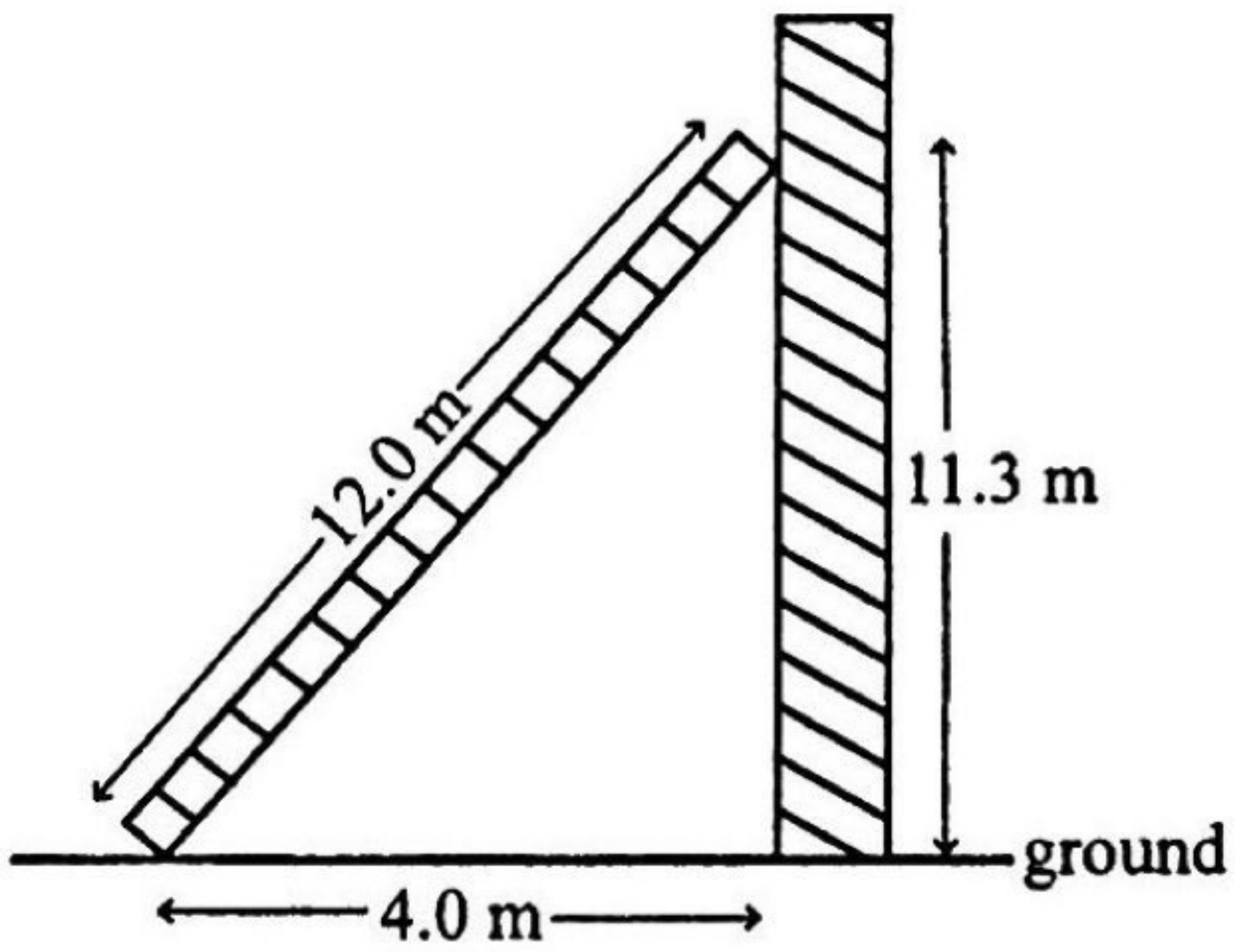

Fig.3.1

A man of mass 60 kg is standing on the ladder's midpoint.

Determine the magnitude of the frictional force that prevents slipping of the ladder.

friction = ______________________ [5]

For Examiner's Use

4 (a) (i) State Coulomb's law for the force between two point charges in a vacuum.

____

____

(ii) Explain any **two** ways in which Coulomb's law is similar to Newton's law of Gravitation for two point masses.

1.______________________________________

____

2.______________________________________

____ [3]

(b) (i) Estimate the distance between two protons in a nucleus.

____

(ii) Calculate the

1. Coulomb force between two protons,

Coulomb force = ____________________

2. gravitational force between the two protons.

gravitational force = ____________________

For Examiner's Use

(iii) Explain why protons inside the nucleus are bound to each other.

____

____

____ [6]

5 (a) State

(i) Faraday's law,

____

____

(ii) Lenz's law.

____

____ [2]

(b) Coil **X** connected to a battery and a switch is placed near coil **Y**, which is connected to a galvanometer, as shown in **Fig.5.1**.

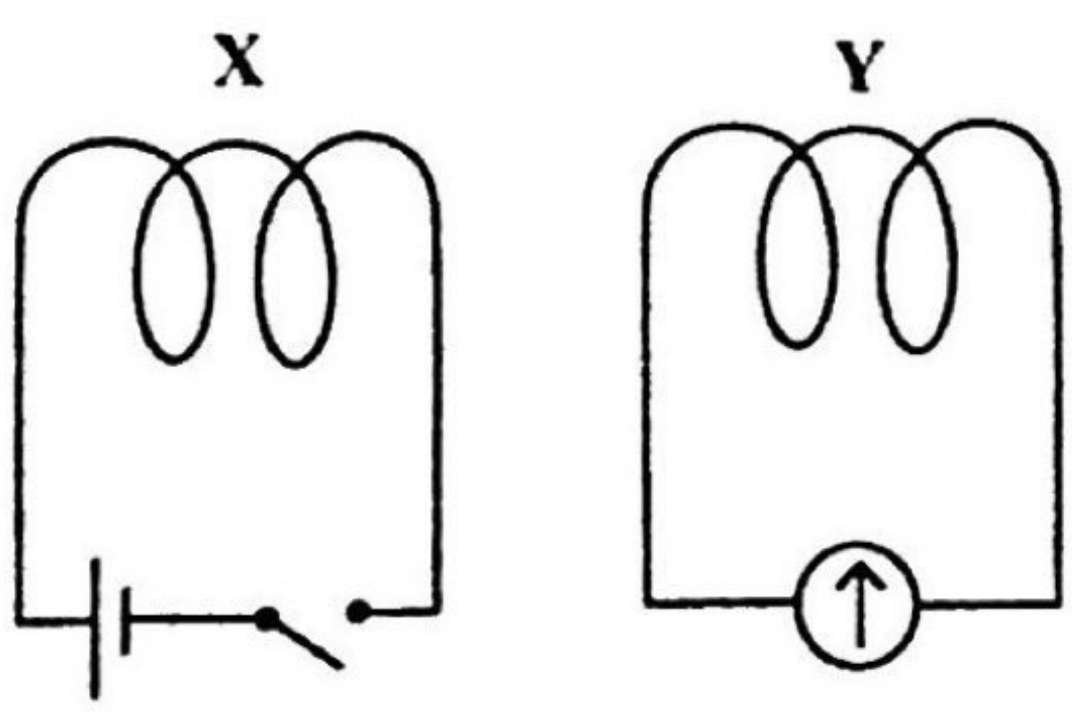

Fig. 5.1

Explain why when the switch is closed

1. the galvanometer deflects momentarily,

____

____

2. coil **Y** moves to the right,

____

____

3. the galvanometer reads zero when the switch is kept closed.

____

____ [6]

6 **Fig. 6.1** shows a potential divider circuit used as an input to an Operational Amplifier.

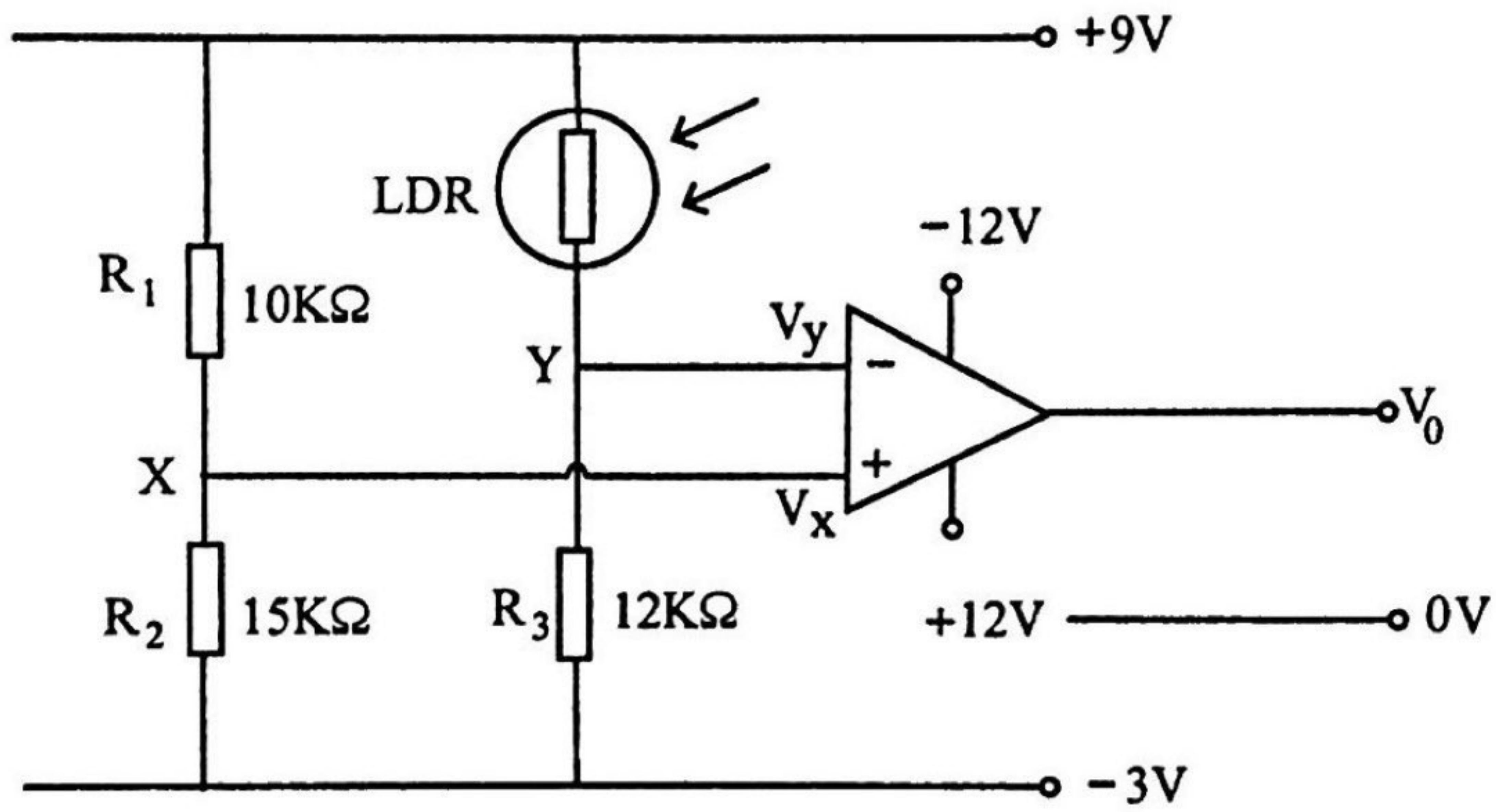

Fig. 6.1

(a) Calculate the potential at X.

Potential at X = ____________________ [3]

For Examiner's Use

(b) Calculate the resistance of the LDR at which $V_X = V_Y$

Resistance of LDR = ______________________ [2]

(c) The circuit in **Fig.6.1** is used to switch on street lights.

Explain how the lights are switched on as it gets dark.

____

____

____

____

____

______________________ [3]

For Examiner's Use

7 (a) Fig.7.1 shows a velocity selector.

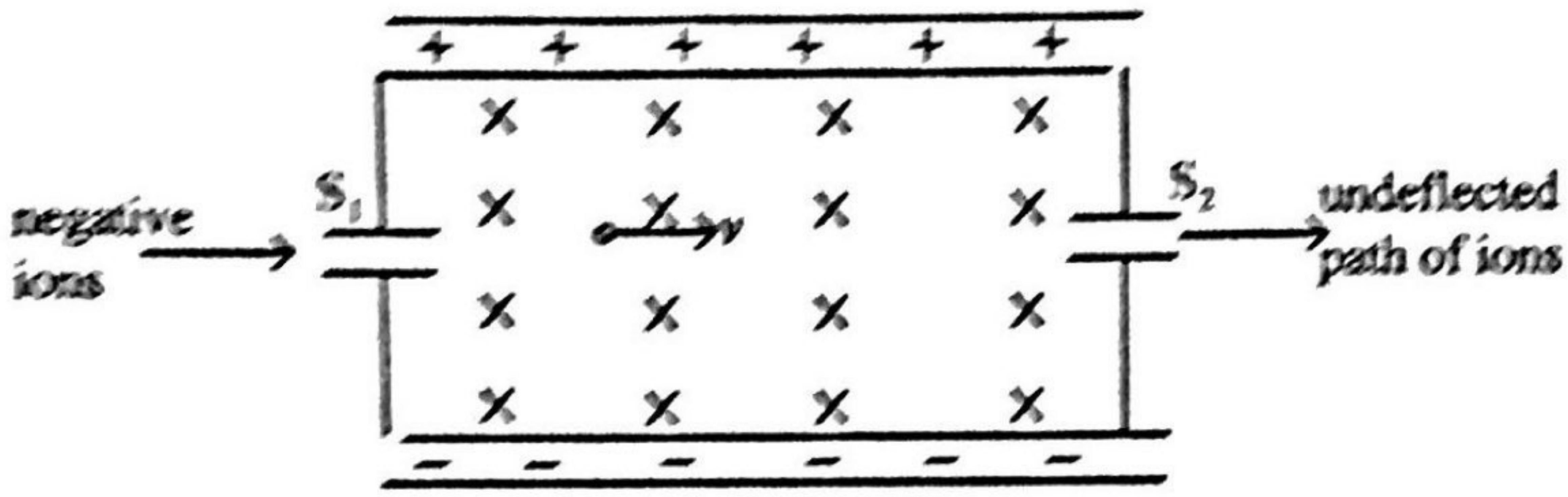

Fig.7.1

Negative ions enter the selector through S_1 and some leave through S_2.

(i) State the directions of the magnetic and electric forces on the ion.

magnetic ____

____

electric ____

____

(ii) Derive an expression of the speed v for ions that pass the selector undeflected.

(iii) The magnetic flux density B is 0.30 T and the electric field strength E is $1.5 \times 10^3 Vm^{-1}$.

Calculate the speed, v.

For Examiner's Use

v = ______________________ [5]

(b) Explain why ions travelling at a speed greater than the answer in **(a) (iii)** will not emerge from the selector.

____

____

____

____

______________________ [3]

8 The half life of a sample of radio active isotope is 8 hours. A freshly prepared sample of this isotope contains 10^{15} atoms.

Calculate the

(a) initial activity,

activity= ______________________ [2]

[Turn over

For Examiner's Use

(b) number of radioactive atoms remaining after 2 hours.

number of atoms ______________________________ [2]

(c) State any **two** uses of radioactivity.

1.____

2.____ [2]

Candidate Name	Centre Number	Candidate Number
MARKING SCHEME		

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

For Performance Measurement

General Certificate of Education Advanced Level

PHYSICS

PAPER 2

6032/2

NOVEMBER 2018 SESSION 1 hour 30 minutes

Candidates answer on the question paper.
Additional materials:
Electronic calculator

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

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Write your answers in the spaces provided on the question paper
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TOTAL	

This question paper consists of 14 printed pages and 2 blank pages.

[Turn over

DATA

speed of light in free space	$c = 3.00 \times 10^{8}\ ms^{-1}$
permeability of free space	$\mu_o = 4\pi \times 10^{-7}\ Hm^{-1}$
permittivity of free space	$\varepsilon_0 = 8.85 \times 10^{-12}\ Fm^{-1}$ $(1/4\pi\varepsilon_0 = 8.99 \times 10^{9}\ mF^{-1})$
elementary charge	$e = 1.60 \times 10^{-19}\ C$
the Planck constant	$h = 6.63 \times 10^{-34}\ Js$
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FORMULAE

uniformly accelerated motion	$s = ut + ½at^2$
	$v^2 = u^2 + 2as$
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gravitational potential	$\emptyset = -\,Gm/r$
hydrostatic pressure	$p = \rho gh$
pressure of an ideal gas	$p = \frac{1}{3}\frac{Nm}{V} < c^2 >$
simple harmonic motion	$a = -\omega^2 x$
velocity of particle in s.h.m.	$v = v_o \cos \omega t$
	$v = \pm\omega\sqrt{(x_o^2 - x^2)}$
Doppler effect	$f_o = \frac{f_s v}{v \pm v_s}$
Attenuation of x-rays	$I = I_o e^{-\mu x}$
electric potential	$V = \frac{Q}{4\pi \varepsilon_0 r}$
capacitors in series	$1/C = 1/C_1 + 1/C_2 + \ldots$
capacitors in parallel	$C = C_1 + C_2 + \ldots$
energy of charged capacitor	$W = \frac{1}{2} QV$
electric current	$I = Anvq$
resistors in series	$R = R_1 + R_2 + \ldots$
resistors in parallel	$1/R = 1/R_1 + 1/R_2 + \ldots$
Hall voltage	$V_H = \frac{BI}{ntq}$
alternating current/voltage	$x = x_o \sin\omega t$
radioactive decay	$x = x_o \exp(-\lambda t)$
decay constant	$\lambda = \frac{0.693}{t_{\frac{1}{2}}}$

[Turn over

1 (a) Define the term *density*.

Mass per unit volume

$\rho = \frac{m}{V}$ symbols defined [1]

(b) A cylindrical coin has a mass of (12.6 ± 0.5) g, thickness of (2.00 ± 0.01) mm and a diameter of (21.2 ± 0.1) mm.

Calculate the density of the coin and its uncertainty.

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

where $V = \frac{\pi d^2}{4} \cdot t$

From $\rho = \frac{4m}{\pi d^2 t}$

$= \frac{12,6 \times 10^{-3}}{\pi \cdot \left(\frac{21,2 \times 10^{-3}}{1}\right) \times 2 \times 10^{-3}}$

$\frac{\Delta \rho}{\rho} = \left(\frac{\Delta m}{m}\right) + \left(\frac{2\Delta d}{d}\right) + \left(\frac{\Delta t}{t}\right)$

$= \frac{0,5}{12,6} + \frac{2 \times 0,1}{21,2} + \frac{0,01}{2,00}$

$= 17847,6 \ kg\,m^{-3}$ / $0,0178476 \ g/mm^3$

$= 0,054$

$\therefore \Delta \rho = 0,054 \times \rho$

$= 0,054 \times 17847,6$

$= 963,8 \approx 1000$

density ρ = ~~0,0178476 g/mm~~ $(18000 \pm 1000) \ kg\,m^{-3}$ / $(1,8 \pm 0,1) \times 10^4 \ kg\,m^{-3}$ [4]

2 (a) Define *torque* of a *couple*.

The turning effect of a pair of equal and opposite forces / product of one of the two equal and oppositely directed forces and perpendicular distance between the two forces. [1]

2 (b) **Fig. 2.1** shows a wheel supported by a pin P at its centre of gravity.

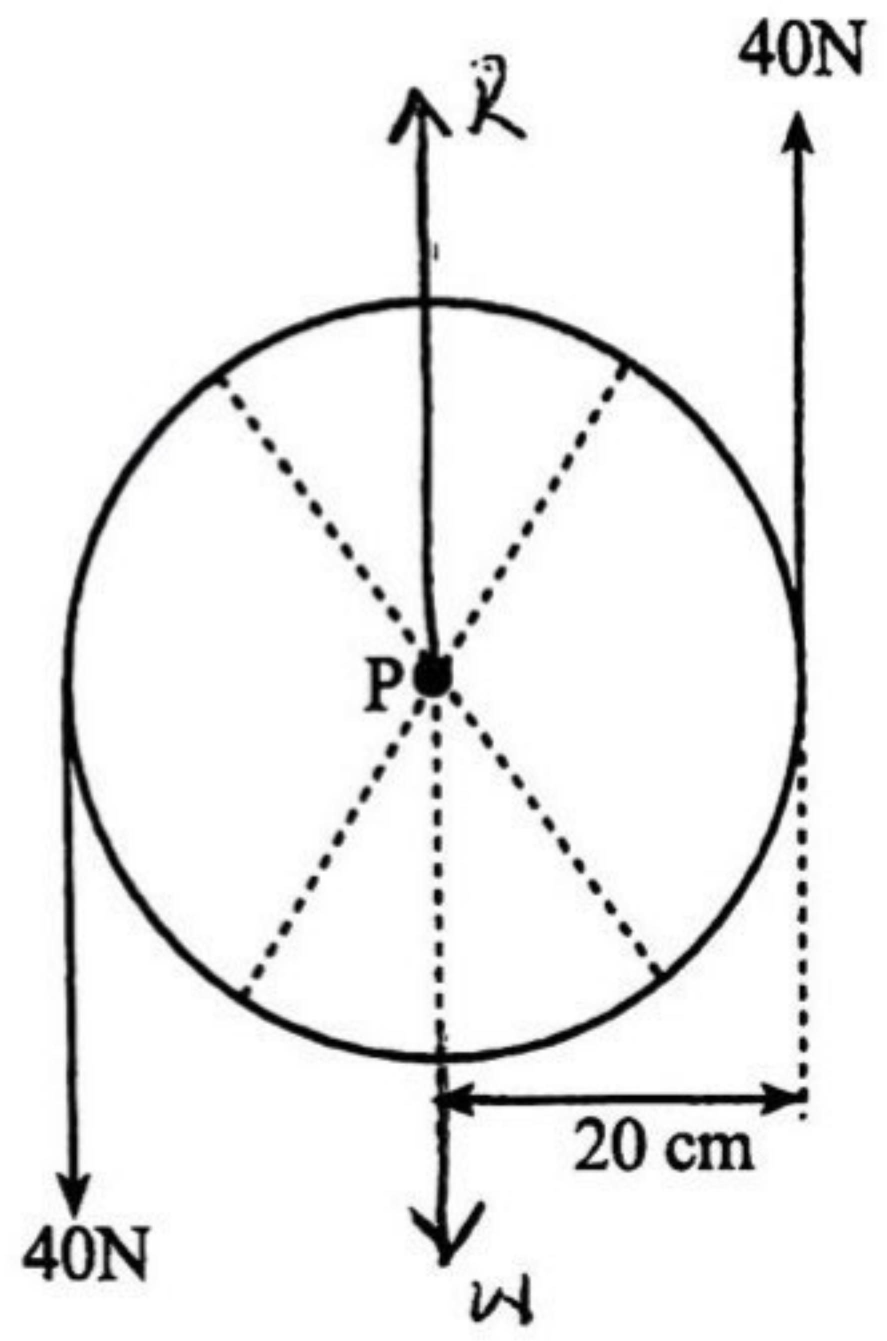


Fig. 2.1

Two parallel forces each 40 N act on the edge of the wheel in the vertical directions. Friction is assumed to be negligible.

(i) Indicate on **Fig.2.1** any **two** other forces present.

(ii) Calculate the torque of the couple on the wheel.

Torque = Fd

= 40 x 0.4

Torque = 16,0Nm / 1600 Ncm

(iii) State and explain whether or not the wheel is in equilibrium.

Not in equilibrium

Resultant torque is zero

[6]

3 **Fig. 3.1** shows plane sound waves passing through a small operture.

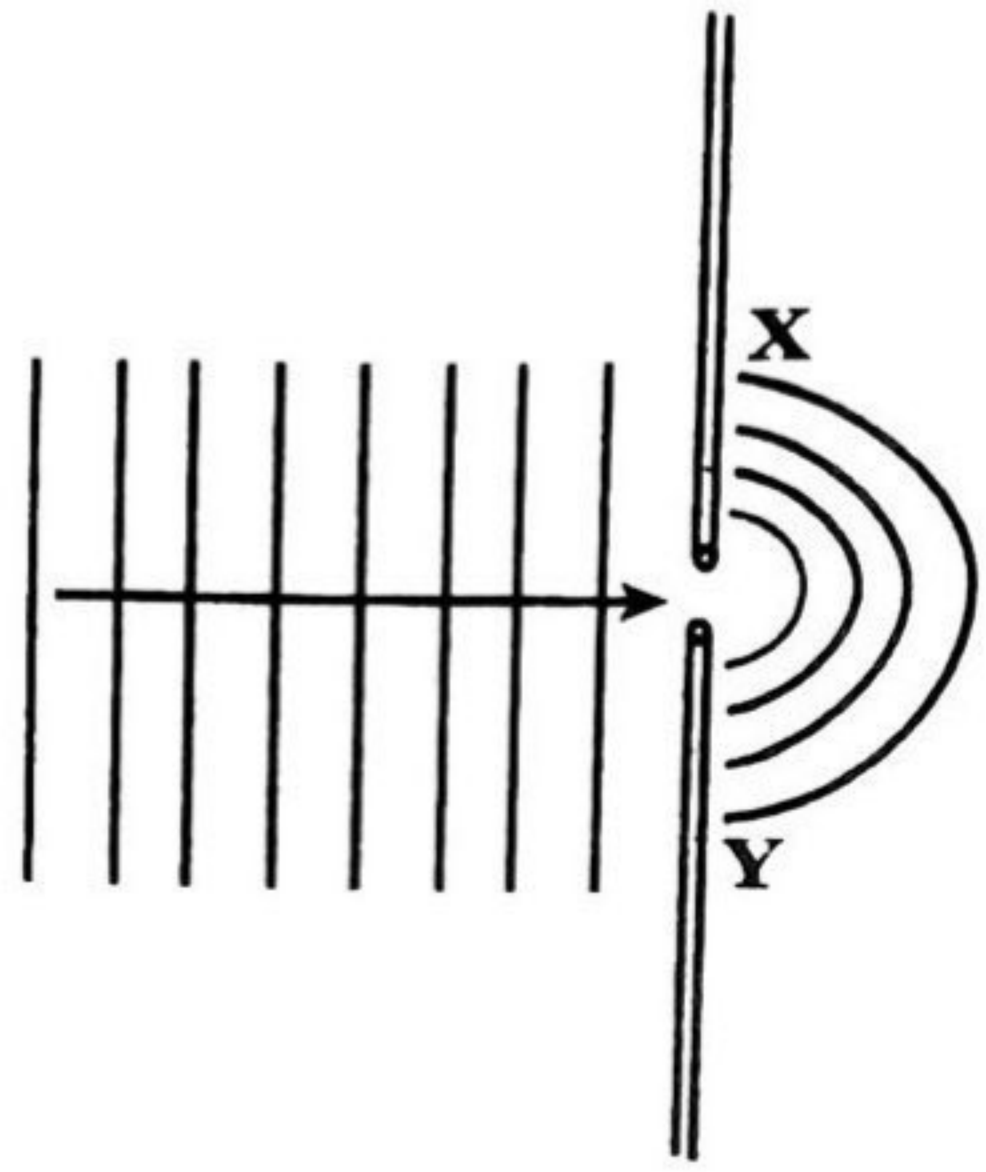


Fig.3.1

Waves are detected at points **X** and **Y**.

(a) Name the phenomenon illustrated in **Fig. 3.1.**

Diffraction [1]

(b) The small aperture is widened almost five fold.

Sketch the plane sound waves after they have just passed the widened aperture.

Parallel plane
waves after slit
slight spreading at edges

[2]

4 A 2 x 2 voxel with intensities shown in **Fig.4.1 (a)** is used in CT scanning to obtain the fixed pattern in **Fig.4.1(b)**

1	5
3	8

Fig. 4.1 (a)

20	32
26	41

Fig. 4.1 (b)

(a) Determine the background intensity.

1 + 5 + 3 + 8

= 17

[1]

(b) Obtain the pattern in **Fig.4.1 (a)** using the final pattern in **Fig.4.1(b)**

20	32
26	41

− 17 =

3	15
9	24

$\frac{1}{3}$ ×

3	15
9	24

[2]

(c) State **one** advantage and **one** disadvantage of using CT scanning.

Advantage 1. Clear image

2. Images are 3D (3) Can distinguish tissues 4 similar densities.

Disadvantage 1. Uses X-rays, exposure is health risk to patients 2. Is expensive.

[2]

[Turn over

5 The LDR in **Fig. 5.1** has a resistance of 1 KΩ in light and 1 M Ω in darkness. The battery has negligible internal resistance.

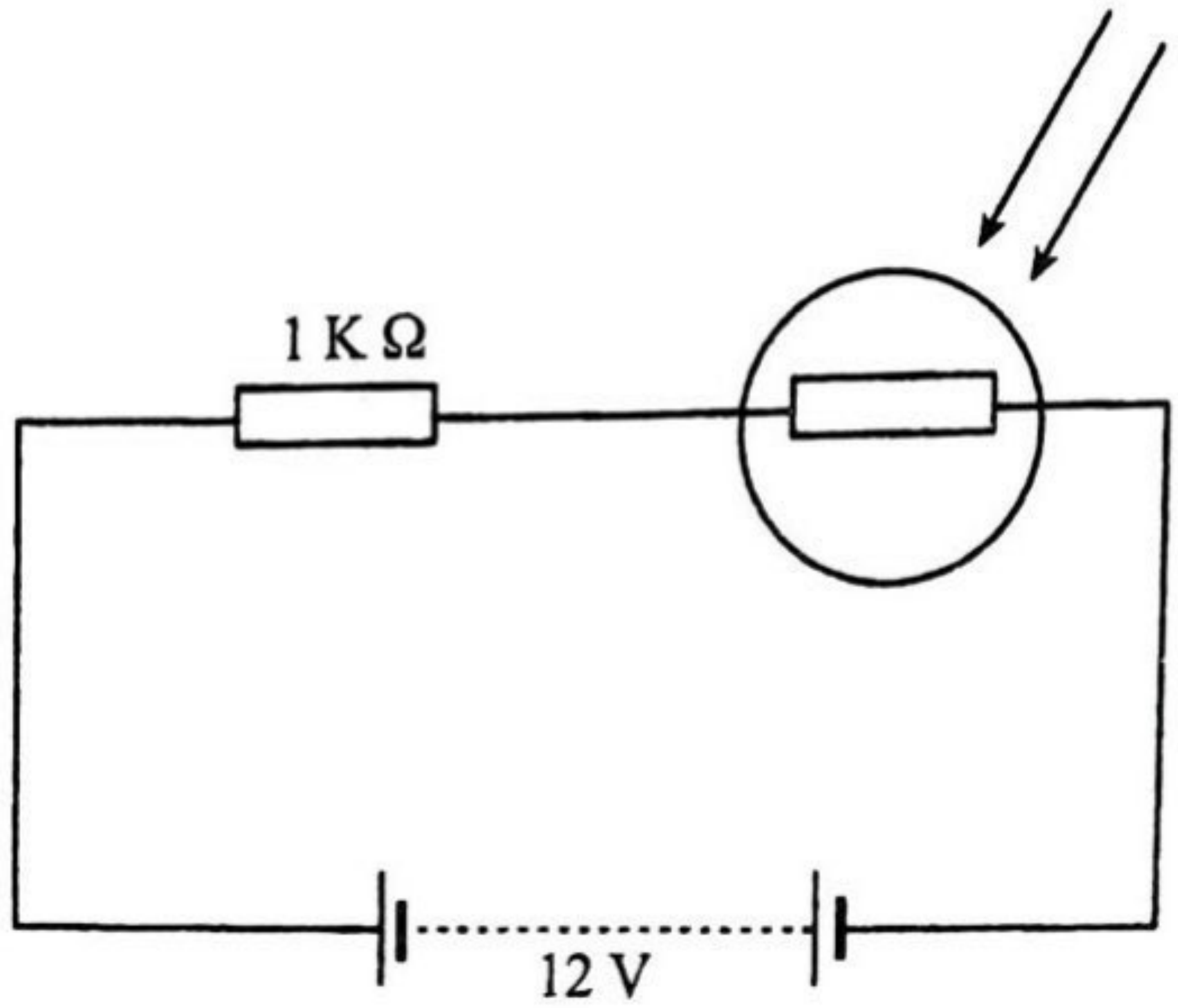


Fig. 5.1

(a) Calculate the voltage across the LDR when in darkness.

$V = (1\times10^6 \times 12)/(1\times10^6 + 1\times10^3)$

$= 11.988 V$

$= 12 V$ ≥ 2 s.f.

[2]

(b) A student connects a 12 V lamp of resistance 10 Ω across the LDR so that the lamp will automatically light in darkness and turn off in bright light.

State and explain whether the student will be successful or not.

In light $I = \frac{12V}{1009,9} = 0,012 A$

In dark $I = \frac{12}{1010} = 0,012 A$

$I_{bulb} = 1,2A = \frac{12}{10}$

In both cases $I << 1,2A$

OR

In light $V = (9.9 \times 12)/1009,9 = 0,12V$

In dark $V = (10 \times 12)/1010 = 0,12V$ [4]

In both cases $V << 12$

∴ Not successful.

6 **Fig. 6.1** shows a circuit used to charge a capacitor using a 6.0 V battery of negligible internal resistance. The capacitor is initially uncharged.

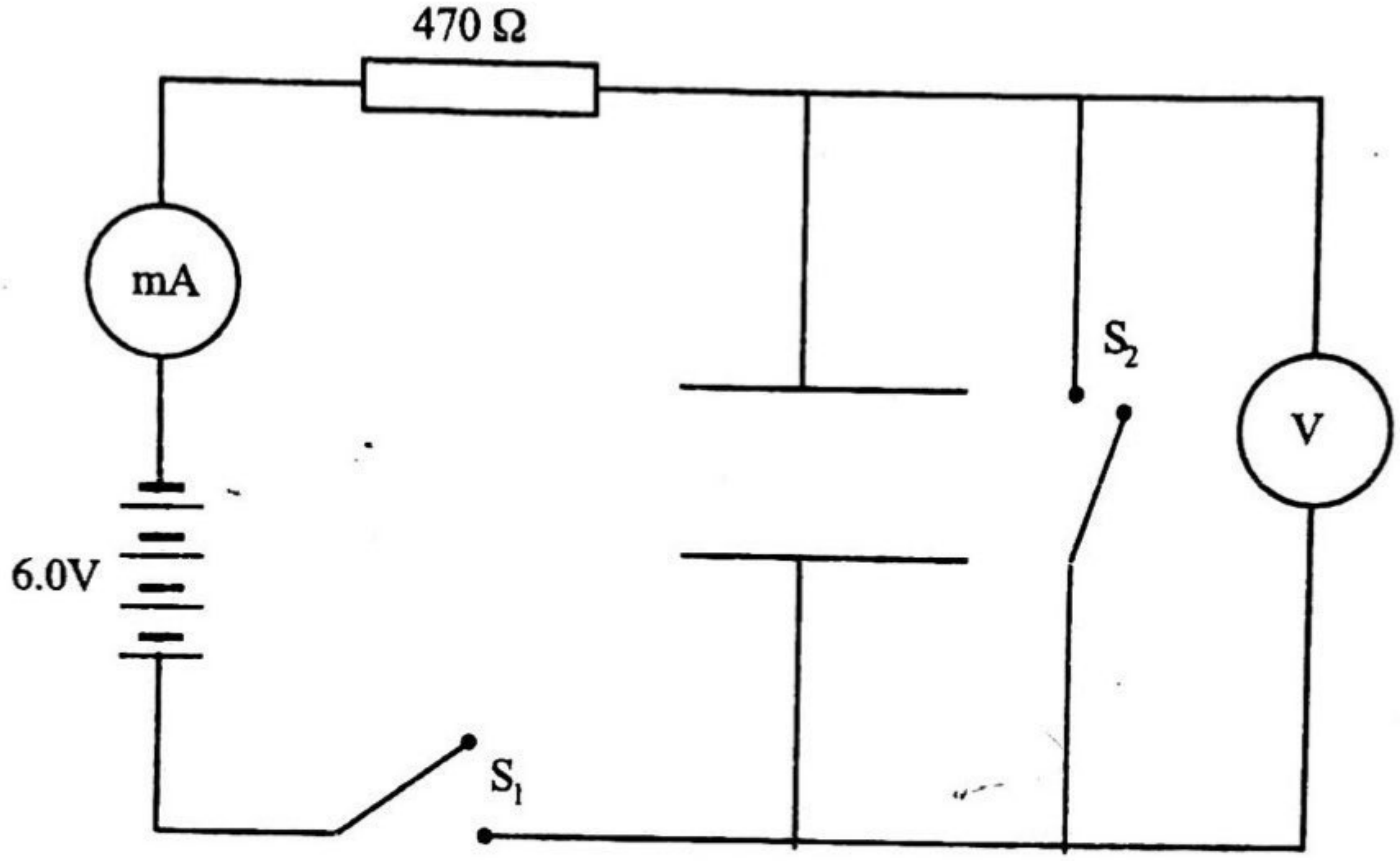
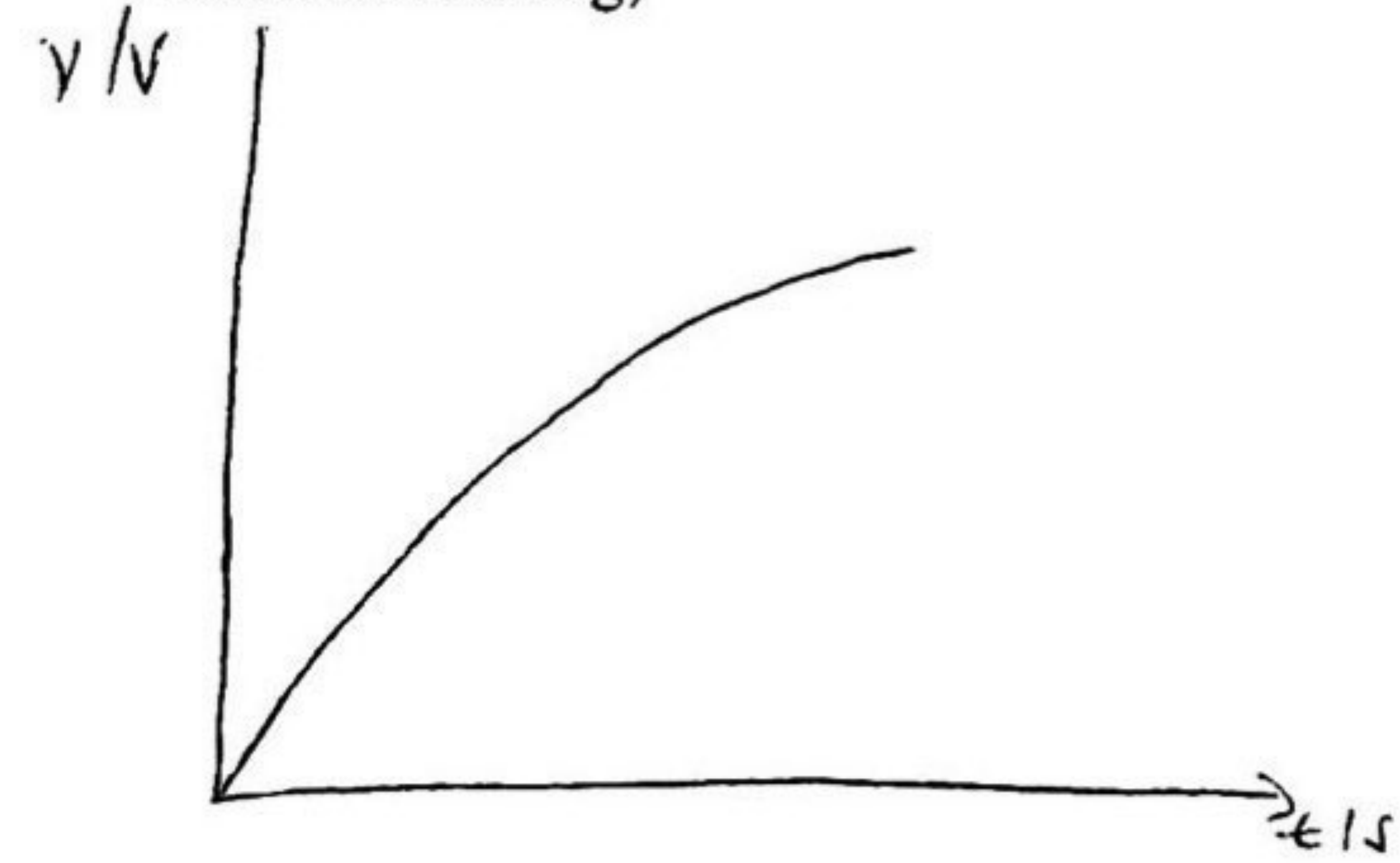


Fig. 6.1

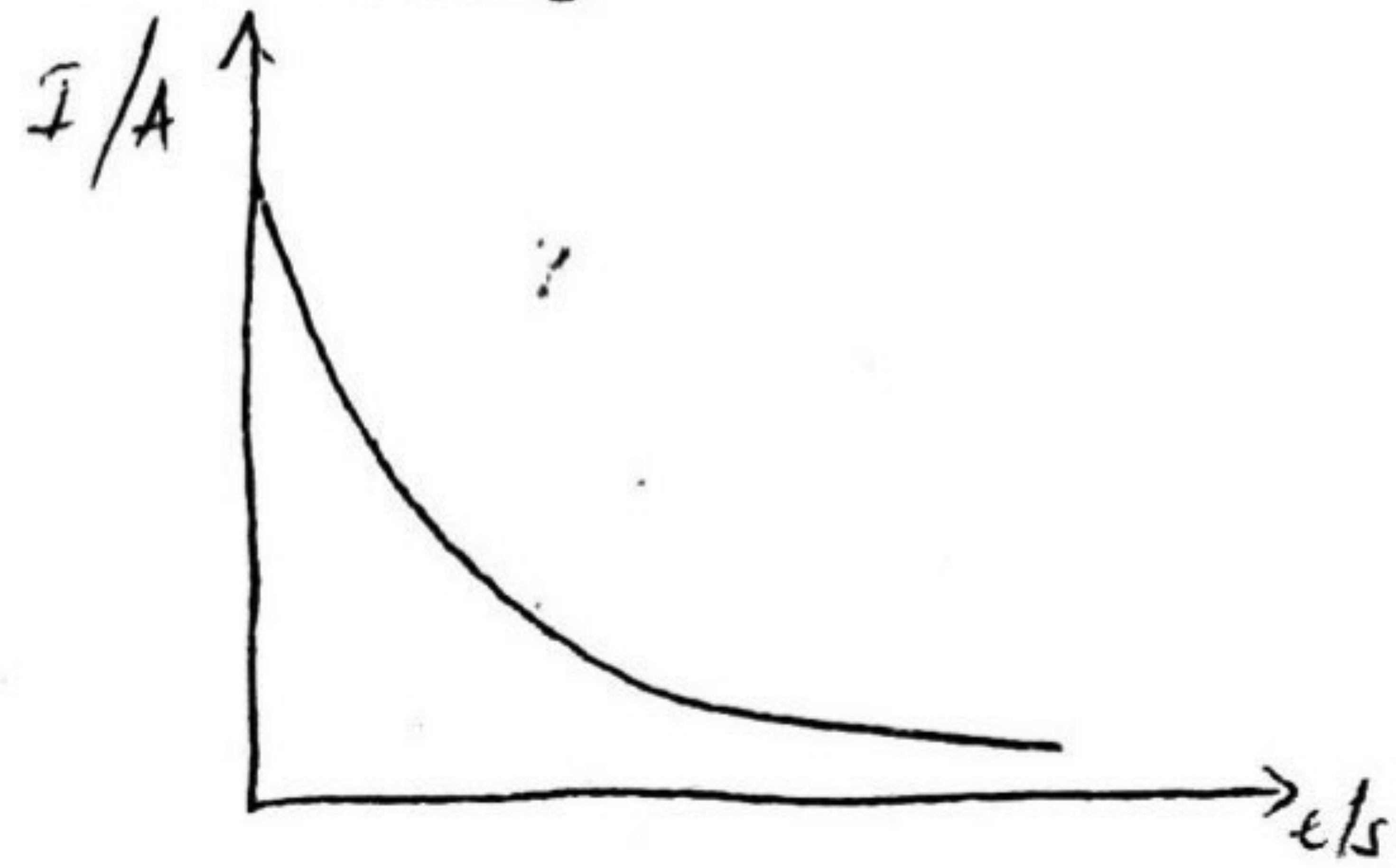
(a) If S_2 is opened and S_1 is closed, sketch a graph to show the variation with time of the

(i) voltmeter reading,



Exponential increase of V with time

(ii) ammeter reading.



Exponential decrease of I with time

[2]

(b) **(i)** Calculate the ammeter reading on closing S_1 with S_2 open.

$I = \frac{6,0}{470}$

$= 12,8 \text{ mA} \; / \; 0,0128 \text{ A}$

(ii) State the voltmeter and ammeter readings when the capacitor is fully charged.

Voltmeter reading 6,0 V

Ammeter reading 0 mA [4]

(c) Suggest the purpose of switch S_2.

Discharging the capacitor [1]

7 **Fig. 7.1** shows a combination of logic gates.

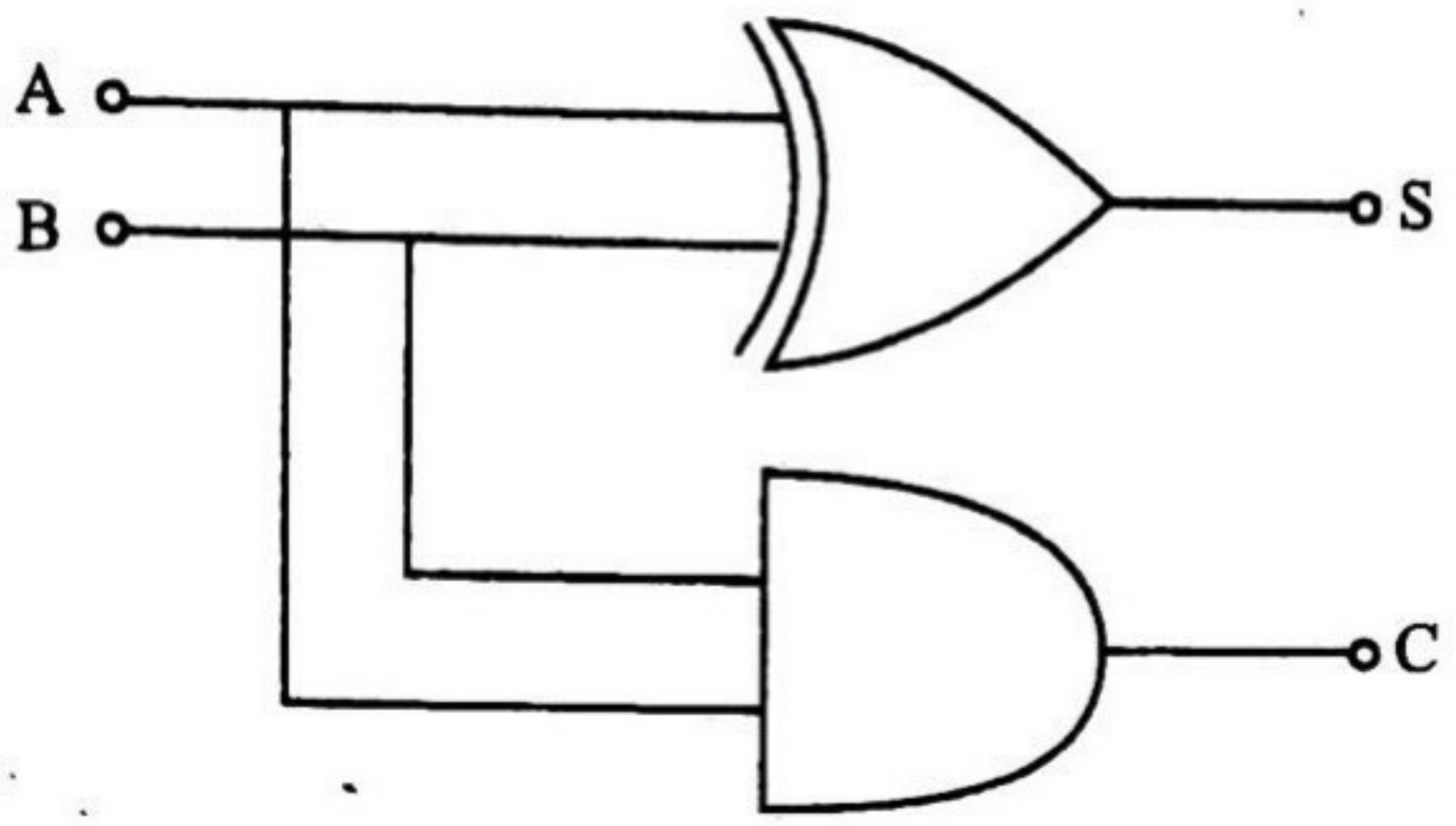


Fig. 7.1

(a) Name the logic gates used.

Ex OR gate / AND gate [1]

(b) Complete the truth table for the circuit in **Fig.7.1**.

A	B	C	S
0	0	0	0
0	1	0	1
1	0	0	1
1	1	1	0

[2]

8 **(a)** A steel cable of length 9.5 m has a cross sectional area of 1.02×10^{-3}m and Young Modulus 2.01×10^{11}Pa.

Calculate the strain energy in the cable when the cable is under a tension of 1.25×10^{5}N.

$$e = \frac{Fl}{AE}$$

strain energy $= \frac{1}{2}Fe$

$= \frac{1}{2}\frac{FL}{AE}\times F = \frac{1}{2}\frac{(1,25\times10^5)^2\times 9.5}{1,02\times10^{-3}\times2,01\times10^{11}}$

$= 362J$ ✓ 2½

[3]

(b) **Fig.8.1** shows a force-extension graph for rubber.

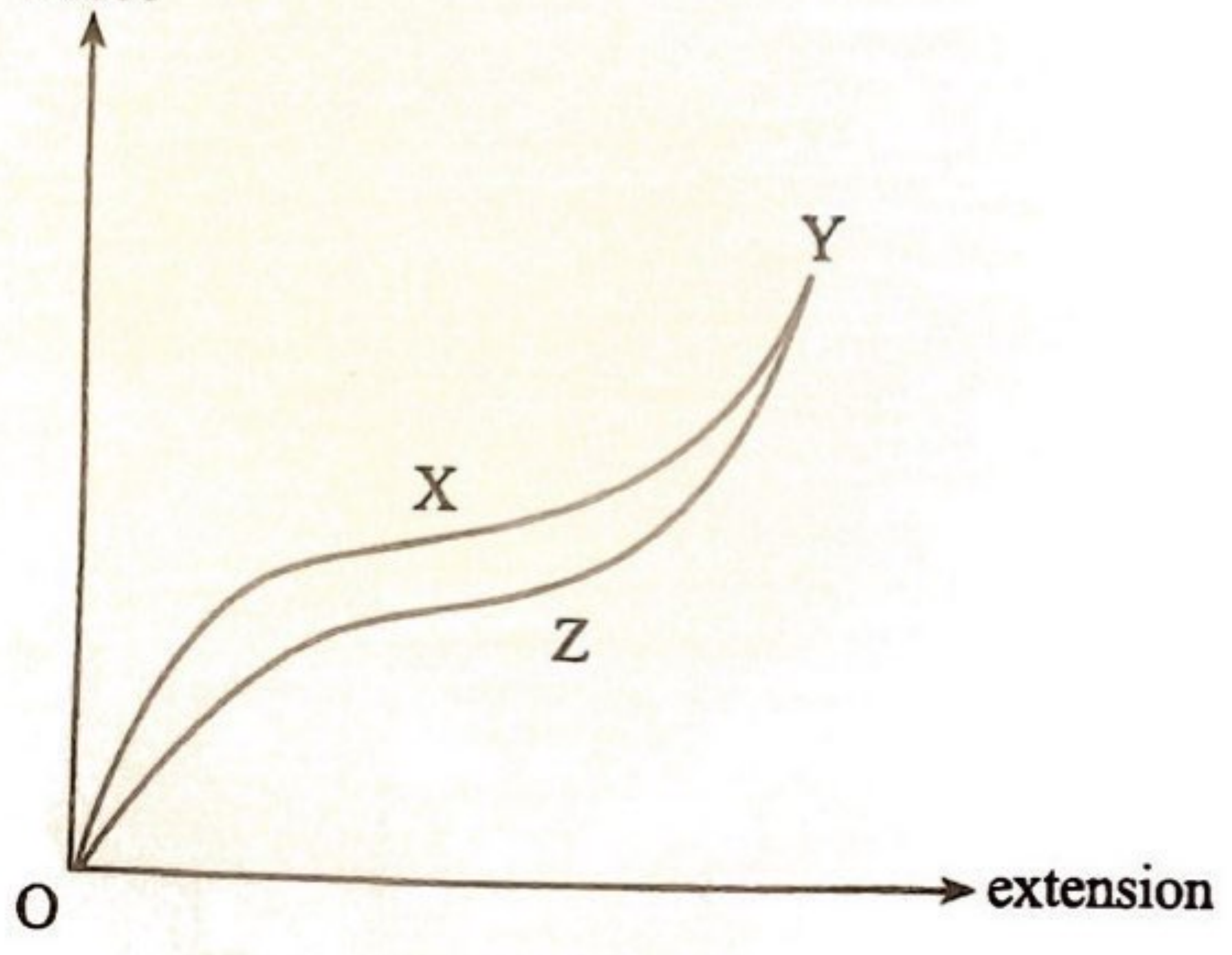


Fig.8.1

(i) State what the area below **OXY** and **OZY** represent.

OXY: is the workdone in stretching or loading

OZY: workdone in unloading the rubber. Energy regained or recovered.

(ii) Explain how **Fig.8.1** can be used to determine the increase in internal energy of the rubber.

Increase in internal energy = Area below OXYZ - Area Below OZY

or Area enclosed by the loop OXYZ

[3]

9 The radioactive decay of an isotope Thorium (Th) is represented by the equation,

$$^{225}_{90}TH \rightarrow ^{A}_{Z}Ra + \alpha$$

The Thorium isotope has a half-life of 8.0 minutes.

(a) Define the term **half-life**.

Time taken for the number of nuclei to decay.

[1]

(b) **(i)** State what the symbols **A** and **Z** in the equation represent.

A mass number

Z Atomic number

(ii) Determine the numerical values of,

A 221

Z 88

(iii) Calculate the decay constant of the Thorium isotope.

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

$$= \frac{\ln 2}{8.0 \times 60}$$

$= 1,44 \times 10^{-3} s^{-1}$ / $0,086$ minute^{-1} (min^{-1})

3,2f.

[6]

(c) Give any **three** uses of radioisotopes.

1. detection of leakages, in under-ground pipes carrying water, oil. (2) Radio Therapy

(3) Sterilization of medical equipment (scalpels)

(4) In industry as level indicators.

[3]

10 **(a)** **(i)** Define the terms

1. *amplitude modulation,*

Information signal varies the amplitude of the carrier wave so that it follows the wave shape of information signal

2. *bandwidth.*

Range of frequencies the signal occupies

(ii) Explain why

1. a larger bandwidth allows a higher transmission,

Large bandwidth allows more frequencies to be transmitted therefore more information can be transmitted.

2. a higher transmission rate allows a more faithful reproduction of information.

Allows signal to be less grainy or smoother. high sampling rate more bits. ⇐ It allows a high sampling rate which allows the digital signal to easily take shape of the original signal. [6]

(b) A carrier of frequency 800 kHz is amplitude modulated by frequencies ranging from 1 kHz to 10 kHz.

Determine the frequency range covered by each sideband.

799 - 790, 801 - 810 [2]

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL
General Certificate of Education Advanced Level

MARKING SCHEME

NOVEMBER 2018

PHYSICS **6032/2**

1 (a) Mass per unit volume/ $\rho = \frac{m}{v}$ symbols defined. B1

(b) $\rho = \frac{m}{v}$ where $V = \frac{\pi d^2}{4}.t$

$$= \frac{12.6 \times 10^{-3}}{\pi.\left(\frac{21.2 \times 10^{-3}}{2}\right)^2 \times 2\times10^{-3}}$$ C1

$= 17\,847.6\ kgm^{-3}$ / 0,0178476 g/mm³ ignore units A1

at least 2 s.f.

From $\rho = \frac{4m}{\pi d^2 t}$

$$\Rightarrow \frac{\Delta\rho}{\rho} = \left(\frac{\Delta m}{m}\right) + \left(\frac{2\Delta d}{d}\right) + \left(\frac{\Delta t}{t}\right)$$ acc $\frac{2\Delta r}{r}$ / $\frac{2\times0{,}05}{10{,}75}$

$$= \frac{0.5}{12.6} + \frac{2\times0.1}{21.2} + \frac{0.01}{2.00}$$ C1

$= 0.054$

$\therefore \Delta\rho = 0.054 \times \rho$

$= 0.054 \times 17\,847.6$

$= 965.8$

$\simeq \pm1\,000$

$\therefore \rho = (18\,000 \pm 1\,000)\ kgm^{-3}$ / $(0{,}018 \pm 0{,}001)\ g\,mm^{-3}$ A1

$(1{,}8 \pm 0{,}1) \times 10^4$ kg $(1{,}8 \pm 0{,}1) \times 10^{-2}$

2 (a) The turning effect of a pair of equal and opposite forces/ product of one of the two equal and oppositely directed forces and the perpendicular distance between the two forces/AW B2

(b) (i) On the diagram; Weight pointing downwards at P ✓ B1
Normal reaction R at P upwards ✓ B1
reject → Centripetal force F towards centre ~~B1~~
[Max B2]

(ii) Torque = F.d

= 40N × 0.4 m C1

= 16.0Nm / 1600Ncm. A1

reject Joules

(iii) Not in equilibrium M1

Resultant torque is not zero A/W B1

Check ecf.

20	32	−17 =	3	15	C1
26	41		9	24	

$\frac{1}{3} \times$

3	15	C1
9	24	

(c) Advantage

- images are three dimensional — B1
- can distinguish tissues with similar densities — B1
- clearer image — Max [1]

Disadvantage
- uses X-rays, exposure is a health risk to the patient — B1
- expensive
- needs a powerful computer

5 (a) $V = (1 \times 10^6 \times 12)/(1 \times 10^6 + 1 \times 10^3)$ — C1

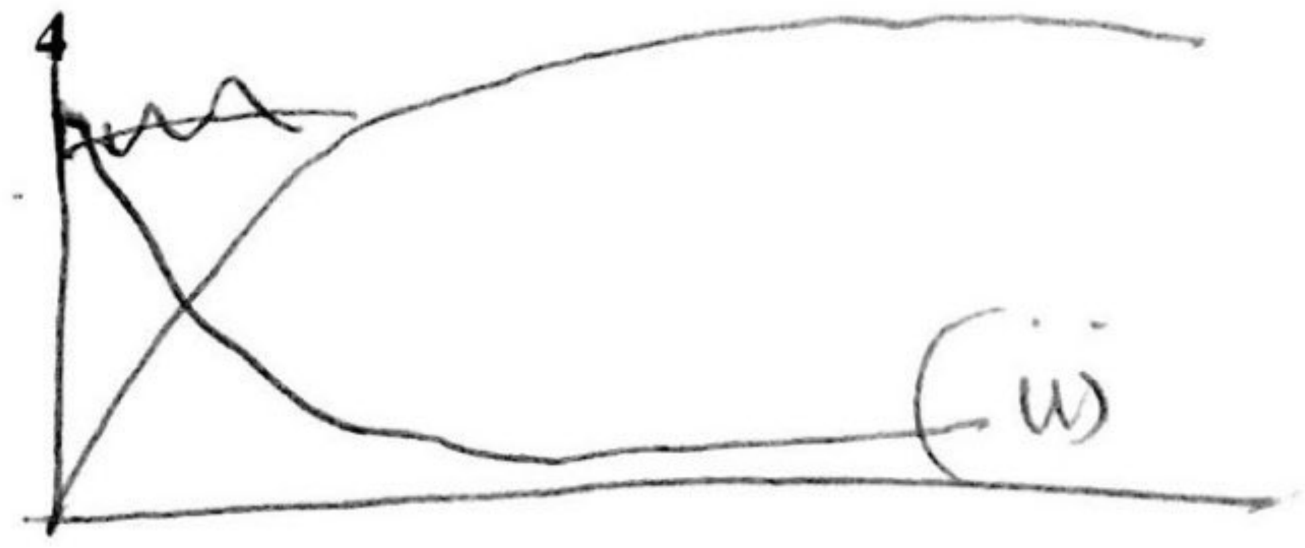
$= 12\text{ V}$ / 11,988 V — A1

(b) In light $V = (9.9 \times 12)/1\,009.9 = 0.12\text{ V}$ I = 0,012 A — C1 A/M

In dark $V = (10 \times 12)/1010\ \ 0.12\text{V}$ I = 0,012 A — C1

In both cases $V \ll 12\text{ V}$ I << 1,2 A — B1

∴ Not successful ∴ Not successful — A1



6 (a) (i) Correct diagram B1

(ii) Correct diagram B1

(b) (i) I = 6.0 / 470 C1

= 12.8 mA / 0.0128 A A1

acc 13 mA

(ii) v = 6.0 V I = 0mA / 0A A2

(c) discharge the capacitor. reject I = 0

7 (a) E X O R gate
AND gate } both correct B1

(b)

C	S
0	0
0	1
0	1
1	0

correct C column A1

correct S column A1

8 (a)

$$e = \frac{Fl}{AE}$$

Strain energy $= \frac{1}{2}Fe$

$$= \frac{1}{2}\frac{F^2 l}{AE}$$ B1

$$= \frac{1}{2}\frac{(1.25 \times 10^5)^2 \times 9.5}{1.02 \times 10^{-3} \times 2.01 \times 10^{11}}$$ C1

= 362 J 2 or more e.f. A1

(b) (i) Area: OXY is work done in stretching or loading / elastic potential energy B1

Area: OZY is work done in unloading the rubber / energy regained / recovered B1

(ii) Increase in Internal energy = Area below OXY – Area Below OZY

or

Area enclosed by the loop OXYZ B1

(ii) Increase in Internal energy = Area below OXY – Area Below OZY

or

Area enclosed by the loop OXYZ B1

9 (a) Time taken for half the number of nuclei to decay A/W mass/Activity B1

(b) (i) A - mass number A/W nucleon # B1

Z - atomic number A/W proton # B1

(ii) A - 221 B1

Z - 88 B1

(iii) $\lambda = \frac{\ln 2}{t_{\frac{1}{2}}}$

$= \frac{\ln 2}{8.0 \times 60}$ C1

$= 1.44 \times 10^{-3}\ s^{-1}$ / $0.0866\ min^{-1}$ A1

(c)
- detection of leakages, in underground pipes carrying water, oil B1
- radio therapy B1
- sterilization of medical equipment (Scapels) B1
- in industry as level indicators B1

Any plausible answer

[Max 3]

10 (a) (i) 1. Amplitude Modulation –

Information signal varies the amplitude of the carrier wave (so that it follows the wave shape of information signal) A/W Amplitude of a carrier wave varies with displacement of information signal B1

2. Bandwidth – range of frequencies (the signal occupies) B1

(ii) 1. - Large bandwidth allows more frequencies to be transmitted therefore more information can be transmitted / greater carrying capacity B1 B1 or more bits

2. - higher transmission rate allows a high sampling rate / B1 which allows the digital signal to easily take shape of the original signal. / less grainy / smoother B1

(b) 799-~~7~~90, 801 – 810. – ignore units ~~B2~~
B1 B1

penalise once for wrong units.

Candidate Name	Centre Number	Candidate Number

For Performance Measurement

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

PHYSICS 6032/2

PAPER 2

SPECIMEN PAPER **1 hour 30 minutes**

Candidates answer on the question paper.
Additional materials:
Electronic calculator and/or Mathematical tables

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided on the question paper.
For numerical answers, **all** working should be shown.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

FOR EXAMINER'S USE	
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	

This specimen paper consists of 13 printed pages and 3 blank pages.

[Turn over

DATA

speed of light in free space	$c = 3.00 \times 10^{8} ms^{-1}$
permeability of free space	$\mu_o = 4\pi \times 10^{-7}$ Hm^{-1}
permittivity of free space	$\varepsilon_0 = 8.85 \times 10^{-12}$ Fm^{-1} ($1/4\pi\varepsilon_0 = 8.99 \times 10^{9}$ mF^{-1})
elementary charge	$e = 1.60 \times 10^{-19}$ C
the Planck constant	$h = 6.63 \times 10^{-34}$ Js
unified atomic mass unit	$1\ u = 1.66 \times 10^{-27}$ kg
rest mass of electron	$m_e = 9.11 \times 10^{-31}$ kg
rest mass of proton	$m_p = 1.67 \times 10^{-27}$ kg
molar gas constant	$R = 8.31$ $JK^{-1}mol^{-1}$
the Avogadro constant	$N_A = 6.02 \times 10^{23} mol^{-1}$
the Boltzmann constant	$k = 1.38 \times 10^{-23}$ JK^{-1}
gravitational constant	$G = 6.67 \times 10^{-11} Nm^{2}kg^{-2}$
acceleration of free fall	$g = 9.81$ ms^{-2}

FORMULAE

uniformly accelerated motion	$s = ut + \frac{1}{2}at^2$
	$v^2 = u^2 + 2as$
work done on/by a gas	$W = p\,\Delta V$
gravitational potential	$\emptyset = -Gm/r$
hydrostatic pressure	$p = \rho gh$
pressure of an ideal gas	$p = \frac{1}{3}\frac{Nm}{V} < c^2 >$
simple harmonic motion	$a = -\omega^2 x$
velocity of particle in s.h.m.	$v = v_o \cos \omega t$
	$v = \pm\omega\sqrt{(x_o^2 - x^2)}$
Doppler effect	$f_o = \frac{f_s v}{v \pm v_s}$
Attenuation of x-rays	$I = I_o e^{-\mu x}$
electric potential	$V = \frac{Q}{4\pi\varepsilon_0 r}$
capacitors in series	$1/C = 1/C_1 + 1/C_2 + \ldots$
capacitors in parallel	$C = C_1 + C_2 + \ldots$
energy of charged capacitor	$W = \frac{1}{2}QV$
electric current	$I = Anvq$
resistors in series	$R = R_1 + R_2 + \ldots$
resistors in parallel	$1/R = 1/R_1 + 1/R_2 + \ldots$
Hall voltage	$V_H = \frac{BI}{ntq}$
alternating current/voltage	$x = x_o \sin\omega t$
radioactive decay	$x = x_o \exp(-\lambda t)$
decay constant	$\lambda = \frac{0.693}{t_{\frac{1}{2}}}$

[Turn over

For Examiner's Use

1 **(a)** Define *angular velocity*.

____

____ [1]

(b) A body is moving in a circular path of radius, r, at constant linear velocity, v, angular velocity, ω, and period T.

Deduce an expression connecting v, r and T.

____

____ [1]

(c) **Fig. 1.1** shows a 0.6 kg stone tied to one end of a string whirled in a vertical of circle of radius 0.4 m at a constant rate of 12.0 turns per minute.

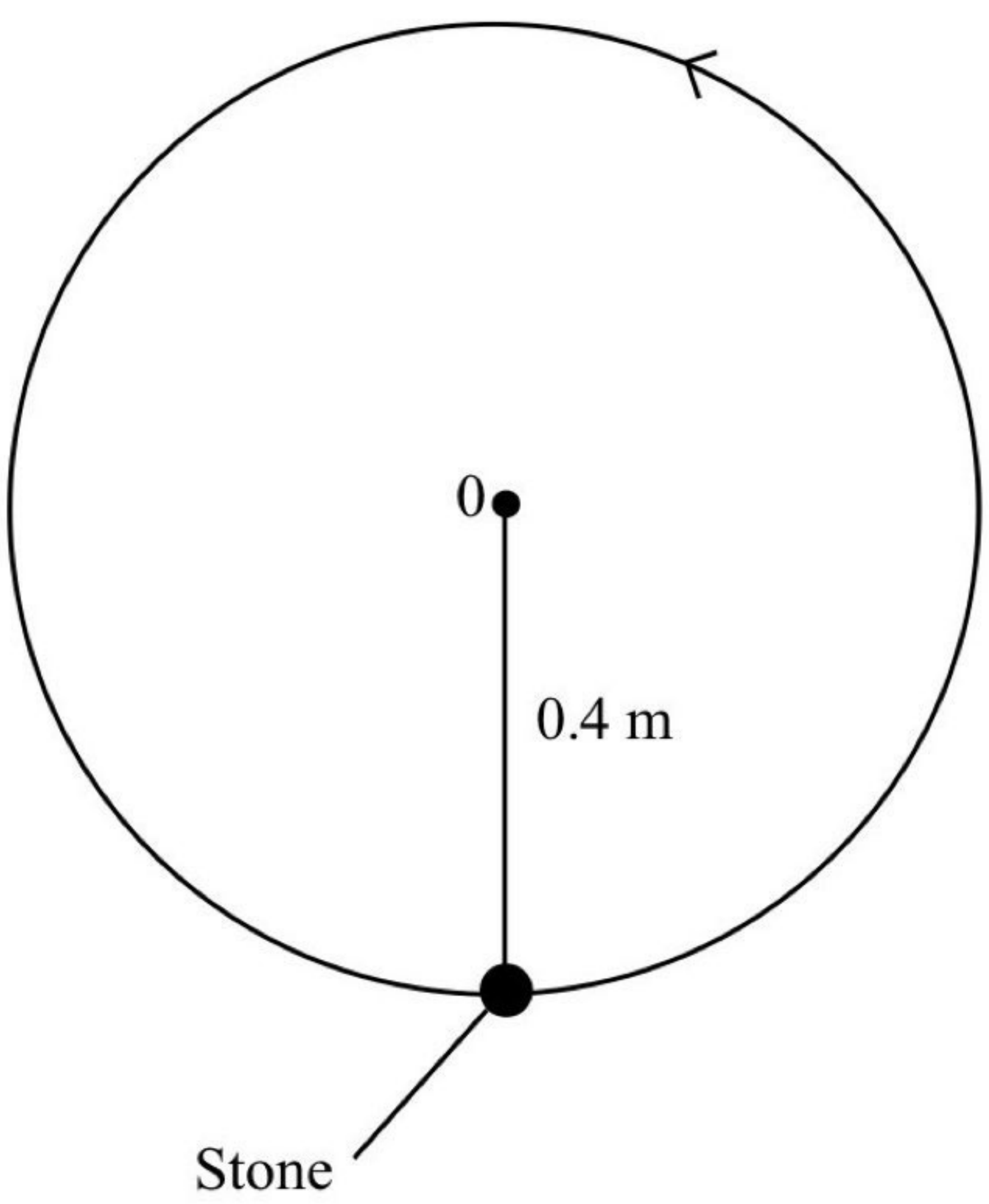


Fig. 1.1

(i) Show on **Fig. 1.1**, the direction of linear velocity v and centripetal acceleration, a.

For Examiner's Use

(ii) Calculate the centripetal acceleration.

centripetal acceleration = _________

(iii) Label a point *Q* where the stone would be when the string is most likely to break.

____

____

(iv) Determine the tension in the string at *Q*.

Tension = ________ [6]

(d) Explain why passengers experience a normal reaction less than their weight when the vehicle goes over the top of a curved bridge.

____

____

____

____ [2]

For Examiner's Use

2 **(a)** Define *gravitational potential*.

____

____

____ [2]

(b) A stone of mass, m, has gravitational potential energy, E_p, at a point, X, in a gravitational field of potential ϕ.

Write an expression for gravitational potential ϕ in terms of m and E_p.

____

____[1]

(c) For an isolated spherical planet of radius R, the value of ϕ at its surface is -6.3×10^{7} $\mathrm{Jkg^{-1}}$.

Calculate the change in gravitational potential energy for a 1.4 kg stone moving towards the planet from a distance of 6R to 3R.

Change in gravitational p.e = _________ [3]

3. **Fig. 3.1** shows a ray incident on a glass-air boundary. The glass-air and air-glass boundaries are parallel to each other.

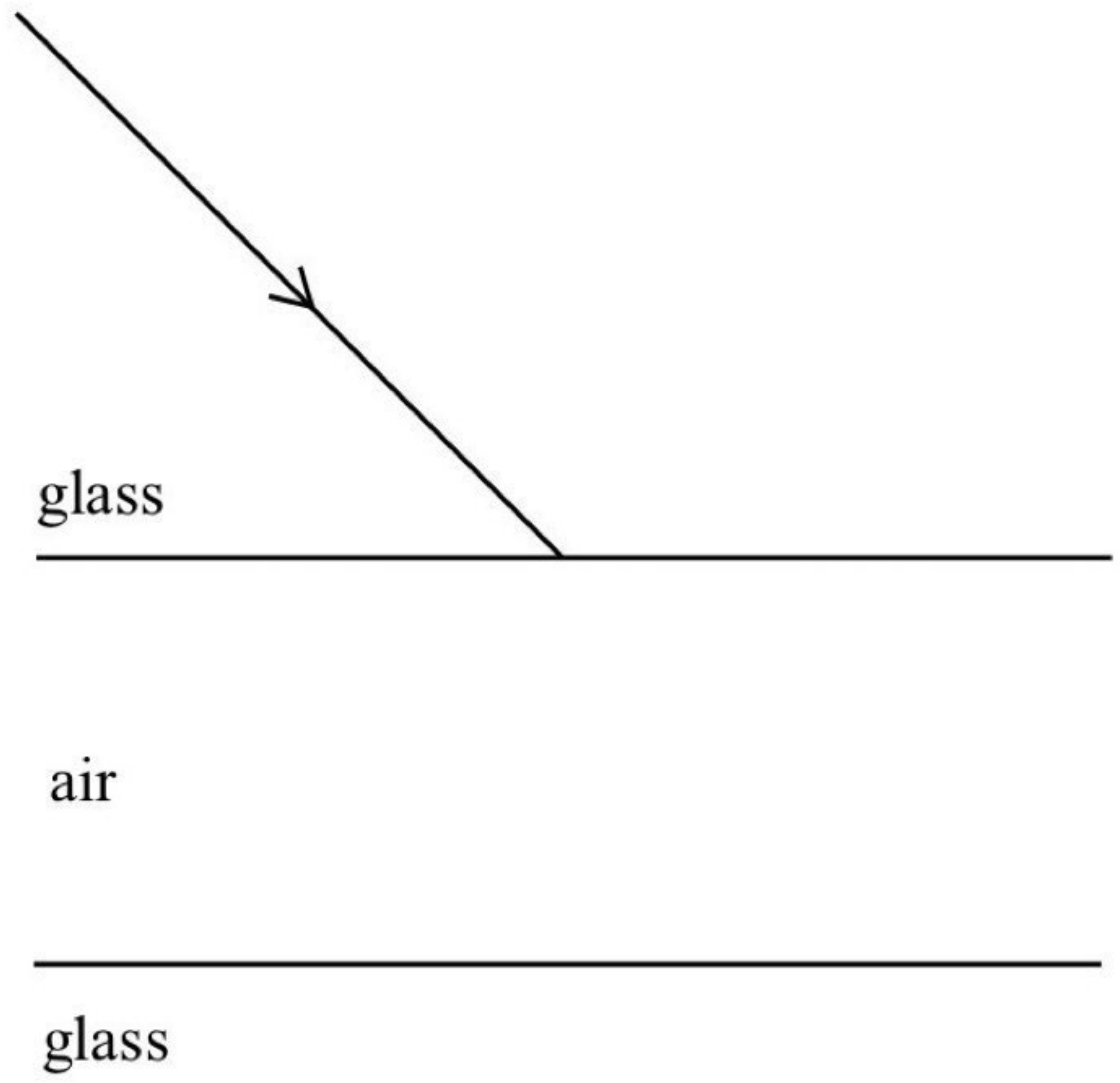


Fig. 3.1

(a) **(i)** Complete the path of the ray as it passes through the air into glass.

(ii) Determine the angle to the horizontal at which the ray emerges from air entering glass if the angle of incidence in glass is 40°.

[5]

For Examiner's Use

(b) Derive the equation $n = \frac{1}{sinc}$.

[1]

4. **Fig. 4.1(a)** and **Fig 4.1(b)** shows an X-ray beam from an anode target.

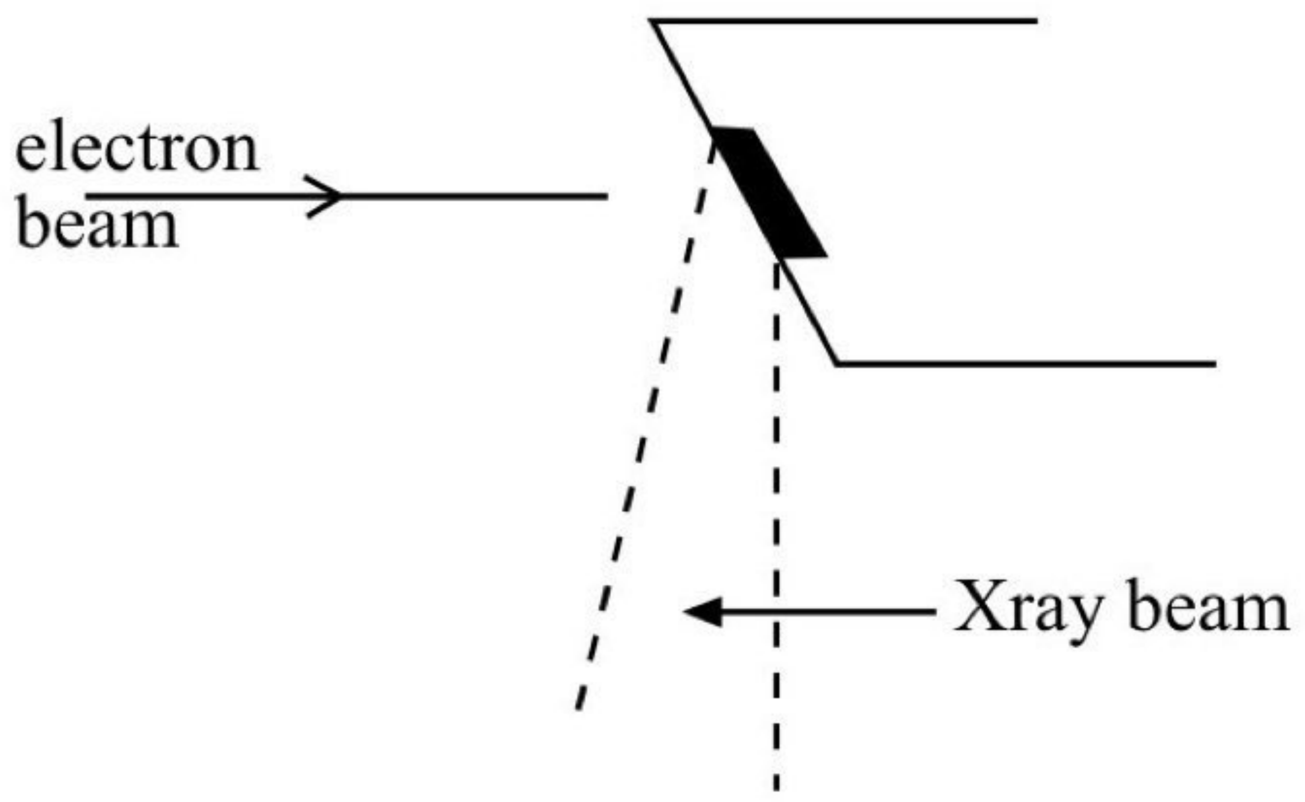


Fig.4.1(a)

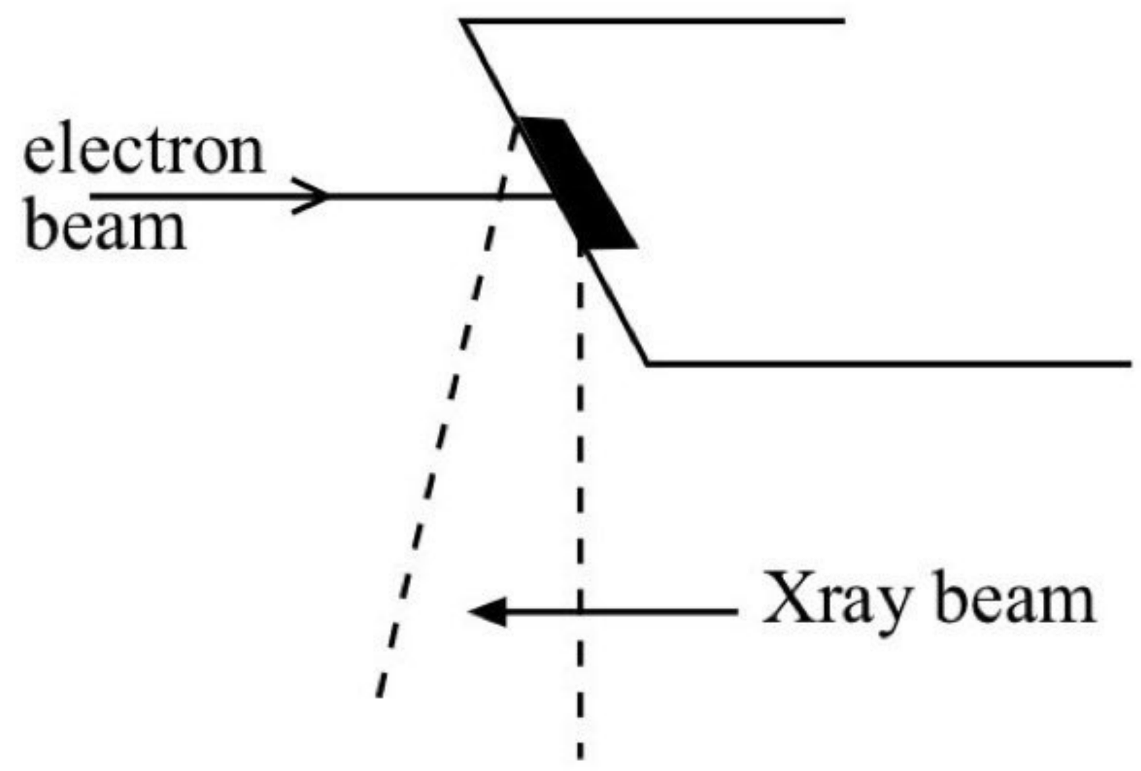


Fig 4.1(b)

(a) **(i)** State the figure which shows the X-ray beam preferred in X-ray imaging.

____

(ii) Explain your choice in part **(a)(i).**

____

____ [2]

For Examiner's Use

(b) Explain why a patient is given a barium meal before an X-ray image of the stomach is taken.

[3]

The number 7 is written in a voxel as shown.

7	

(c) State what the number 7 represents.

[1]

(d) State the advantage of the image obtained using CT scanning over the image obtained using X-rays.

[1]

5. When a slide wire potentiometer is used to measure the *emf* of a cell, a balance point cannot be found along the resistance wire.

Explain how a voltmeter may be used to discover the cause of the problem.

[3]

[Turn over

For Examiner's Use

6. **(a)** State Faraday's law of electromagnetic induction.

____

____ [1]

(b) **Fig. 6.1** shows a lump of soft solders at the centre of a coil. The coil is connected to a signal generator.

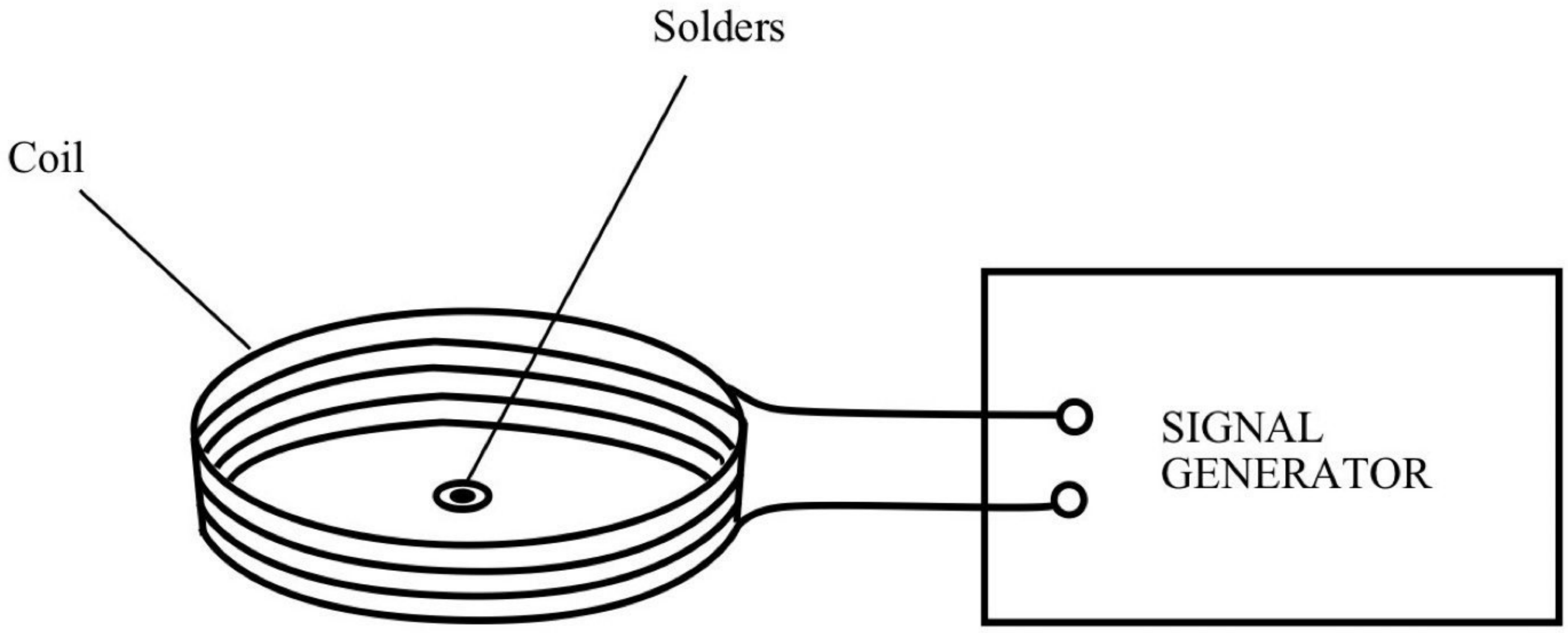


Fig. 6.1

Describe and explain what happens to the solder when the a.c. frequency is increased to a high value.

____

____

____

____

____

____ [5]

For Examiner's Use

7. **(a)** State **two** devices of modern electronic technology which have improved speed of communication.

____

____ [2]

(b) Suggest, with an explanation, an electronic input transducer which can be used in a car to detect that

(i) the seat belt is not fastened,

____

____

(ii) headlamps are not switched on,

____

____

(iii) the engine requires cooling.

____

____ [6]

8. **(a)** Define

(i) *Density* ____

____

(ii) *Pressure* ____

____

[2]

For Examiner's Use

(b) Use the definitions you have given in **(a)** to derive the equation $P=\rho gh$ for the pressure, P, at a depth, *h*, in a fluid of density ρ.

[1]

9. **(a)** Explain why it is much more difficult to reduce the effects of noise when transmitting an analogue signal than when transmitting in digital form.

____

____

____

____ [2]

(b) **(i)** State **two** advantages of optical fibre cables over copper cables.

____

____

____

(ii) Explain the term *attenuation*.

____

____

(iii) State **one** cause of *attenuation* in optical fibres.

____

____[4]

(c) **(i)** Distinguish between a *geostationary* satellite and a *polar* satellite.

For Examiner's Use

____

____

____

____

(ii) Give **three** reasons why microwaves are used for satellite communication.

____

____

____ [5]

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ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

PHYSICS 6032/2

PAPER 2

SPECIMEN PAPER 2018

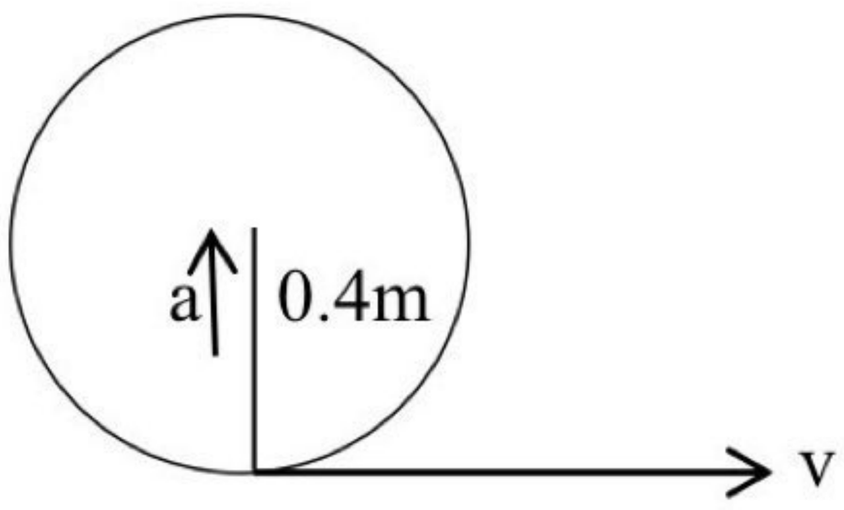
MARKING SCHEME

SPECIMEN6032/2

1(a) Rate of change of angular displacement B1

(b) $v = r\omega$ $\omega = \frac{2\pi}{T}$ $\therefore v = \frac{2\pi r}{T}$ B1B1

(c)(i)



B1

(ii) $a = r\omega^2 = 4\pi^2 f^2 r$ f = 12rev/min = 0.2Hz

$= 4\pi^2(0.2)^2 \; x \; 0.4 = 0.632\text{m/s}^2$ C1A1

(iii) Point Q is at the bottom of the circular path B1

(iv) Tension T $= mg + \frac{mv^2}{r}$

$= 0.6 \times 9.81 + 0.6 \; x \; 0.632$ C1

$= 6.27\text{N}$ A1

2(a) Work done per unit mass taken from infinity to a point in gravitational field. B1

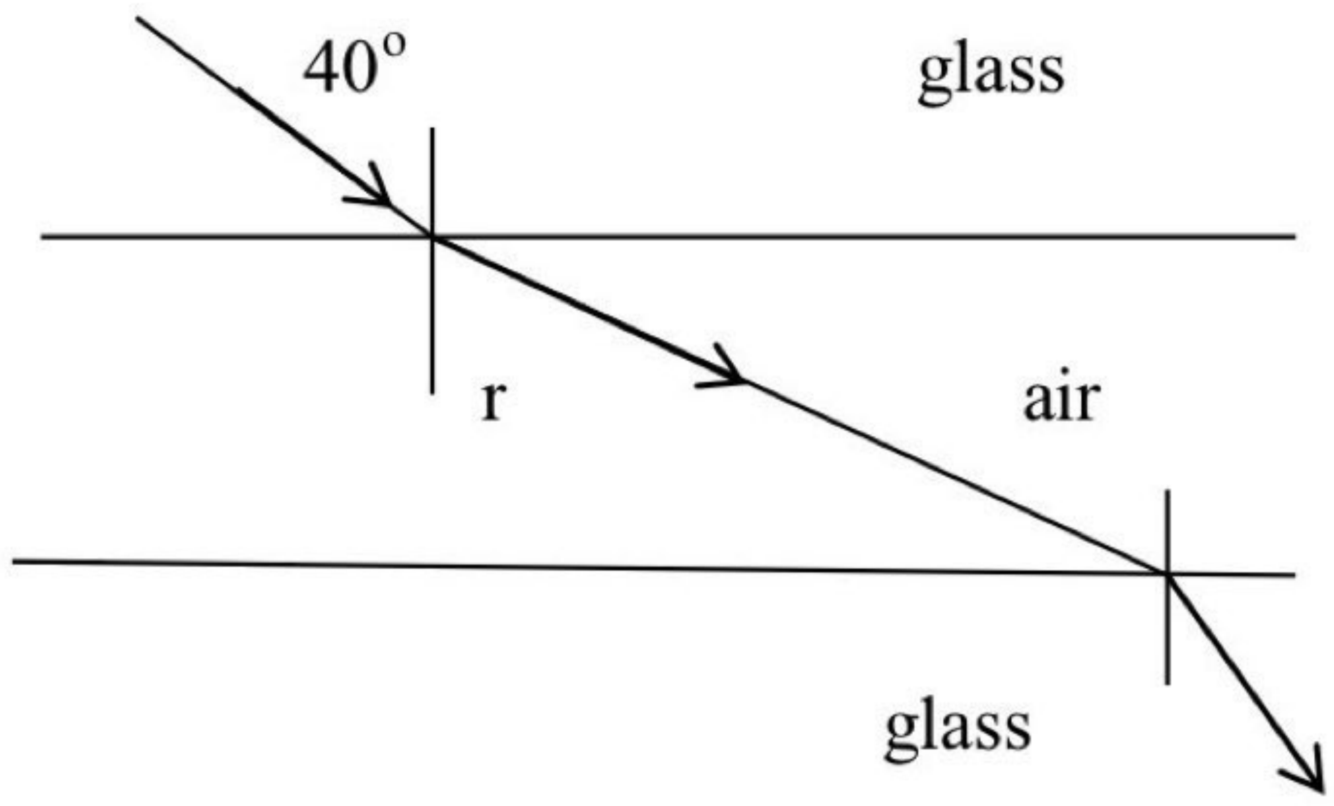
(b) $E_p = \Phi m$ $\Phi = -\frac{GM}{R}$ B1

(c) $\Delta E_p = -\frac{GMm}{R}\left(\frac{1}{6} - \frac{1}{3}\right)$ $\Phi = -\frac{GM}{R} = -6.3 \times 10^7 \text{Jkg}^{-1}$ C1

$= -6.3 \times 10^7 \times 1.4 \left(\frac{1}{6} - \frac{1}{3}\right)$ C1

$= 1.47 \times 10^7\text{J}$ A1

3(a)(i)



B2

(ii) Refracticve of glass = 1.50

$$\frac{sin40}{sinr} = \frac{1}{1.5}$$ C1

sinr = 1.5sin40

r = 74.6° A1

(b) Using $n_1 sini_1 = n_2 sini_2$ $i_1 = c$ $i_2 = 90°$

$n_1 sini_1 = n_2$ C1

$\frac{n_1}{n_2}$ sinc = 1 $\frac{n_1}{n_2} = n$ C1

$$n = \frac{1}{sinc}$$ A0

4(a)(i) Fig 4.1 (b) B1

(ii) Electron beam strikes target on anode B1

(b) Muscle tissues in the stomach lining have same density, so contrast is very low B1

Barium meal has heavy atomic density that causes more attenuation, thereby increasing contrast B1

(c) Pixel number or pixel intensity B1

(d) CT scan image is not superposed as is the case with x-ray image, so it has detail/depth and exact location which are lacked by x-ray images B1

Image is 3-D, so it can be rotated and viewed from different angles while x-ray image is 2-D, so it cannot be viewed from different angles B1

5 A voltmeter is a fault finder.
A voltmeter is placed across each supply, to identify if they are not flat. B1
It is then connected across a switch, each connecting wire and the bridge wire to observe any gap. B1
For each connection, the voltmeter reads the emf if there is a gap. B1

6(a) Magnitude of the induced emf is directly proportional to rater of change of magnetic flux density B1

(b) The solder melts B1
Alternating current into coil produces a changing magnetic field that links the solder B1
An emf is induced in the solder B1
Eddy currents flow in the solder B1
causing joule heating, hence the melting of the solder. B1

7(a) Communication systems- e g mobile phones B1
Computer and information technology- e g internet, whatsapp, facebook, twitter, skype, etc B1
Satellite communication technology B1
(An two)

(b)(i) Strain gauge B1
pressure sensor B1

(ii) LDR B1
light sensor B1

(iii) Thermistor B1
temperature sensor B1

8(a)(i) mass per unit volume / $\rho = \frac{m}{v}$ (symbols defined) B1

(ii) Force per unit area / $p = \frac{F}{A}$ (symbols defined) B1

(b) $p = \frac{F}{A}$ and $\rho = \frac{m}{v}$ m = volume V x density ρ F = mg V = area A x height h B1

$p = \frac{V\rho g}{A} = \frac{Ah\rho g}{A}$ B1

$= h\rho g$ A0

9(a) When any signal (analogue or digital signal) is transmitted over distance, it will pick up noise. B1
For an analogue signal, noise is not filtered out. Both are amplified on amplification. B1
This distorts or attenuates the signal
For a digital signal, the noise picked up is filtered out and the signal regenerated B1

(b)(i) Much greater bandwidth, so can transmit information at a much faster rate B1
Less signal attenuation, so regeneration stations can be much farther apart B1
Virtually impossible to tap into, so much secure B1
Negligible radiation of energy, so very little cross-talk/linking B1
Much cheaper than copper coaxial cables B1
Low weight B1
Pick up less noise, so it is much clearer signal B1
Higher carrying capacity B1
Any **two** advantages

(ii) Loss of (signal) power B1

(iii) Absorption by impurities in glass B1
Scattering due to imperfections in the glass B1

(c)(i) A satellite that orbits the Earth in a geostationary orbit and its period is 24hrs as that of the Earth B1
while a polar satellite is a satellite that has a lower orbit and it passes over the poles B1

(ii) Microwaves can pass through ionosphere to reach the satellites in space B1
Microwaves have a high bandwidth and secure since they are difficult to tap into B1
Microwaves are line-of-sight and often use a satellite or microwave link B1

Candidate Name	Centre Number	Candidate Number

For Performance Measurement

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

PHYSICS **6032/2**

PAPER 2

JUNE 2019 SESSION 1 hour 30 minutes

Candidates answer on the question paper.
Additional materials:
Electronic calculator

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the spaces at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided on the question paper.
For numerical answers, **all** working should be shown.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

FOR EXAMINER'S USE	
1	
2	
3	
4	
5	
6	
TOTAL	

This question paper consists of 18 printed pages and 2 blank pages.

[Turn over

Answer **all** questions.

For Examiner's Use

1 **(a)** **(i)** Define *moment of a force*.

____

____

(ii) Explain why the unit of torque is not expressed in Joules.

____

____

____ [2]

(b) **Fig. 1.1** shows a winch used to extract water from a well.

For Examiner's Use

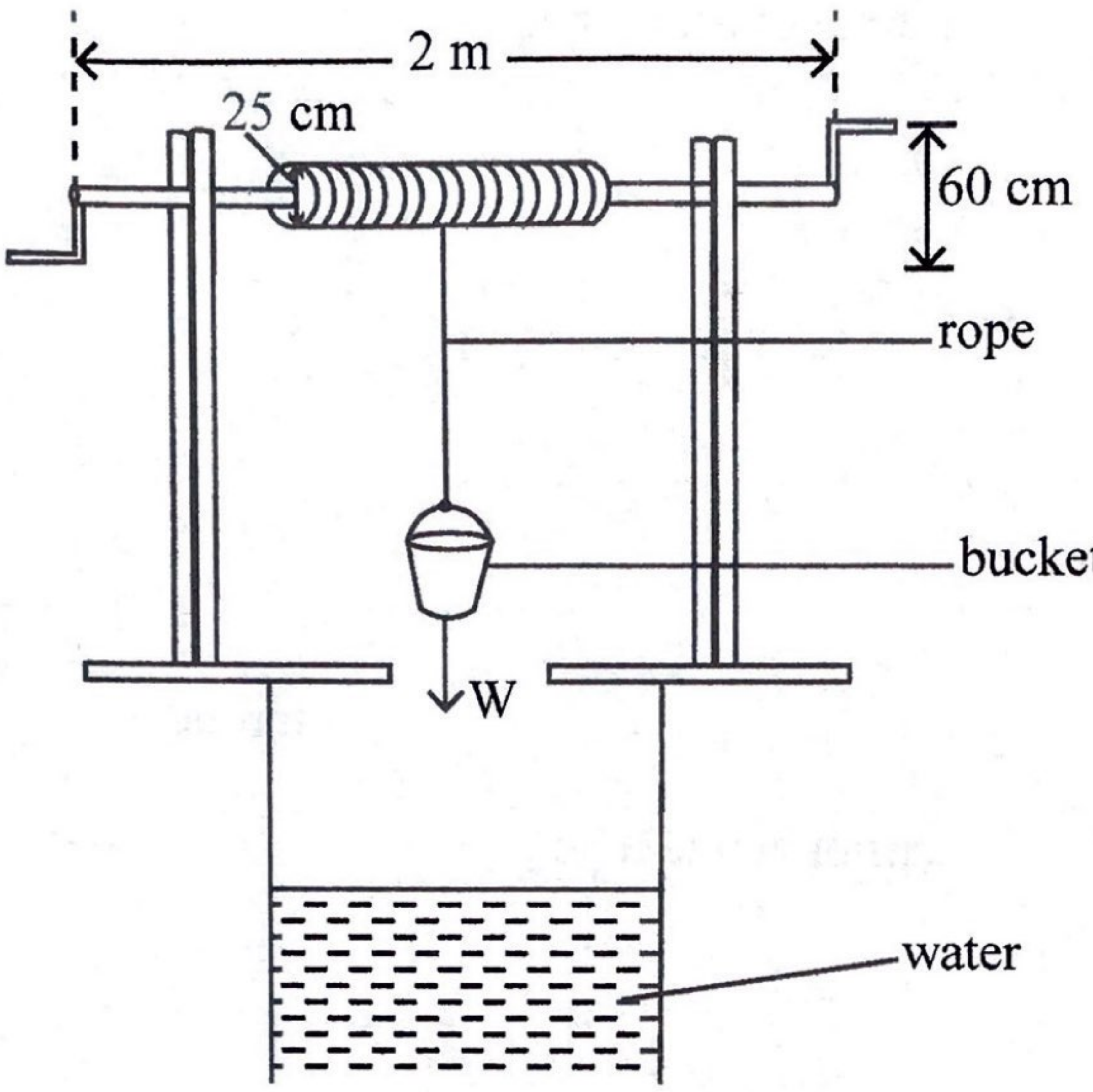


Fig. 1.1

Forces of 40 N are applied normal at the ends of the winch to allow a turning effect. A rope is attached at the end of the winch drum with a bucket full of water. The system is in static equilibrium.

For Examiner's Use

(i) Calculate the

1. torque of the couple,

torque = ______________

2. tension in the rope.

tension = ______________

(ii) Deduce the weight of the bucket and water.

____

____

[4]

For Examiner Use

(c) Explain quantitatively, using Stoke's law how a body falling through a viscous fluid under laminar conditions attains a terminal velocity.

____

____

____

____

____

____ [4]

2 **(a)** **Fig. 2.1** shows a device used for detecting the level of acid in a battery.

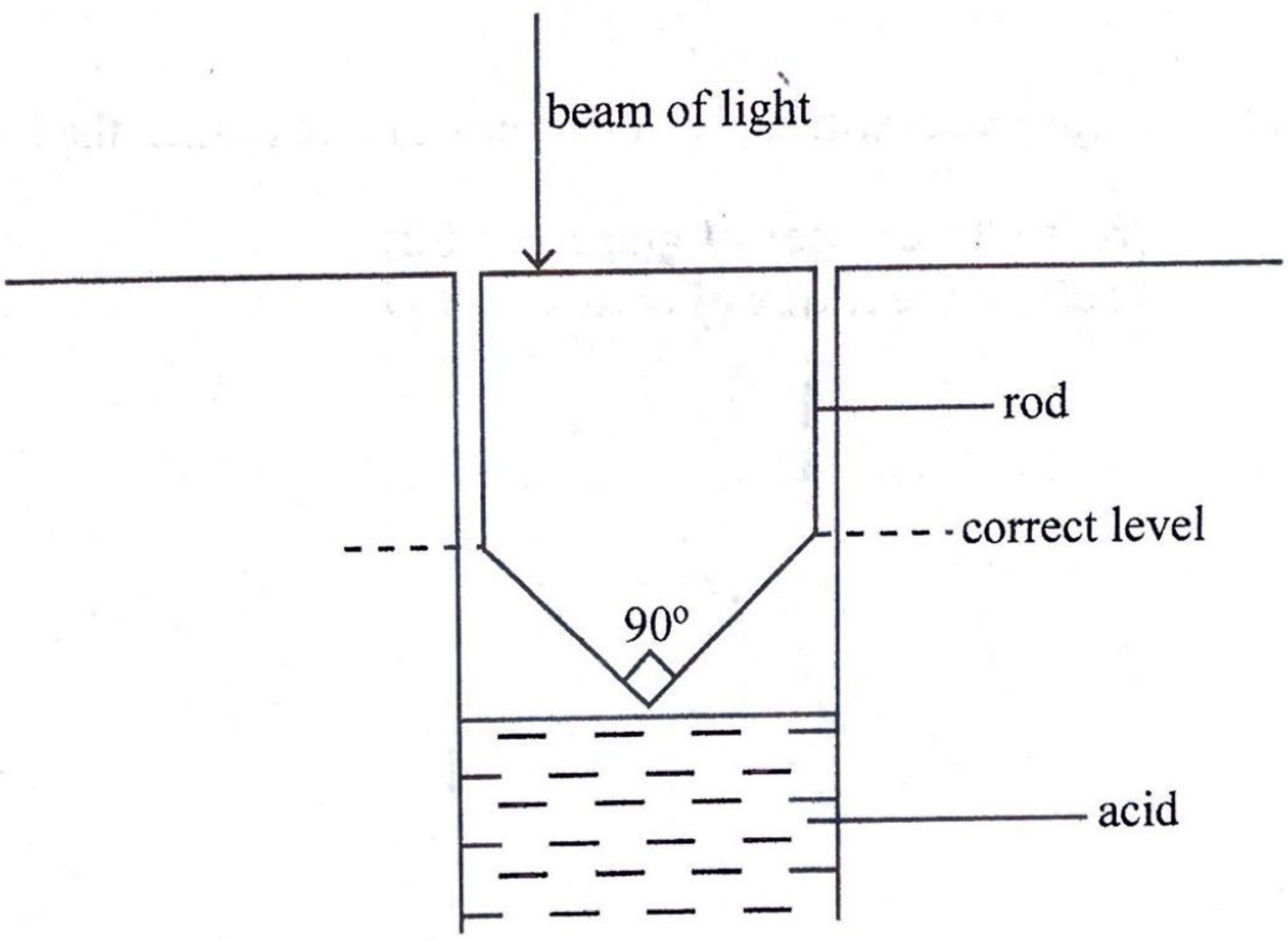


Fig. 2.1

A glass rod with its end shaped as a right angled prism dips into the acid when the level is correct. When the acid level is too low, the end of the rod is in air.

[Turn over

For Examiner's Use

(i) A beam of light is shone on one side of the rod and a strong reflected beam is observed emerging upwards from the other side when the acid level is too low.

Explain this effect.

____

____

____

____

____

____

(ii) Predict what will happen to the beam of light when the level is correct.

[refractive index of glass = 1.52
refractive index of acid = 1.35]

[6]

(b) **Fig. 4.1** shows a particle, of mass m, enclosed in a cubical container of side L. The particle has a velocity u_1, towards surface A.

For Examiner's Use

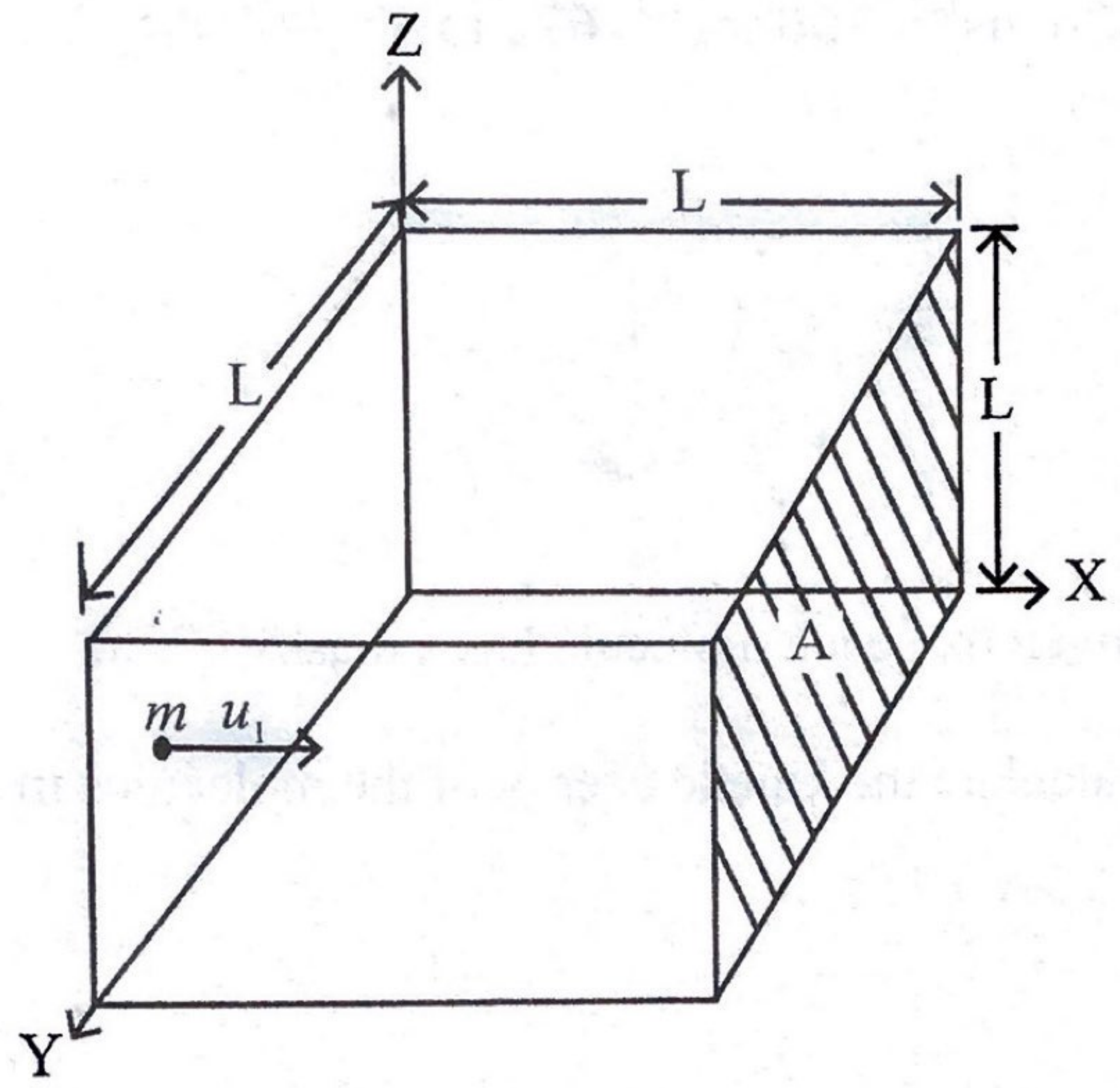


Fig. 4.1

Show that the pressure exerted by the particle on the wall is given by

$$P = \frac{mu_1^2}{L^3}.$$

[3]

(c) (i) Calculate the mean square speed of four molecules having the following velocities

$630\ ms^{-1}$, $700\ ms^{-1}$, $670\ ms^{-1}$, $800\ ms^{-1}$

(ii) Given that each molecule has a mass of 22u.

Calculate the kinetic energy of the molecules in **(i)**.

[3]

5 **(a)** State the principles on which the following are based on,

(i) *the equation of continuity*,

___

___

(ii) *Bernoulli's effect.*

___

___ [2]

For Examiner's Use

(b) **(i)** State what is meant by *hardness of an X ray beam.*

____

(ii) **Fig. 2.2** shows part of an X ray tube.

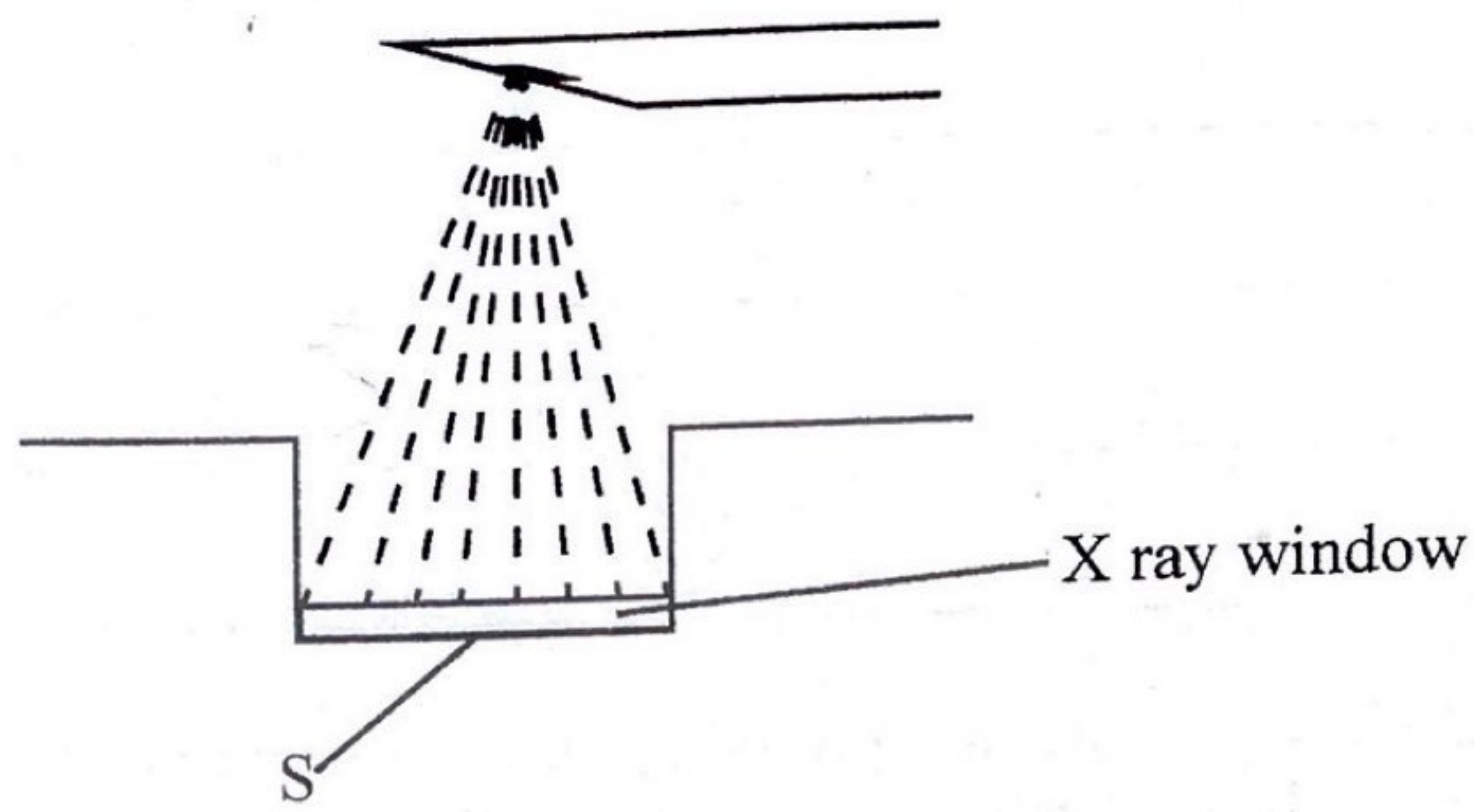


Fig. 2.2

1. Suggest a suitable material for S.

____

2. State the purpose of S.

____

3. Give **one** method of improving the sharpness of an X ray image.

____

______________________________ [4]

For Examiner's Use

3 **(a)** Explain how a transformer produces an output voltage greater than the input voltage.

____

____

____

____

____

____ [3]

(b) **Fig. 3.1** shows a generator providing power to equipment rated at 130 kW, 240 V a.c. The generator is connected to the equipment by two conductors which have a total resistance of 0.30 Ω.

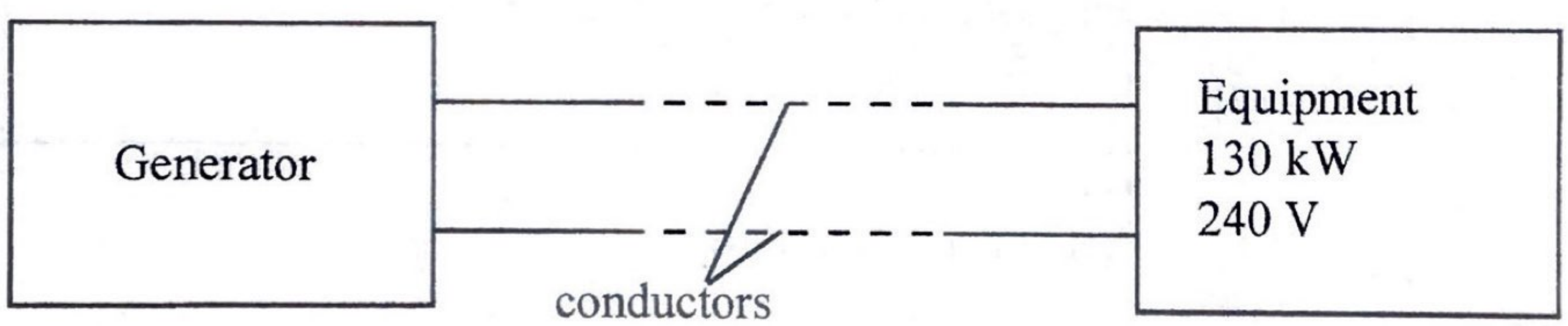


Fig. 3.1

The equipment is operating at its rated power.

Calculate the

(i) power loss in the conductors,

power loss ______________

(ii) voltage developed by the generator,

voltage ___________

(iii) efficiency of the transmission system.

efficiency __________ [5]

(c) Explain why transformers produce a buzzing sound when they are operating.

____

____

____

____

____ [2]

[Turn over

For Examiner's Use

4 (a) (i) State the

1. *zeroth law of thermodynamics*,

2. *first law of thermodynamics*.

[2]

(ii) Calculate, the thermodynamic temperature given that

$\frac{(pV)_T}{(pV)_{tr}} = 2.230$ for an ideal gas at temperature T.

[2]

For Examiner's Use

(b) **Fig. 5.1** shows a horizontal pipe with a fluid, of density ρ, in motion. Part L has a diameter of 140 mm and part M a diameter of 90 mm. The fluid has a velocity of v_1 and v_2 at L and M respectively.

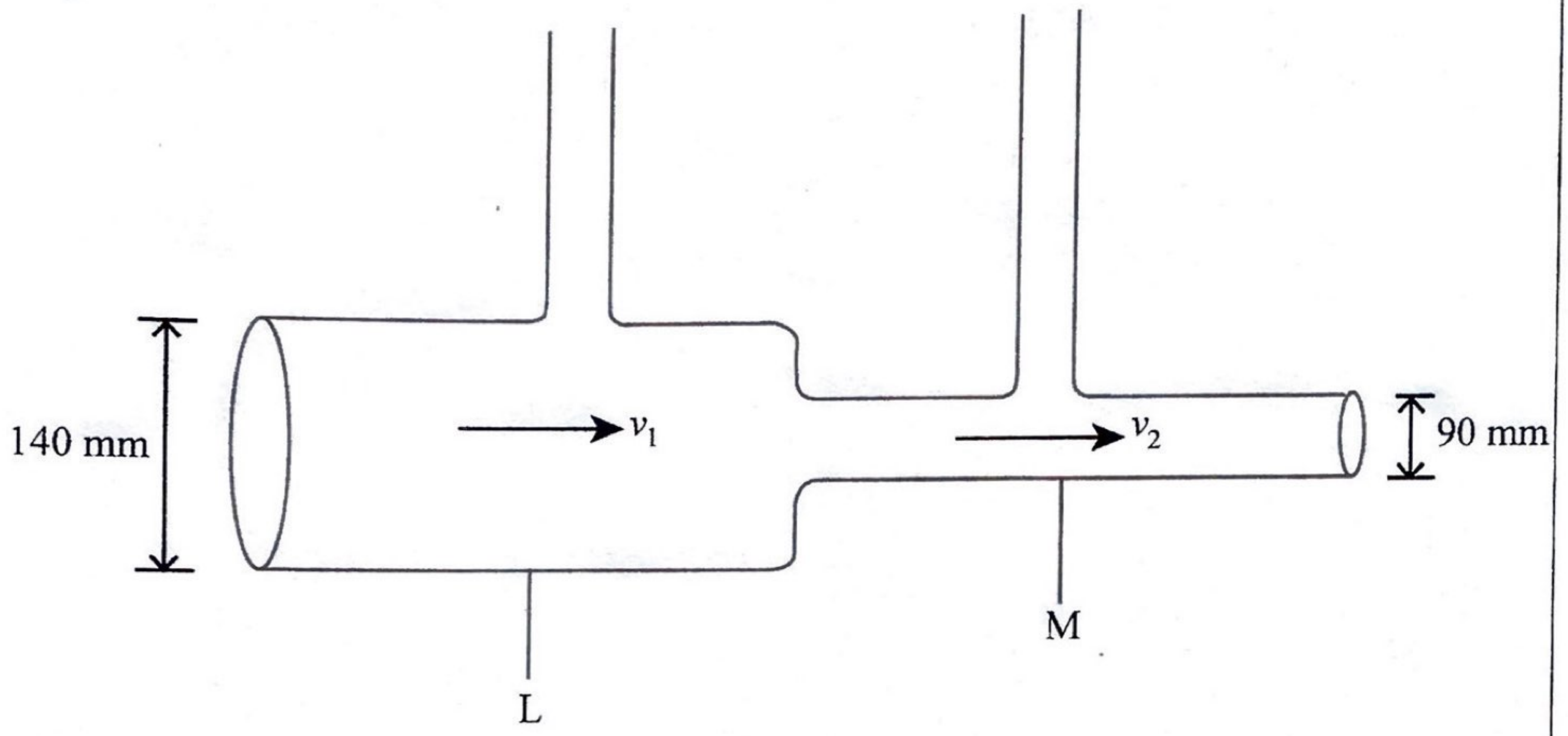


Fig. 5.1

(i) On **Fig. 5.1** show the vertical height of the fluid at L and M.

(ii) Show that the pressure difference, Δp, at L and M is given by

$$\Delta p = \frac{1}{2}\rho v_1^2\left(\frac{A_1^2}{A_2^2} - 1\right).$$

For Examiner's Use

(iii) Calculate the pressure difference of a fluid in motion of density $890\ kgm^{-3}$ when its velocity is $13\ ms^{-1}$.

[8]

6 **(a)** Explain why there is signal attenuation in

(i) communication wires,

____

____

____

(ii) air,

____

____

____

(iii) optical fibres.

____

____

____ [3]

For Examiner's Use

(b) A signal of power 15 mW is transmitted in a cable whose attenuation is 15 dB. The cable is connected to another cable which has an attenuation of 25 dB.

Calculate the power transmitted at the end of the second cable.

[4]

[Turn over

For Examiner's Use

(c) **Fig. 6.1** shows the variation of displacement of an amplitude modulated radio wave with time.

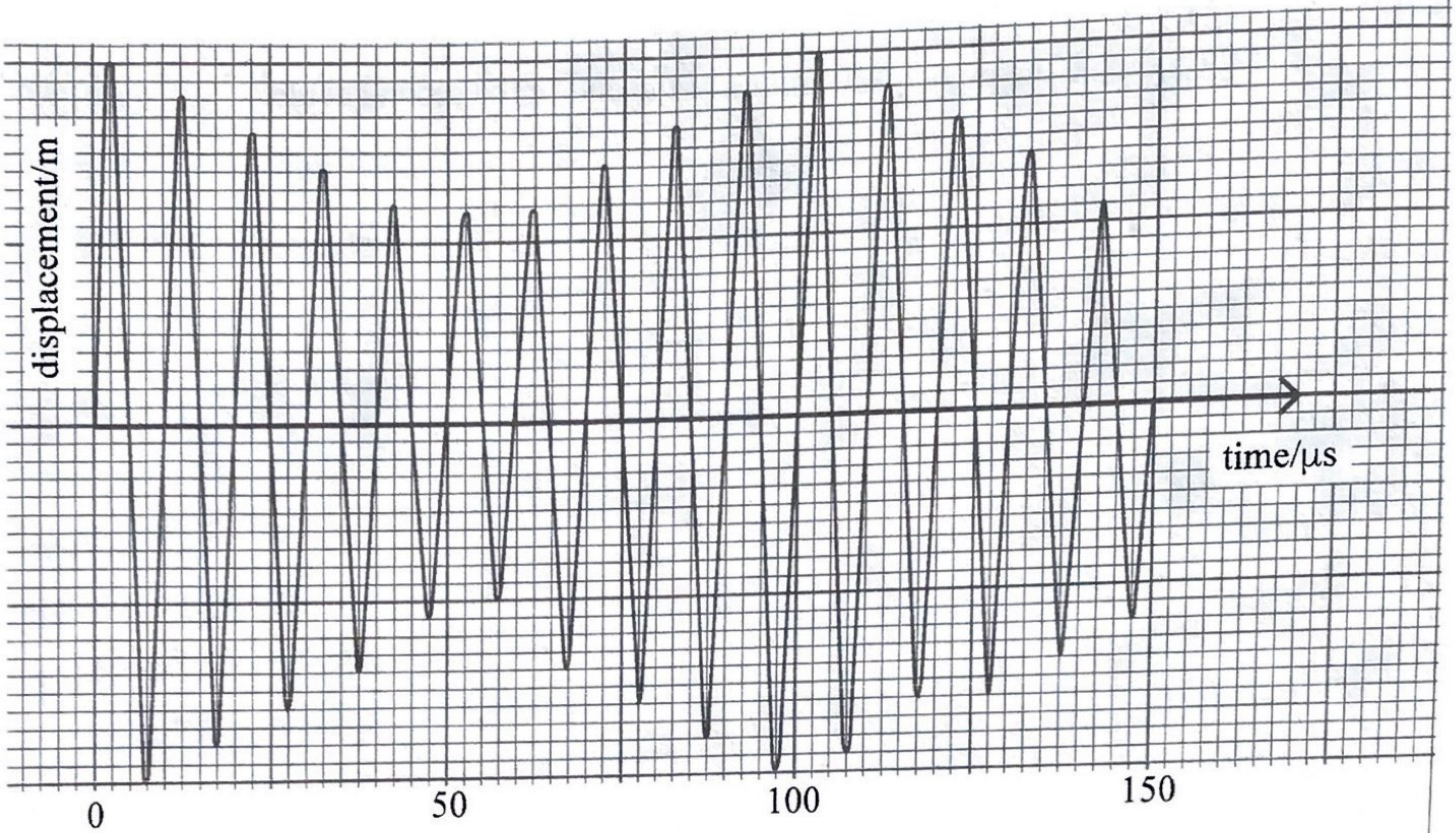


Fig. 6.1

Calculate the frequency of the

(i) carrier wave,

frequency ____________

(ii) information signal.

frequency ____________ [3]

For Performance Measurement

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL
General Certificate of Education Advanced Level

PHYSICS **6032/2**
PAPER 2

NOVEMBER 2019 SESSION 1 hour 30 minutes

Candidates answer on the question paper.
Additional materials:
Electronic calculator

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the spaces at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided on the question paper.
For numerical answers, **all** working should be shown.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

FOR EXAMINER'S USE	
1	
2	
3	
4	
5	
6	
TOTAL	

This question paper consists of 18 printed pages and 2 blank pages.

[Turn over

Scanned with CamScanner

DATA

speed of light in free space	$c = 3.00 \times 10^{8} ms^{-1}$
permeability of free space	$\mu_o = 4\pi \times 10^{-7}$ Hm^{-1}
permittivity of free space	$\varepsilon_0 = 8.85 \times 10^{-12}$ Fm^{-1} ($1/4\pi\varepsilon_0 = 8.99 \times 10^{9}$ mF^{-1})
elementary charge	$e = 1.60 \times 10^{-19}$ C
the Planck constant	$h = 6.63 \times 10^{-34}$ Js
unified atomic mass unit	$1 u = 1.66 \times 10^{-27}$ kg
rest mass of electron	$m_e = 9.11 \times 10^{-31}$ kg
rest mass of proton	$m_p = 1.67 \times 10^{-27}$ kg
molar gas constant	$R = 8.31$ $JK^{-1}mol^{-1}$
the Avogadro constant	$N_A = 6.02 \times 10^{23} mol^{-1}$
the Boltzmann constant	$k = 1.38 \times 10^{-23}$ JK^{-1}
gravitational constant	$G = 6.67 \times 10^{-11} Nm^{2}kg^{-2}$
acceleration of free fall	$g = 9.81$ ms^{-2}

FORMULAE

uniformly accelerated motion	$s = ut + ½at^2$
	$v^2 = u^2 + 2as$
work done on/by a gas	$W = p\,\Delta V$
gravitational potential	$\phi = -Gm/r$
hydrostatic pressure	$p = \rho gh$
pressure of an ideal gas	$p = \frac{1}{3}\frac{Nm}{V} < c^2 >$
simple harmonic motion	$a = -\omega^2 x$
velocity of particle in s.h.m.	$v = v_o \cos \omega t$
	$v = \pm\omega\sqrt{(x_o^2 - x^2)}$
Doppler effect	$f_o = \frac{f_s v}{v \pm v_s}$
Attenuation of x-rays	$I = I_o e^{-\mu x}$
electric potential	$V = \frac{Q}{4\pi\varepsilon_0 r}$
capacitors in series	$1/C = 1/C_1 + 1/C_2 + \ldots$
capacitors in parallel	$C = C_1 + C_2 + \ldots$
energy of charged capacitor	$W = \frac{1}{2}QV$
electric current	$I = Anvq$
resistors in series	$R = R_1 + R_2 + \ldots$
resistors in parallel	$1/R = 1/R_1 + 1/R_2 + \ldots$
Hall voltage	$V_H = \frac{BI}{ntq}$
alternating current/voltage	$x = x_o \sin\omega t$
radioactive decay	$x = x_o \exp(-\lambda t)$
decay constant	$\lambda = \frac{0.693}{t_{\frac{1}{2}}}$

[Turn over

Answer **all** questions.

1 **(a)** **Fig. 1.1** shows a student whirling a can at the end of a string.

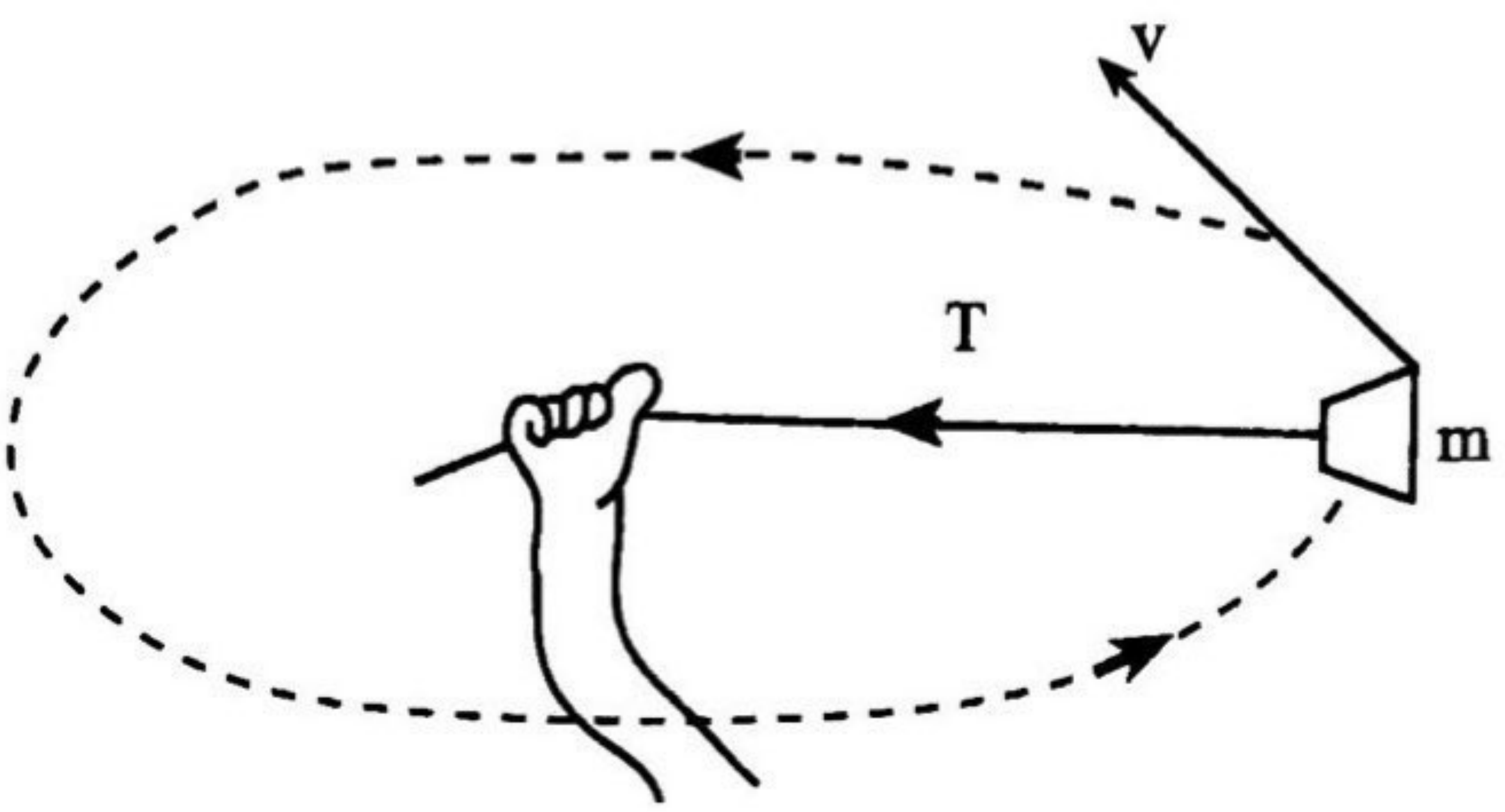


Fig. 1.1

Explain why the string cannot be held horizontal while the can is rotating in a circular path.

____

____

____

____ [2]

(b) **Fig. 1.2** shows the variation of gravitational potential near a certain planet.

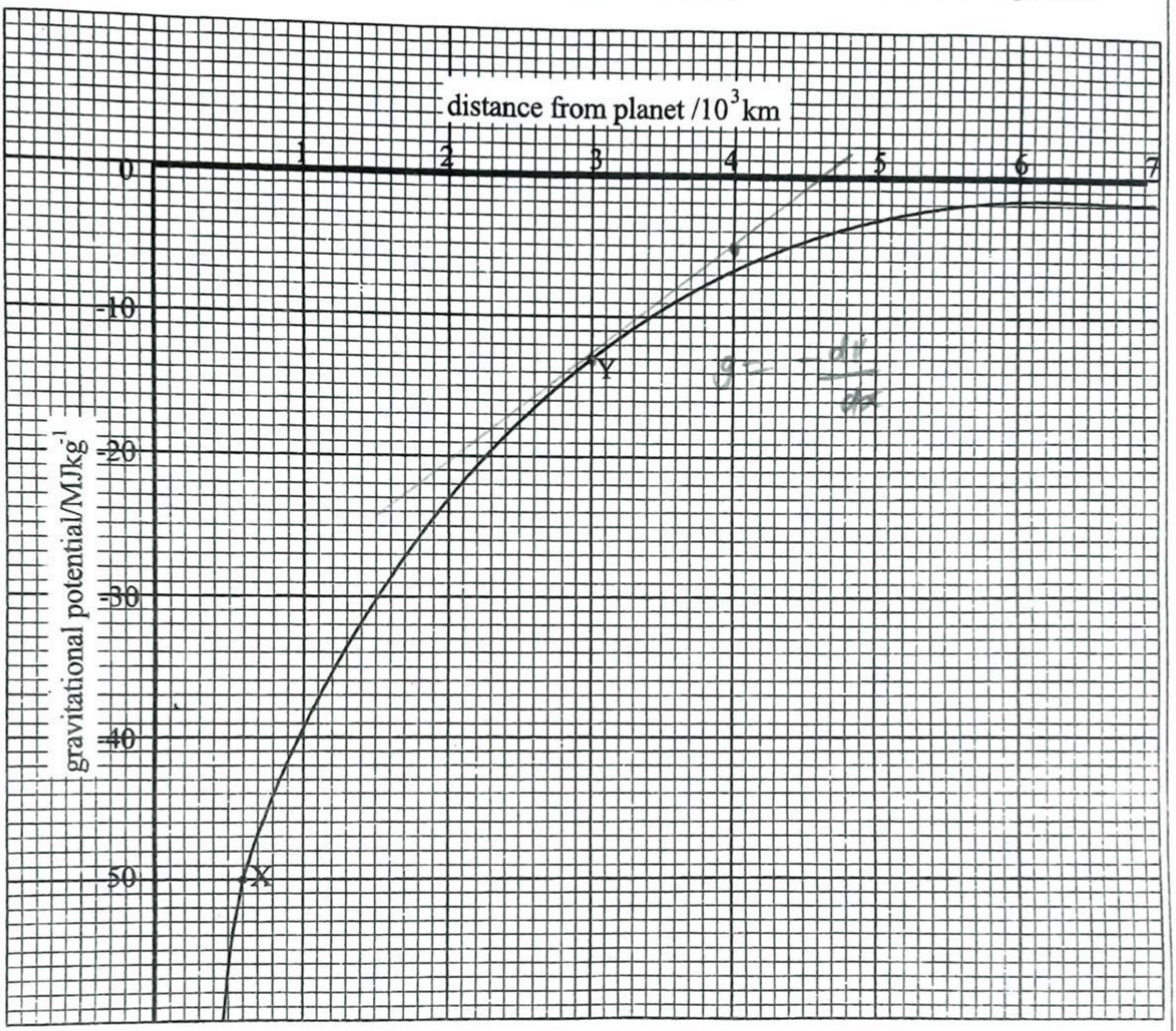


Fig. 1.2

Determine the

(i) gravitational potential at Y,

(ii) change in potential energy of a 200 kg mass moved from point Y to point X,

*change in potential energy*____________

(iii) gravitational field strength at Y.

*gravitational field strength*____________

[5]

(c) Explain why values of gravitational potential near an isolated planet are all negative.

____

____

____

____

____

____

____

____

____ [3]

2 (a) Define the *Farad*.

____

____

____ [1]

(b) Fig. 2.1 shows a 2 μF capacitor connected in a circuit with a 12 V source, 1 kΩ and 3 kΩ resistors.

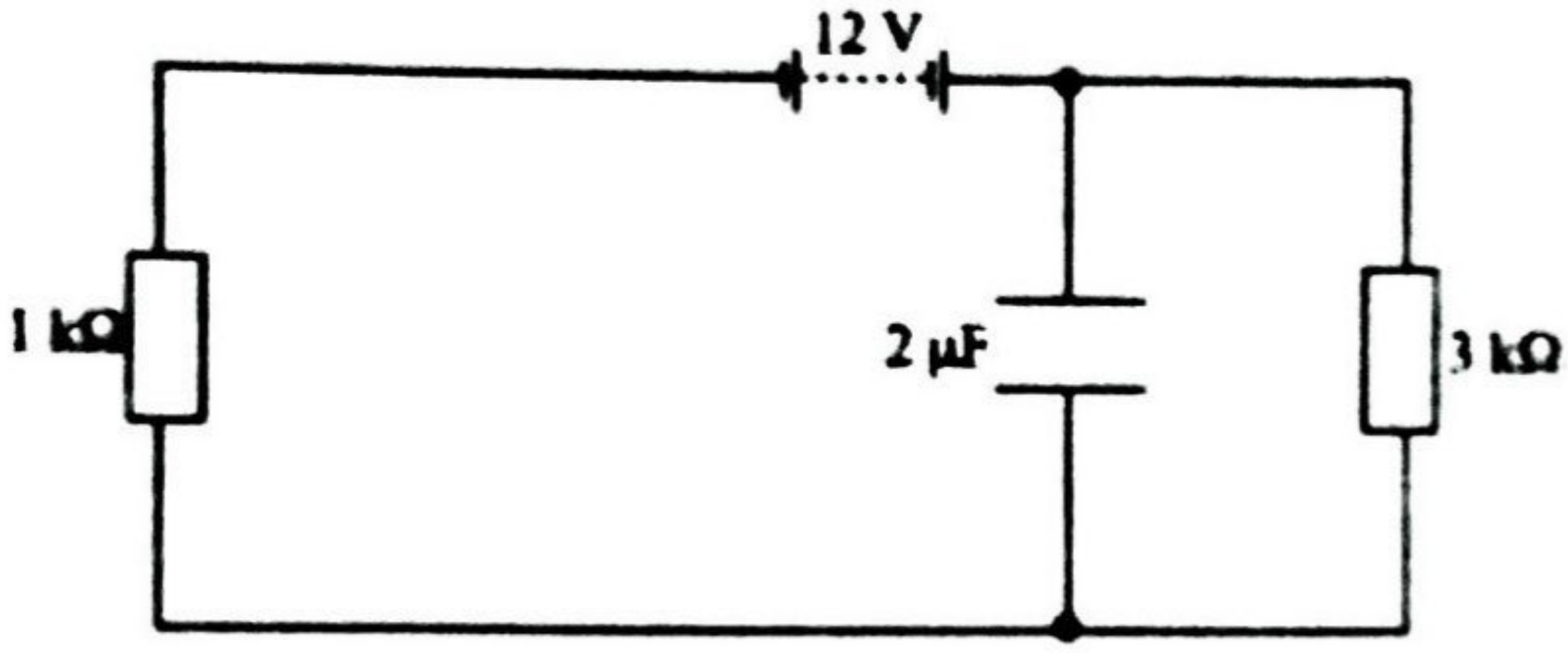


Fig. 2.1

(i) Calculate the charge on the plates of the capacitor.

charge ______________

(ii) Explain why a capacitor stores electric potential energy not charge.

____

____

____ [4]

(c) **Fig. 2.2** shows a voltage waveform from a C.R.O across a 300 Ω resistor in an a.c circuit. The time base is set at 5 $\mathrm{mscm^{-1}}$ and y–gain is set at 0.5 $\mathrm{Vcm^{-1}}$. (Drawn to scale)

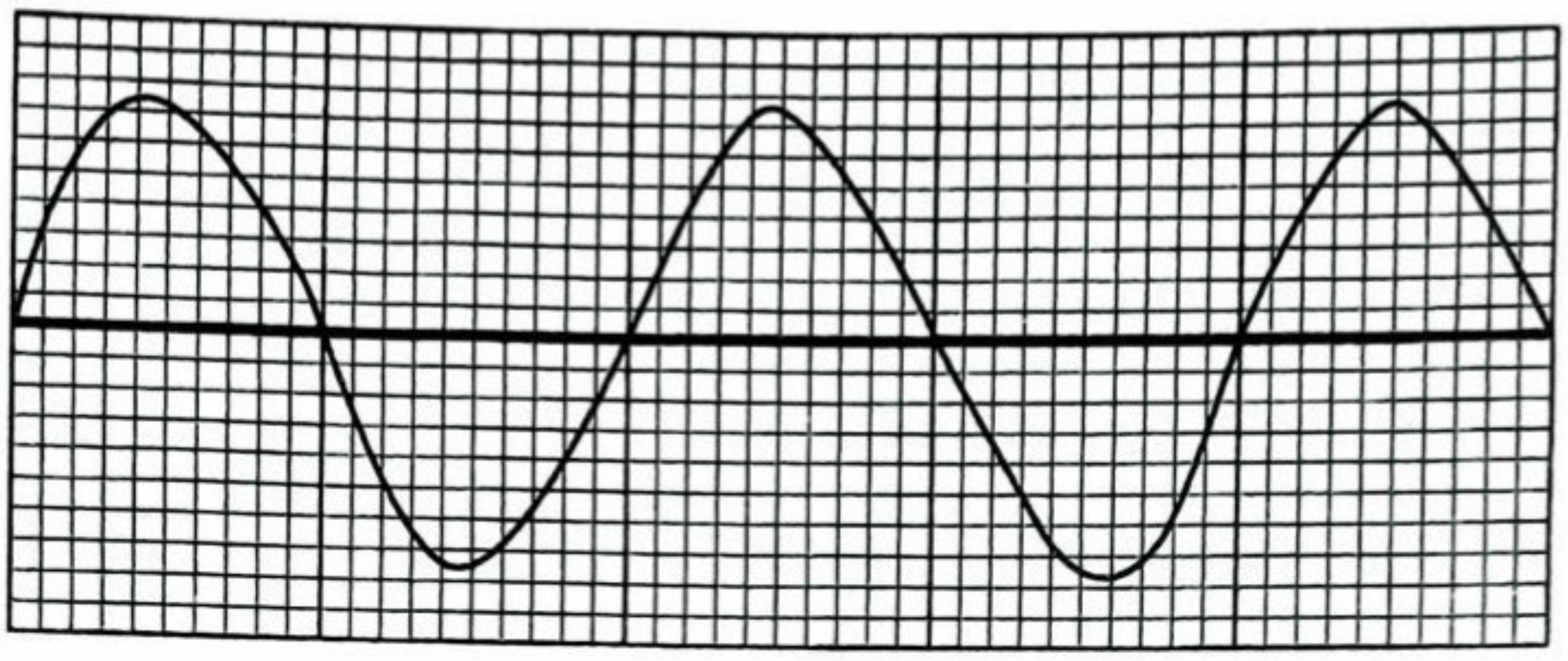


Fig. 2.2

Determine the

(i) peak to peak voltage,

peak to peak voltage ____________

(ii) r.m.s current through the resistor,

r.m.s current ____________

(iii) mean power dissipated in the resistor.

For Examiner's Use

mean power _______________

[5]

3 (a) A conductor of length 4.0 cm carrying a current of 1.5 A is placed in a uniform magnetic field as shown in **Fig. 3.1**. The force experienced by the conductor is 4.2×10^{-2}N when the angle between the conductor and the field is 40 °.

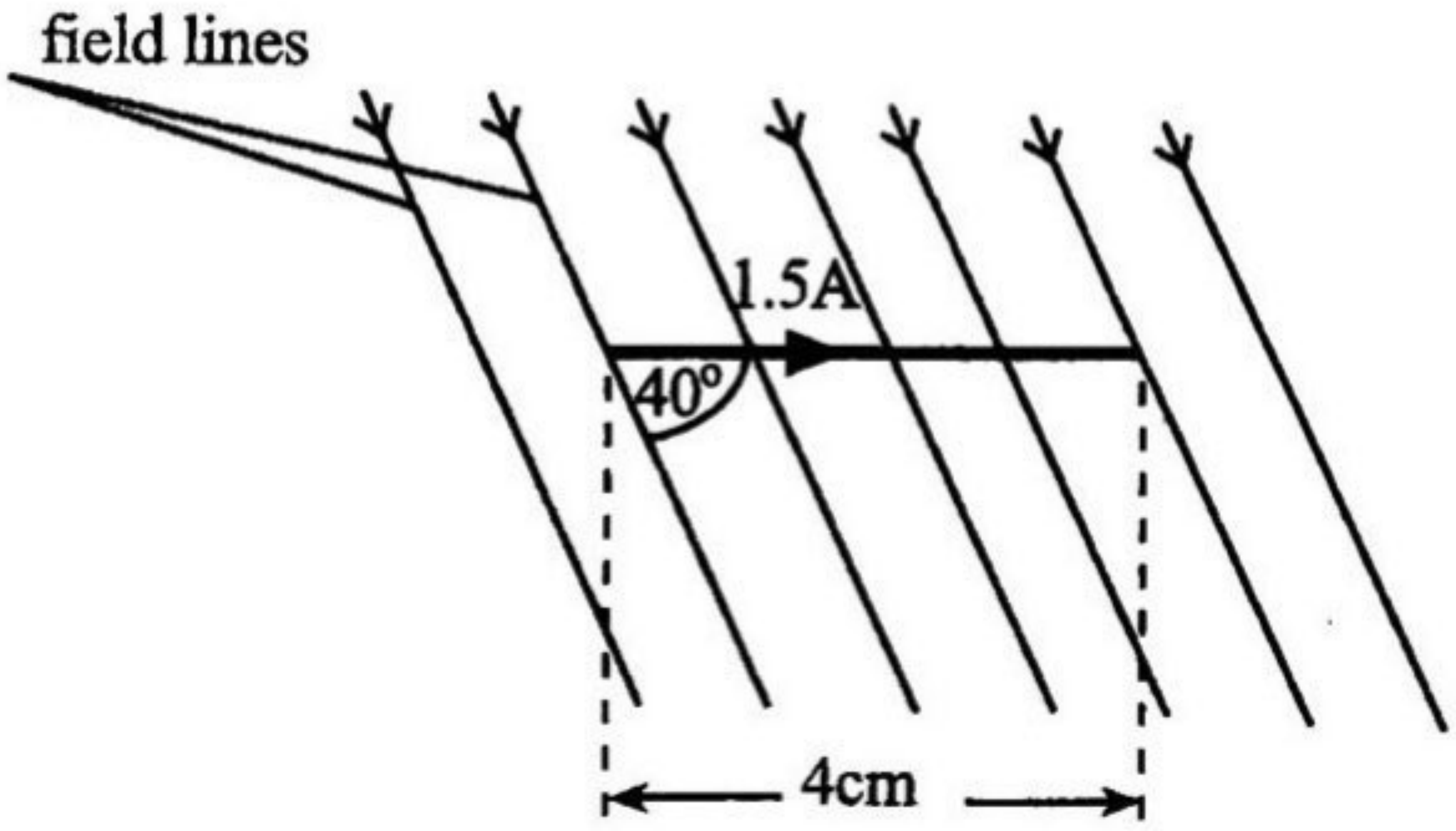


Fig. 3.1

(i) Calculate the magnetic field strength.

Magnetic field strength ___________

(ii) Deduce the direction of the force experienced by the conductor.

___

___

(iii) State how a maximum force can be experienced by the conductor.

___

___

[3]

(b) (i) Define the *Weber*.

___

___

For Examiner's Use

(ii) **Fig. 3.2** shows how the magnetic flux density through a 300 turn coil of a cross-sectional area $2.2 \times 10^{-3} m^2$ varies with time.

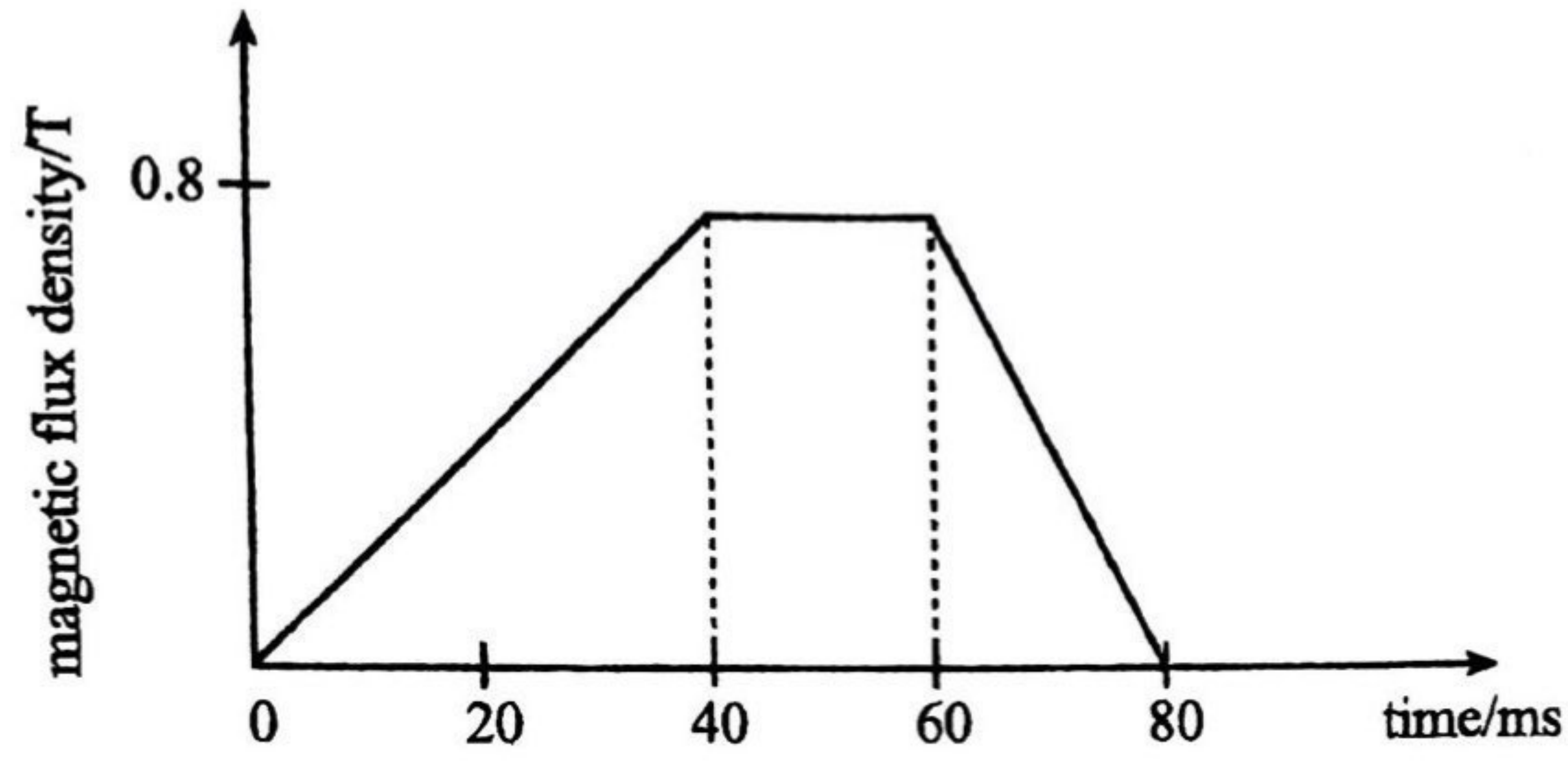


Fig. 3.2

1. Determine the maximum rate of change of flux linkage in the coil.

maximum rate of change ______________

2. Sketch a graph to show how the induced e.m.f varies with time.

[5]

(c) Explain why a back e.m.f in the primary coil of a transformer is developed when an alternating potential difference is applied across it.

____

____

____

____ [2]

4 (a) **Fig. 4.1** shows a circuit containing a transformer and an ideal operational amplifier. The transformer has a sinusoidal input of 8.0 μV r.m.s and an output of 50 μV r.m.s.

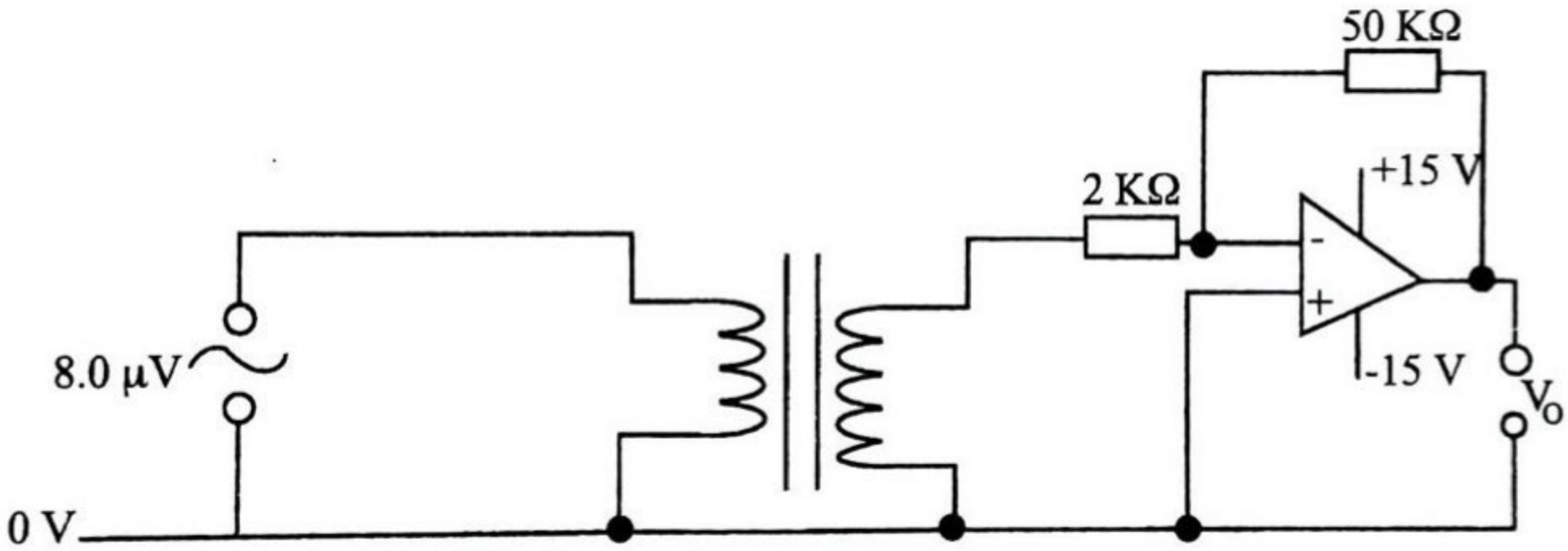


Fig. 4.1

Calculate the

(i) gain of the amplifier,

gain ______________

(ii) values between which the output of the amplifier varies.

output of the amplifier ___________ [4]

(b) Explain how it is possible to obtain a square wave output from a sine wave input when using an operational amplifier circuit as a Schmitt-trigger.

____

____

____

____

____

_______________ [3]

(c) List any **three** advantages of electronics in modern communication.

____

____

____

_______________ [3]

5 **(a)** State with a reason, the most suitable thermometer used in measuring the temperature of an electric motor bearing in a manufacturing plant.

____

____

____

____ [2]

(b) Explain why a constant volume gas thermometer is rarely used in industry.

____

____

____

____ [2]

(c) The resistance, R_t, of a platinum wire at a temperature, *t*, measured by a mercury-in-glass thermometer is given by

$$R_t = R_0(1 + \beta t^2)$$

where $\beta = 1.96 \times 10^{-6}\ °C^{-2}$.

The wire is used in a resistance thermometer.

Calculate the temperature recorded by the resistance thermometer when mercury thermometer reads

(i) 100 °C,

(ii) 80 °C.

(iii) Comment on the values in (c)(i) and (c) (ii).

____

____

____

____ [6]

6 (a) Wave particle duality suggests that light exhibits both wave and particle properties. If light falls upon a metal plate, photoelectrons are ejected.

Explain the observation from the viewpoint of

(i) wave theorists,

____

____

____

(ii) particulate theorists.

____

____

____

____ [4]

(b) State the experiments that provide evidence for the

(i) wave nature of particles.

(ii) particulate nature of waves.

[2]

(c) **Fig. 6.1** shows a graph of maximum kinetic energy against frequency from a photoelectric experiment.

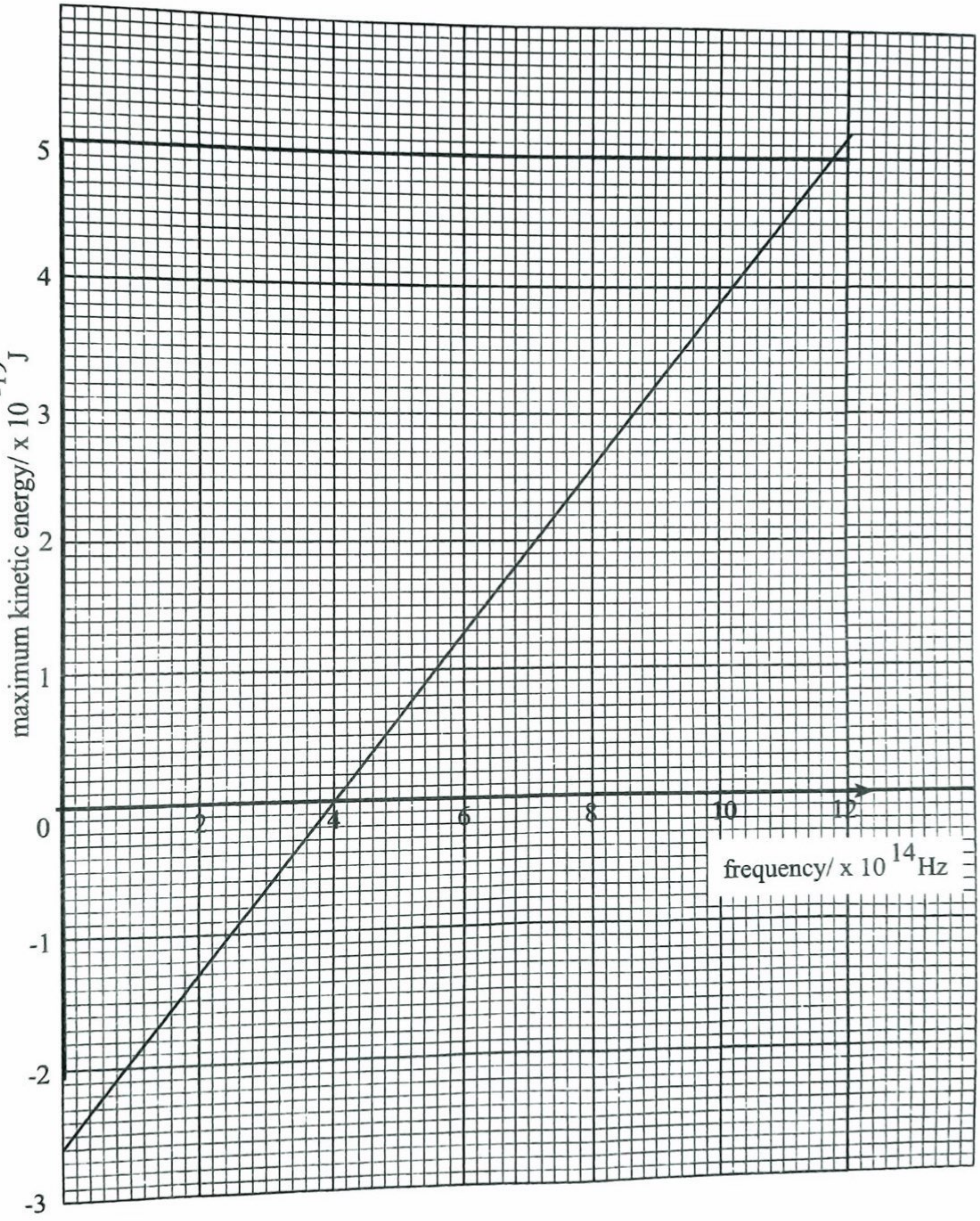


Fig. 6.1

[Turn over

Deduce, from **Fig. 6.1**, the

(i) Plank's constant,

Plank's constant = ___________

(ii) minimum frequency of radiation that causes photoelectric emission,

minimum frequency = __________

(iii) work function.

work function = __________ [4]

Candidate Name | Centre Number | Candidate Number

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL
General Certificate of Education Advanced Level

PHYSICS
PAPER 2

6032/2

JUNE 2020 SESSION **1 hour 30 minutes**

Candidates answer on the question paper.
Additional materials:
Electronic calculator

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

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Answer **all** questions.
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INFORMATION FOR CANDIDATES

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FOR EXAMINER'S USE	
1	
2	
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4	
5	
6	
TOTAL	

This question paper consists of 15 printed pages and 1 blank page.

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Attenuation of x-rays	$I = I_o e^{-\mu x}$
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radioactive decay	$x = x_o \exp(-\lambda t)$
decay constant	$\lambda = \frac{0.693}{t_{\frac{1}{2}}}$

For Examiner's Use

1 **(a)** State the type of error associated with

(i) accuracy,

____

(ii) precision.

______________________________ [2]

(b) In a simple electrical circuit, current flowing through a resistor is (2.80 ± 0.05)mA.

The resistor is marked $4.5\ \Omega \pm 2\%$.

Calculate the percentage uncertainty in the power dissipated in the resistor.

[3]

For Examiner' Use

(c) The equation relating current, I, through a diode to the applied potential difference, V, at temperature, T, is given by $I = I_0 e^{-\frac{eV}{kT}}$, where e is the electronic charge and k is the Boltzmann constant.

Show that the base units of k are $kgm^2s^{-2}K^{-1}$.

[2]

(d) **Fig. 1.1** shows a uniform ladder leaning on a vertical smooth wall and a rough floor. The ladder is in equilibrium.

Draw a free body diagram to show all the forces acting on the ladder. [3]

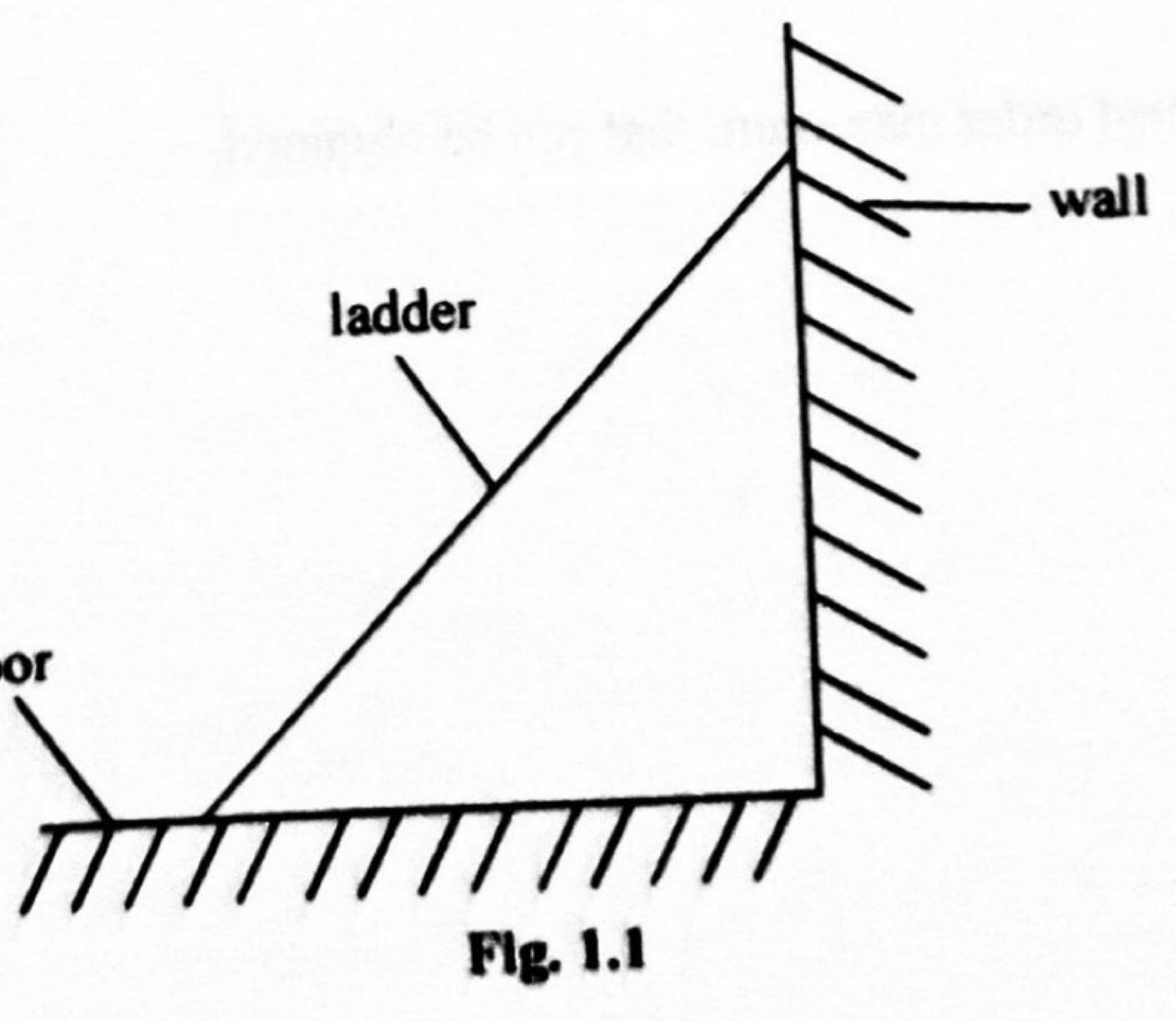

Fig. 1.1

2 (a) State any two conditions necessary for the formation of stationary waves.

____

____

____

____[2]

(b) A diffraction grating of 300 lines per mm is illuminated normally by light of wavelength 530 nm.

Calculate the

(i) angle between first and second order maxima,

(ii) highest order maximum that can be obtained.

[5]

(c) An X-ray beam is passed through an aluminium plate of thickness 5.0 cm. The intensity of transmitted beam is 1.49 Wm^{-2}. The average linear attenuation coefficient is 250 m^{-1}.

Calculate the incident intensity.

incident intensity ____________________ [2]

(d) State **one** use of X-rays.

____ [1]

3 (a) **Fig. 3.1** shows an experiment to determine the charge on a small insulated charged ball of mass 0.04×10^{-2} kg which is suspended between parallel plates.

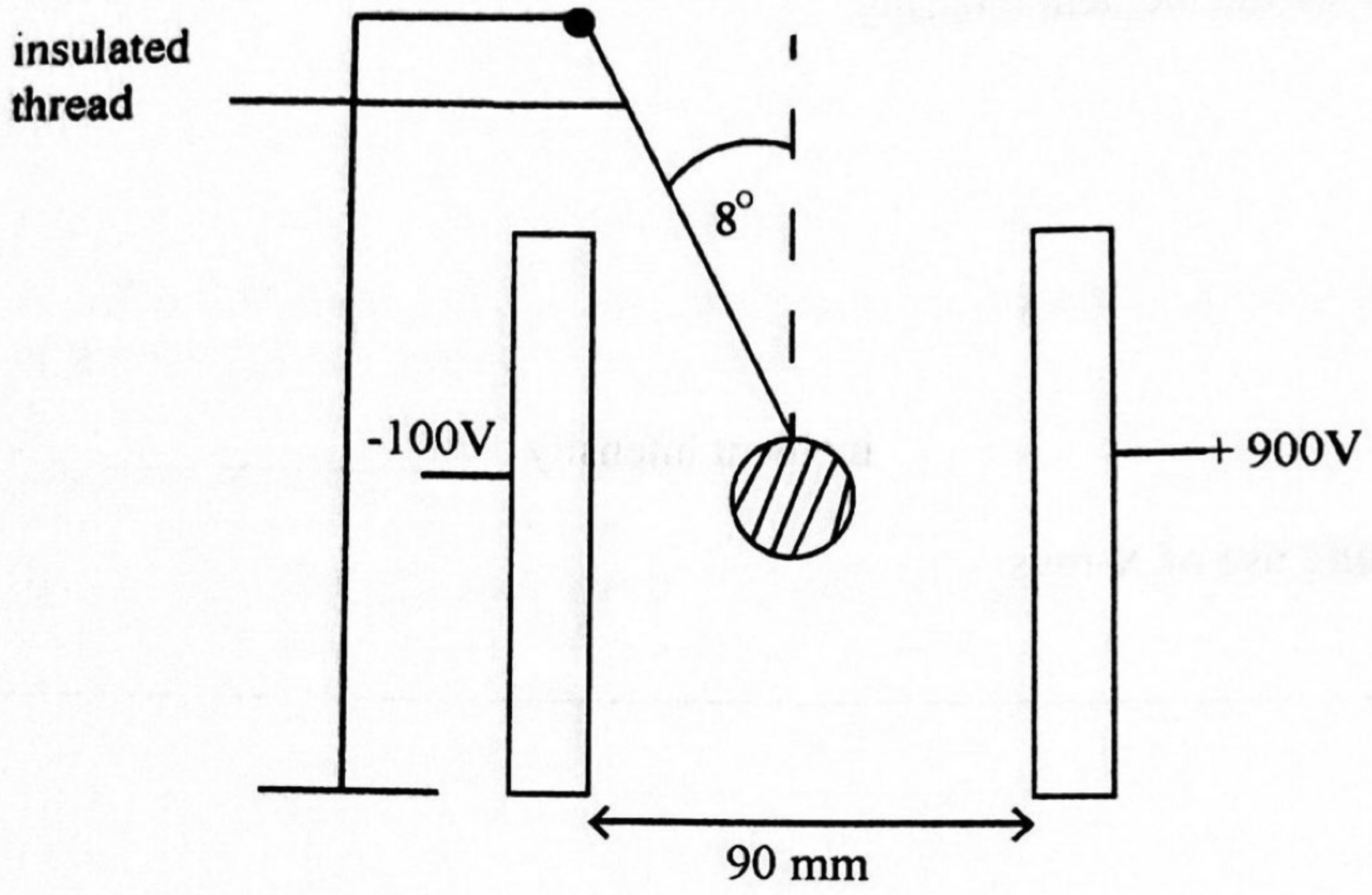

Fig. 3.1

Calculate the

(i) tension in the thread,

tension ______________

(ii) electric force on the ball,

electric force ______________

(iii) charge on the ball.

charge ____________________

[6]

(b) Explain the application of electrostatics in photocopying.

____

____

____

____

____

____

____

____ [4]

4 **(a)** Distinguish between *fatigue* and *creep*.

____

____

____

____ [2]

Ex

For Examiner's Use

(b) Fig. 4.1 is a graph of load against extension for a metal wire of diameter 1.8 mm and original length 2.0 m. When the load reaches the value at **D** the wire breaks.

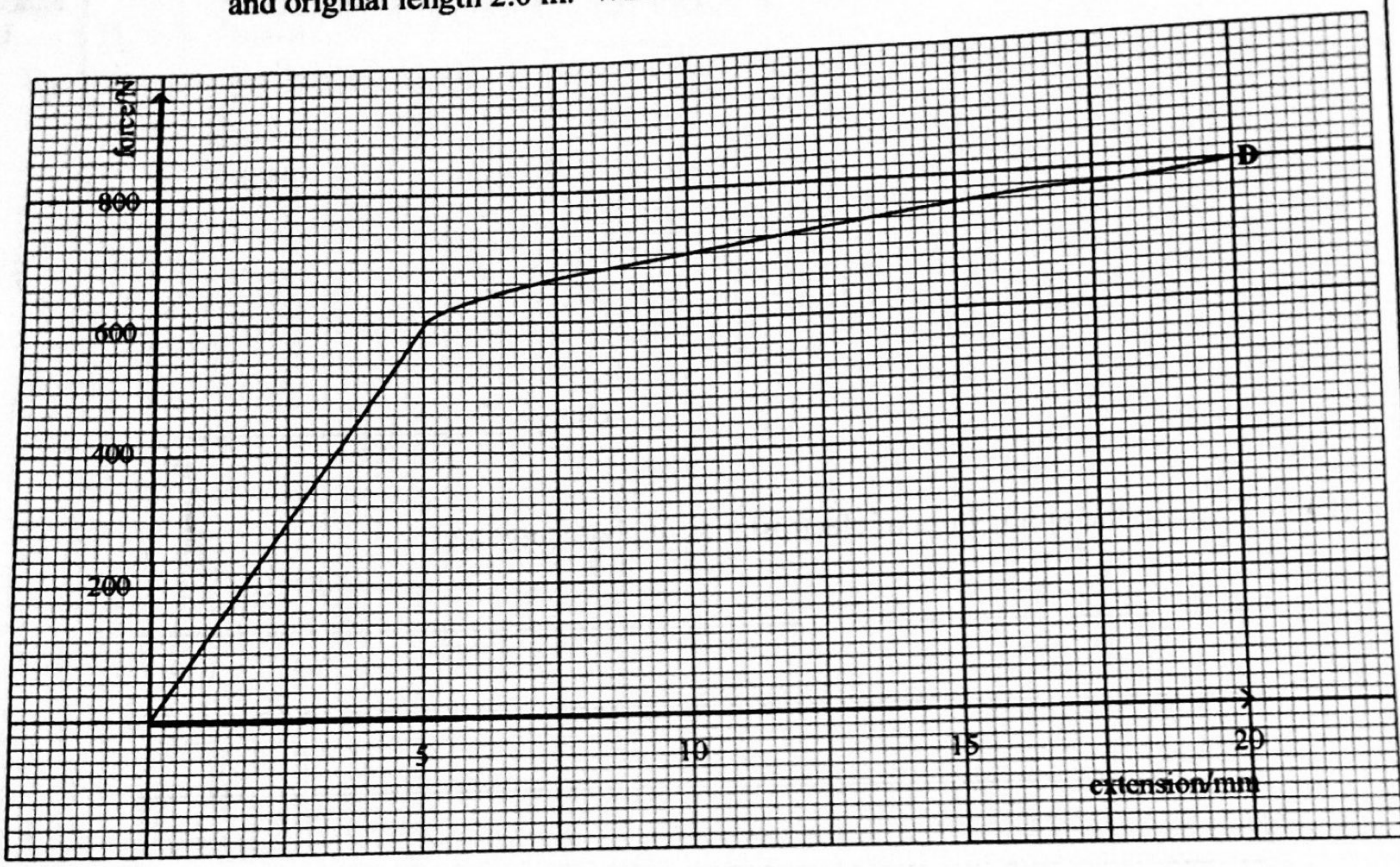

Fig. 4.1

Determine, from the graph, the

(i) value of the maximum tensile force,

____

For Examiner's Use

(ii) work done in breaking the wire,

(iii) Young modulus for the metal of the wire,

(iv) elastic potential energy stored in the block assuming its limit of proportionality is not exceeded.

[8]

For Examiner's Use

5 **(a)** Explain the formation of

(i) line emission spectra,

____

____

____

____

(ii) line absorption spectra.

____

____

____

____ [4]

(b) **Fig. 5.1** shows an energy level diagram of an atom **X**.

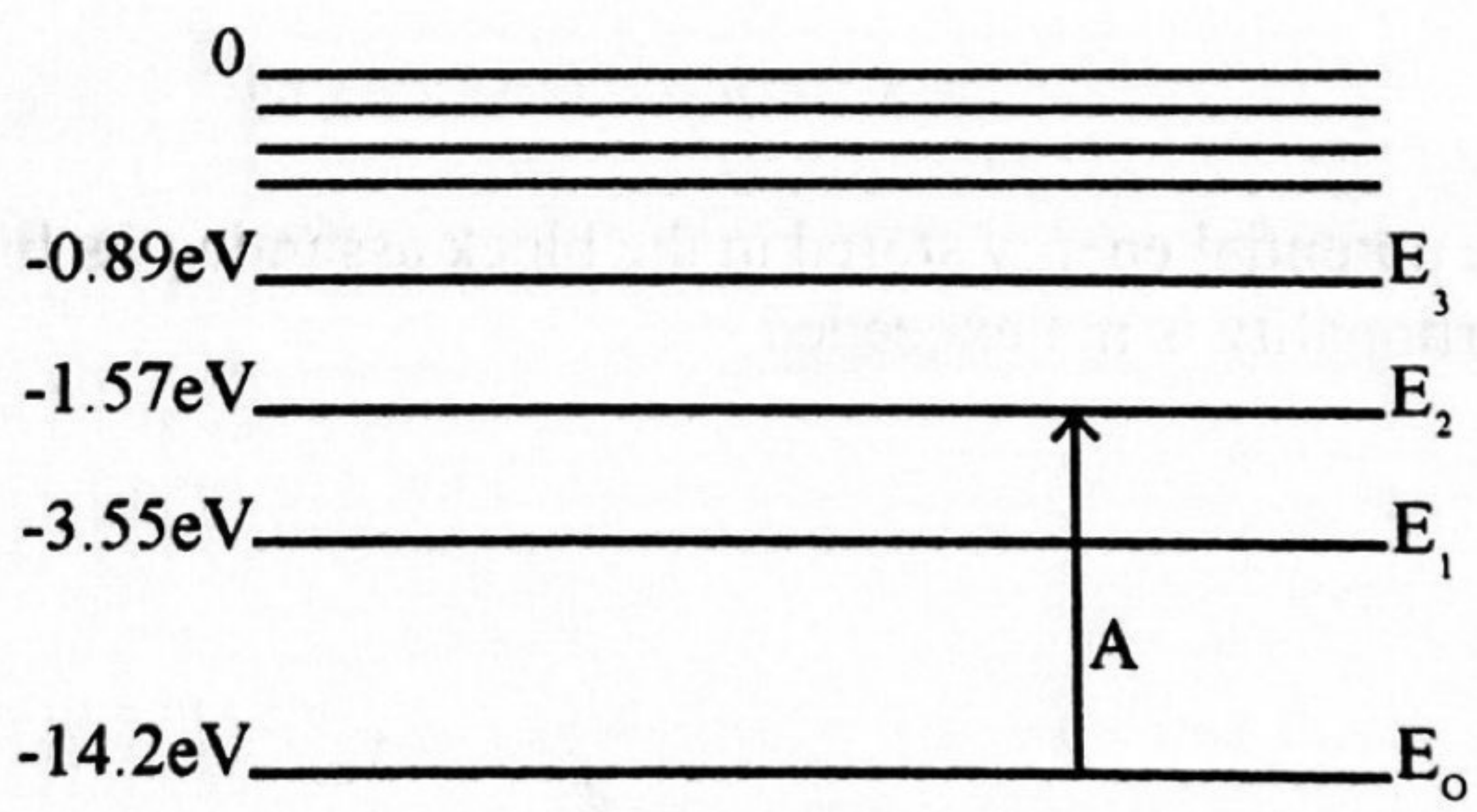

Fig. 5.1

Calculate, using Fig. 5.1, the

(i) **ground state energy,**

(ii) **excitation energy of the electron represented by transition A, in Joules,**

(iii) **wavelength of the emitted radiation when the electron returns to ground state.**

[4]

Ex

(c) Explain why energy levels in Fig. 5.1 are given with negative values.

____

____

____

____

____

____ [2]

6 (a) A sample of Technetium $^{99}_{43}Tc$ is to be used for medical diagnosis in thyroid of a patient. The isotope has a half life of 6 hours. The sample is to be given to the patient when its activity is $1.36 \times 10^{19}\ s^{-1}$.

(i) Calculate the mass of $^{99}_{43}Tc$ in the sample at the time it is given to the patient.

(ii) Suggest any **one** advantage and any **one** disadvantage of using the sample for medical diagnosis in the patient.

1. *advantage*

____

____

____

2. *disadvantage*

____

____

____

(iii) Explain why alpha radiation will be more ideal for medical diagnosis in the patient.

____

____

______________________________ [8]

(b) State any **two** safety precautions taken when using radioactive materials in the laboratory.

1. ______________________________

____

2. ______________________________

______________________________ [2]

Exar

Candidate Name

Centre Number

Candidate Number

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

PHYSICS

PAPER 2

6032/2

NOVEMBER 2020 SESSION **1 hour 30 minutes**

Candidates answer on the question paper.
Additional materials:
Electronic calculator

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the spaces at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided on the question paper.
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FOR EXAMINER'S USE	
1	
2	
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4	
5	
6	
TOTAL	

This question paper consists of 18 printed pages and 2 blank page.

[Turn over

For Examiner's Use

1 **(a)** Distinguish between a *scalar* and a *vector* quantity.

____

____

____

____ [2]

(b) **Fig. 1.1** shows a ball leaving point **P** at the edge of a cliff with a horizontal velocity of 18 ms^{-1}.

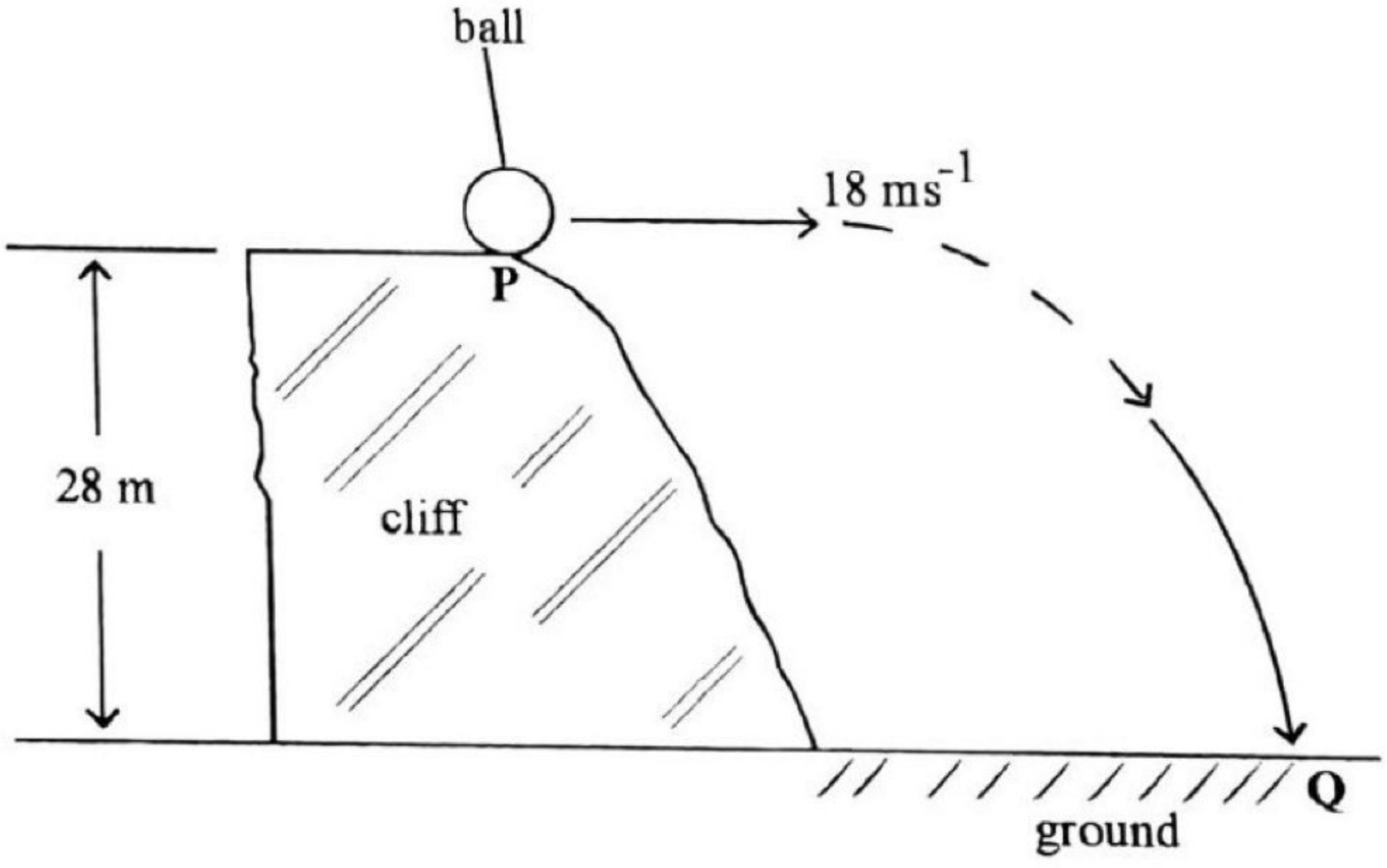

Fig. 1.1

(i) Assuming negligible air resistance, calculate the vertical velocity of the ball just before impact with the ground at **Q**.

For Examiner's Use

(ii) Show that the time taken for the ball to fall to the ground is approximately 2.4 s.

(iii) Calculate the horizontal displacement of the ball at point **Q** from **P**.

displacement = ______________

(iv) Explain why the distance travelled by the ball is different from the magnitude of the displacement of the ball.

____

____

____

[8]

For Examiner's Use

2 (a) A spacc rockct has an upthrust of 3.6×10^7 N. Thc spacc rockct cxpcll gascs at a ratc of 900 kgs^{-1}.

Calculatc thc spccd at which propcllant gascs arc cxpcllcd.

spccd ________________ [2]

(b) Thc air in a car tyrc has a volumc of $7.8 \times 10^3 cm^3$. Thc tyrc suddcnly bursts whcn thc air cxpands to 2.5 timcs its original volumc in a timc of 2.5 ms.

[Atmsophcric prcssurc is 1.0×10^5Pa.]

Calculatc thc

(i) work donc by thc air in thc tyrc during cxpansion,

workdonc ________________

(ii) mcan powcr dissipatcd during thc bursting of thc tyrc.

mcan powcr ________________ [3]

(c) **Fig. 2.1** shows the displacement – time graph for a loaded spring when it is displaced and allowed to vibrate.

For Examiner's Use

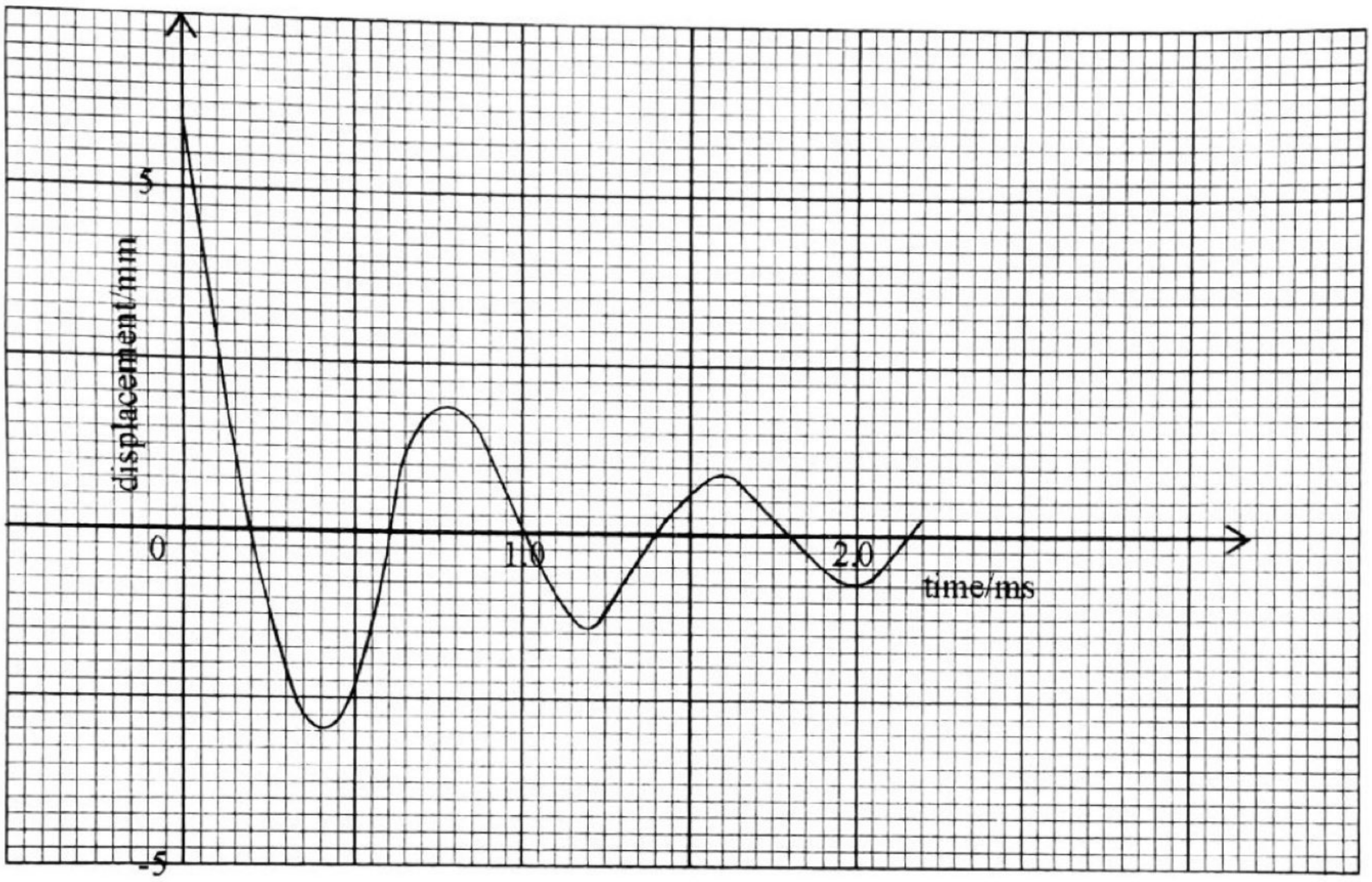

Fig. 2.1

(i) State the feature on the graph which suggests that the oscillations are

1. simple harmonic,

____

____

2. damped.

____

____

[Turn over

For Examiner's Use

(ii) Calculate the

1. natural frequency of oscillation of the spring,

natural frequency ______________

2. maximum acceleration of the oscillating spring during the time interval shown in **Fig. 2.1**.

acceleration ________________ [5]

For Examiner's Use

3 (a) State the instrument used to measure the speed of water at different depths.

____

____ [1]

(b) Given that the total pressure and static pressure at a certain depth are 6.31×10^6 Pa and 3.42×10^5 Pa respectively. The fluid in motion is water of density 1 000 kgm^{-3}.

Calculate the

(i) dynamic pressure of the water,

(ii) velocity of the water,

[3]

For Examiner Use

(c) **Table 3.1** shows values of specific latent heat and specific heat capacities of ice, water and copper.

Table 3.1

substance	specific heat capacity C/J Kg^{-1} K^{-1}	specific latent heat	
		l_v/Jkg^{-1}	l_f/Jkg^{-1}
ice	2100		3.25×10^5
water	4200	2.25×10^6	
copper	3800		

A well insulated copper calorimeter of mass 135 g contains 45 g of ice and 115 g of water, initially at 0°C.

Steam at 100°C is blown through the water until the temperature of water is 41°C.

Calculated the

(i) heat gained by calorimeter,

heat gained = ____________________

(ii) mass of steam that must have condensed.

For Examiner Use

mass = ____________________

(iii) Suggest **one** source of error in the experiment.

____

____

____

[6]

4 **Fig. 4.1** shows the force-extension graphs for two materials **A** and **B**.

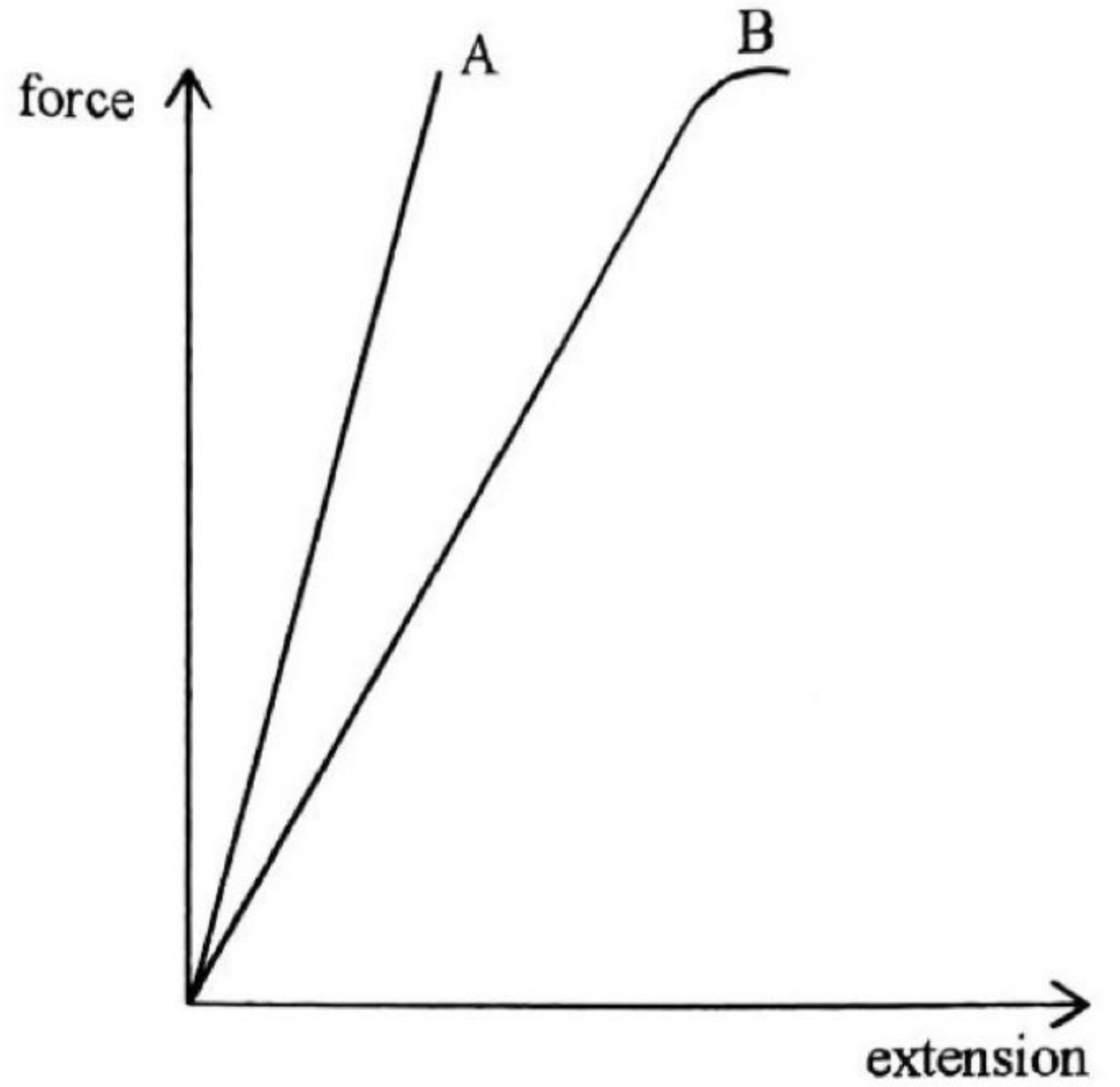

Fig. 4.1

(a) State the material which is

(i) brittle,

____

____

(ii) ductile.

____

____ [2]

(b) Explain why in plastic deformation, the material does not regain its original dimensions.

____

____

____ [1]

For Examiner's Use

(c) A selected flask of volume 75 cm^3 contains hydrogen gas at a pressure of 8.8×10^3 Pa and a temperature of 35°C.

Calculate the

(i) number of molecules of hydrogen gas in the flask.

number of molecules = ________________

(ii) r.m.s speed of hydrogen molecules in the flask, given that hydrogen has a molar mass of 2.0×10^{-3} kg.

r.m.s speed = ________________

(iii) pressure of hydrogen molecules in the flask if its temperature is increased to 75°C.

pressure = ____________

[7]

5 (a) **Fig. 5.1** shows a mass spectrometer consisting of an ion generator, velocity selector and ion separator, all placed in a vacuum. The distance between the plates is 2.0 cm.

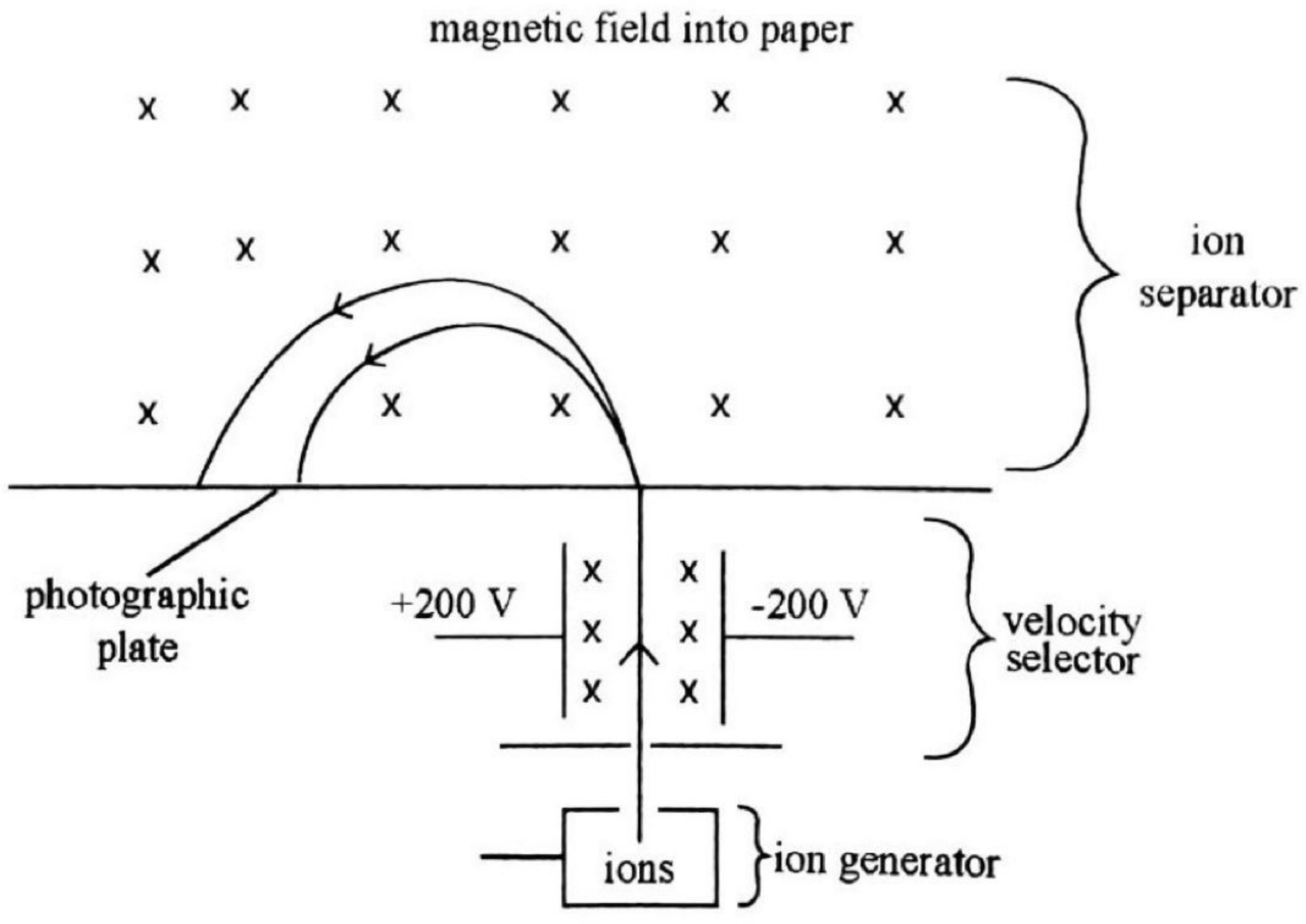

Fig. 5.1

(i) Calculate the magnetic flux density required to select ions of speed 190 kms^{-1}.

Magnetic flux density = ______________

After leaving the selector, the ions are separated using a magnetic field only as on **Fig 5.1**.

(ii) Show that the radius of the path is proportional to the mass of the ion.

[4]

For Examiner's Use

(b) **(i)** The conventional notation for an isotope of bromine is $^{81}_{35}Br$.

Deduce the binding energy per nucleon for bromine in MeV.

[Nucleus mass = 80.8971u; proton mass = 1.0073u; neutron mass = 1.0087u].

(ii) Comment on the stability of the atom.

[6]

6 **Fig. 6.1** shows an op-amp circuit.

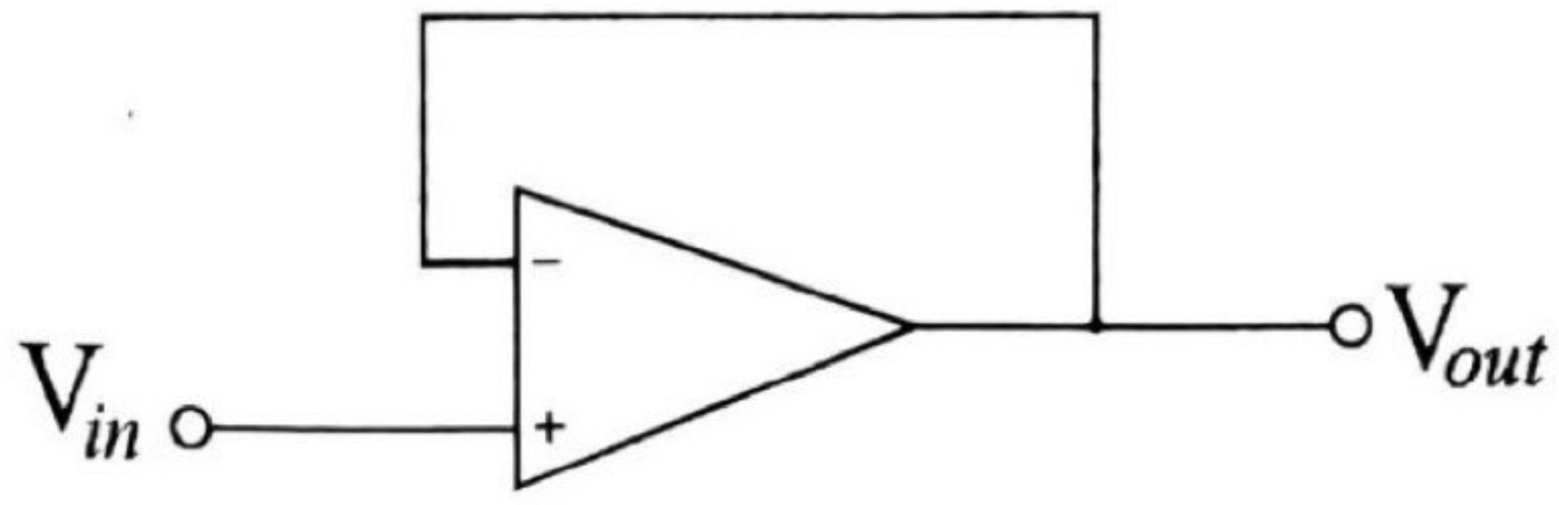

Fig. 6.1

(a) **(i)** Name the circuit shown in **Fig. 6.1**.

____

(ii) State the gain of the op-amp.

____

An analogue voltmeter reads 1.50 V when connected across a torch cell but a digital voltmeter connected across the same cell reads 1.63 V.

(iii) Explain this observation.

____

____

____

(iv) Sketch a diagram to show how the op-amp of **Fig. 6.1** and an analogue voltmeter can be used to give the same reading of voltage as that shown by the digital voltmeter.

[5]

(b) Define *frequency modulation*.

____

____

____ [1]

(c) A coaxial cable has input power of 480 mW and output power 0.12 mW. Its attenuation per unit length is 8.0 dB km^{-1}.

Determine the,

(i) reduction in signal power,

(ii) maximum unbroken length of this cable.

[4]