G.C.E. (Advanced Level) Examination - April 2002

PHYSICS - I

Provisional Scheme of Marking

2002 Answers

Q					
01	1	2	3	X	5
02	1	2	3	4	X
03	1	2	3	X	5
04	X	2	3	4	5
05	1	2	X	4	5
06	1	2	3	X	5
07	1	X	3	4	5
08	1	2	3	4	X
09	X	2	3	4	5
10	1	2	3	X	5
11	1	X	3	4	5
12	1	2	X	4	5
13	1	2	X	4	5
14	1	2	X	4	5
15	1	2	3	X	5
16	1	X	3	4	5
17	X	2	3	4	5
18	X	2	3	4	5
19	1	X	3	4	5
20	1	2	X	4	5
21	1	2	3	4	X
22	1	2	X	4	5
23	1	2	3	X	5
24	X	X	X	X	X
25	1	X	3	4	5
26	1	2	3	4	X
27	1	2	X	4	5
28	1	2	3	X	5
29	1	X	3	4	5
30	1	2	X	4	5
31	1	2	X	4	5
32	1	2	X	4	5
33	X	2	3	4	5
34	1	2	3	X	5
35	1	X	3	4	5
36	X	2	3	4	5
37	1	X	3	4	5
38	X	2	3	4	5
39	1	2	X	4	5
40	1	2	X	4	5
41	1	2	3	4	X
42	1	2	3	X	5
43	1	X	3	4	5
44	X	2	3	4	5
45	1	X	3	4	5
46	X	2	3	4	5
47	1	2	3	4	X
48	1	2	3	4	X
49	1	2	3	4	X
50	1	X	3	4	5
51	1	2	3	X	5
52	X	2	3	4	5
53	1	2	3	X	5
54	1	2	3	X	5
55	1	2	X	4	5
56	1	2	3	4	X
57	X	X	X	X	X
58	X	2	3	4	5
59	1	2	X	4	5
60	1	X	3	4	5

G.C.E. (Advanced Level) Examination - April 2002
PHYSICS - II
Provisional Scheme of Marking

A - PART

01. (a) (i) 0.95 mm or $\frac{19}{22}$ mm 01

(ii) 0.05 mm or 0.005 cm 01

(iii) 0.05 mm or 0.005 cm

(b) (i) d_1 - External Jaws 01
(ii) h_1 - External Jaws 01
(iii) d_2 - Internal Jaws 01
(iv) h_2 - Depth bar 01

(c) $V = \frac{\pi d_1^2 h_1 - \pi d_2^2 h_2}{4}$ or $\frac{\pi(d_1^2 h_1 - d_2^2 h_2)}{4}$

or $\pi\left(\frac{d_1}{2}\right)^2 h_1 - \pi\left(\frac{d^2}{2}\right)^2 h_2$

(d) (i) 1.665 cm or 16.65 mm

(ii) $\frac{0.005}{1.665}$ or $\frac{0.05}{16.65}$ or $\frac{5}{1665}$ or $\frac{1}{333}$ or 0.003

02. (a) The rmometer, Balance (chamical, Electronic, three beam, four beam balance) 01

(b) (i) Mass of empty calorimeter (m_1)
(ii) Mass of calorimeter (m_2)
(iii) Initral temperature (θ_1)
(iv) Final temperature (θ_2)
(v) Mass of calorimeter + Water + nails (m_3)
(all correct 02 any three - 01)

(c) $(m_3 - m_2)(100 - \theta_2)\left[\frac{30}{100} C_P + \frac{70}{100} C_m\right]$

$= [m_1 C_M + C_w (m_3 - m_1)](\theta_2 - \theta_1)$

LHS 01
RHS 01
equating terms 01

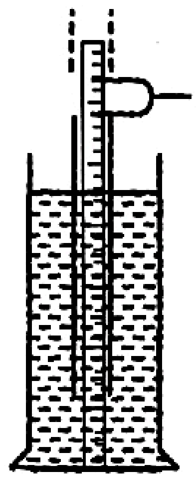
(d) (i) Heat loss from nails when transferring to water
(ii) Heat loss from the system
(iii) Heat loss from the calorimater to surroundings
(iv) Heat loss due to convenction / conduction (Any one) 01

(e) (i) Transfer the nails quickly or
Bring the calorimeter to nails at 100 °C
(ii) Cover the calorimeter with an insulating material or
Use a cooling correction or
Redus the initial temperature of water by a few degrees before starting the experiment. 01

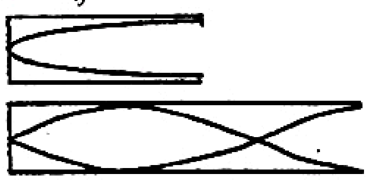
(f) No
Reasons - Nails may not properly cover with water
- Then nails may not mix properly with water
- Heat loss to surrounding may be large
- Water may not absorb all the heat from nails
- Evaporation of water is possible
- final temprature may not be accurate.

(g) Heat tranfer from plastic in nails will take place quickly
OR
Reduce the heat loss to surroundings OR
Thermal conductivity of plastic is low
anyone 01

03. (a)



(b) Start with the lowest length of the air column. or fully immesed tube. Hold the vibrating tuning fork as shown and increase the length of the oir column or pull the tube out until maximum sound is heard or resonance is obtained.
(c) Seale readings at water level and open end of the tube. 01
(d) $\ell = n\lambda / 4$ 01
(e) $\ell = n\frac{v}{4f}$ 01
(f)



both corret 01

(g) standing wave 01
(h) $\ell + \varepsilon = n\frac{v}{4f}$ 01

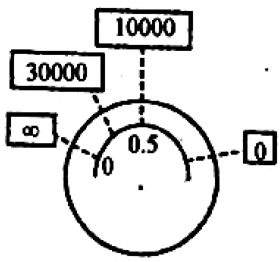
(i) $0.15 + \varepsilon = \frac{V}{4 \times 512}$ $15 + \varepsilon = \frac{v}{4 \times 512}$

OR

$0.48 + \varepsilon = \frac{3V}{4 \times 512}$ $48 + \varepsilon = \frac{3V}{4 \times 512}$

$V = 338 mS^{-1}$ (337.8 - 338.0) or $V = 33792\ cmS^{-1}$ (33790 - 33800) 01

04.



(a) (i) $E = I(25+s)$ or $10 = 10^{-3}(25 + S)$ 01

$S = 9975\Omega$ 01

(ii) short circuit (x and y) or connect x - y by a thick wire (or conductor) OR using a variable resistor and make $R = 0$ 01

(b) (i) $I = o$ OR no current through the milliameter 01

(ii) open circuit (x and y) or without connecting x = y OR remove R, or remove the infinity key of a resistane box (concted across x - y) 01

(c)Half the full scale deflection

$$10 = \frac{1}{2} \times 10^{-3}(25 + 9975 + R)$$

$$20000 = R + 10000$$

$$R = 1000\Omega$$ 01

Quarter of the full scale deflcetion

$$10 = \frac{1}{4} \times 10^{-3}(25 + 9975 + R)$$

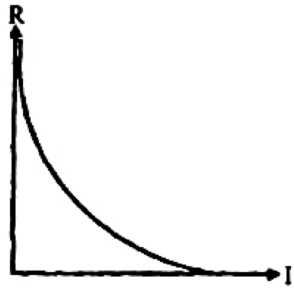
$$40000 = 10000 + R$$

$$R = 30000\Omega$$ 01

(d) (i) ohm - meter 01

(ii) linear } non linear } 01

(iii)



01

PART B

01. (i) (a) Applying

$V^2 = U^2 + 2aS$

$5^2 = 2a \times 5$ 01

$a = 2.5\ ms^{-2}$ 01

(b) $v = u + at$

$5 = 2.5\,t$ 01

$t = 2S$ 01

Alternative method

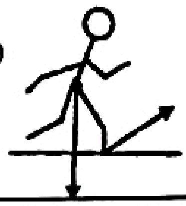
$S = t\left(\frac{u+v}{2}\right)$

$5 = \frac{5t}{2}$ or $5 = 2.5\,t$ 01

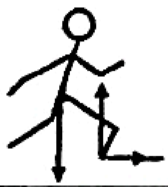
$t = 2S$ 01

(c) Pushing or pressing the toes on the floor of the platform/ Pushing or pressing the floor of the platform/ By exerting a force on the floor of the platform/ Through friction between the toes and the floor of the platform. 01

(d)



OR



01

(ii) (a) Applying $\downarrow S = ut + \frac{1}{2}at^2$

$7.2 = \frac{1}{2} \times 10t^2$

$1.44 = t^2$

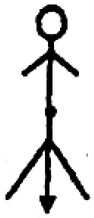
$t = 1.2s$ 01

(b) Applying $\rightarrow$ $S = ut$

$S = 5 \times 1.2$

$S = 6m$ 01

(c)



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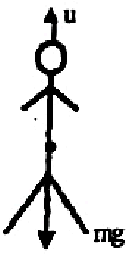
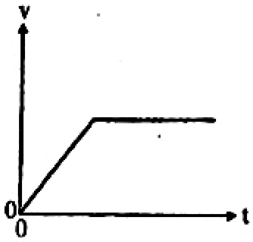


01

(iii)



01

(iv) (a) Applying $\downarrow V^2 = u^2 + 2aS$

$V_y^2 = 2 \times 10 \times 1.25$

$V_y = 5ms^{-1}$

$V = \sqrt{5^2 + 5^2}$

$V = 5\sqrt{2}ms^{-1}\left(7.0 - 7.1ms^{-1}\right)$ 01

$\tan\theta = \frac{5}{5}$

$\tan\theta = 1$

$\theta = 45^\circ$ 01

(b) Centripetal acceleration $= g\sin\theta$

$10\sin 45^\circ$

$10 \times \frac{1}{\sqrt{2}}$

$\frac{10}{\sqrt{2}}ms^{-2}$ or $5\sqrt{2}ms^{-2}$ or $(7.0 - 7.1)ms^{-2}$ 01

(c) $g\sin 45 = \frac{V^2}{r}$, $mg\sin 45^\circ = \frac{mV^2}{r}$ or $50g\sin 45^\circ = \frac{50V^2}{r}$

$5\sqrt{2} = \frac{50}{r}$

$r = 7.07m$ or $(7.0 - 7.1)m$ 01

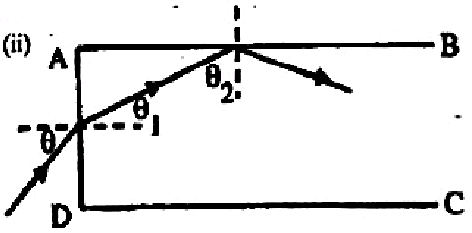
02. (i) $n = \frac{1}{\sin c}$

$\sin c = \frac{1}{n}$

$C = \sin^{-1}\left(\frac{1}{1.6}\right)$

$C = 38^{\circ}\ 41'\ (\pm 6')$ 01

(ii)



For total internal reflection at AB, θ_2 must be greater than the critrcal angle OR the value obtained in (i) above OR θ_2 minimum $= 38^{\circ} 41'$) 01

ot have total internal reflection at AB, θ_1 must be less than $90 - 38^{\circ}41' = 51^{\circ}19'$ 01

However the maximum posisible value for θ_1 which occurs when $\theta = 90^{\circ}$ is $38^{\circ}41'$ (critical angle) and it is less than $51^{\circ}19'$. 01

Therefore the ray always undergoes tatal internal reflection at AB

[OR θ maximum is 90° and therefore θ_1 maximum = Critical Angle $38^{\circ}41'$]

θ_2 minimum $= 90 - 38^{\circ}41' = 51^{\circ}19'$ 01

Therefore θ_2 is always greater than the critrcal Angle ($38^{\circ}41'$) Hence total internal reflaction) 01

(iii) $n_1 \sin\theta_1 = n_2 \sin\theta_2$

$1.6 \sin\theta_1 = 1 \times \sin 30^{\circ}$

$\sin\theta_1 = \frac{1}{2 \times 1.6}$

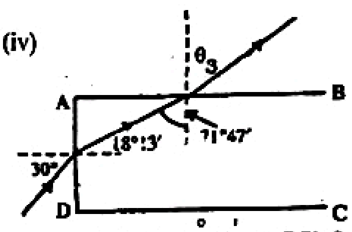
$\theta_1 = \sin^{-1}\left(\frac{1}{3.2}\right)$

$\theta_1^1 = 18^{\circ}13'\ (\pm 6')$ 01

$\theta_2 = 90^{\circ} - 18^{\circ}13'$

$= 71^{\circ}47'\ (\pm 6')$ 01

(iv)



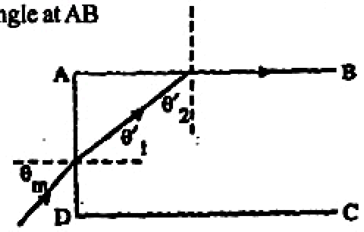
$1.6 \sin 71^{\circ}47' = 1.7 \sin\theta_3$ 01

$\sin\theta_3 = \frac{1.6 \sin 71^{\circ}47'}{1.7}$

$\theta_3 = 63^{\circ}23'\ (\pm 6')$ 01

Ray diagram 01

(v) (a) Consider the limiting case when θ_2' is the new critical angle at AB



$1.5 \sin 90^{\circ} = 1.6 \sin\theta_2'$ 01

$\theta_2' = 69^{\circ}38'$

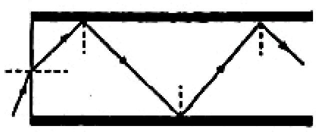
$\theta_1' = 90^{\circ} - 69^{\circ}38'$
$= 20^{\circ}22'$

of AD, $\sin\theta_m = 1.6 \sin\theta'_1$ or $\sin\theta m = 1.6 \sin 20^{\circ}22'$ 01

$\theta_m = 33^{\circ}50'\ (\pm 6')$ 01

if $\theta > \theta m$, θ_1' is larger and θ'_2 is smaller than the critical angle and the ray leaves the material or ray is refracted at AB or ray does'nt undergo total internal reflection or if the ray is drawn correctly. 01

(b)



For the refraction and first reflection 01

Showing at least one more total internal reflection incicating the ray propagates along the tube. 01

03. (i) (a) $E = \frac{V}{d}$ 01

From A to B in AB or ⟶ at AB or $\overline{AB}$

From C to D in CD or ⟶ at CD or $\overline{CD}$ 01

(b) Energy at B = qv 01

Let V_b be the speed of the proton of B

then $\frac{1}{2} m v_b^2 = qv$

$v_b = \sqrt{\frac{2qv}{m}}$ 01

$F = qE$

$F = \frac{qv}{d}$

$F = ma$

$\frac{qv}{md} = a$

$V^2 = u^2 + 2as$

$V_b^2 = 2\frac{qv}{md} = d$

$V_b = \sqrt{\frac{2qv}{m}}$ 01

(ii) (a) Let B the magnetic flux density along path BC

then $qv_b B = \frac{mV_b^2}{r}$

$\therefore B = \frac{mV_b}{rq}$

$B = \frac{m}{qr}\sqrt{\frac{2qV}{m}}$ or $\frac{1}{r}\sqrt{\frac{2mv}{q}}$

Direction of B - into the paper or marked as ⊗ 01

(b) Speed of the proton at C = V_b or same as in (i) or $\sqrt{\frac{2qv}{m}}$ 01

Reason - Magnetic force is perpendicular to the direction of motion of the proton or magnetic force does not do any work on the proton.
and proton exceed a cercular motion the tangent speed to the same. 01

(iii) (a) New energy at D, 2qv or qv + $1/2 mV_b^2$

Let V_d be the speed of the proton at D

then $\frac{1}{2} m v_d^2 = 2qv$

$v_d = \sqrt{\frac{4qv}{m}}$ or $2\sqrt{\frac{qv}{m}}$ 01

(b) No

Let B' be the magnetic flux density along path DA

then $B' = \frac{m v_d}{rq}$

$B' = \frac{m}{qr}\sqrt{\frac{4qv}{m}}$ or $\frac{2}{r}\sqrt{\frac{mv}{q}}$

(iv) Allow the proton to repeat the above motion while providing necessary magnetic field to keep the radius of the orbit fixed. 01

(v) No

Allow the proton to trarvel in vacuum 01

04. (i) (a) If reduces air pollution

If removes particulate matter from combustion gases.

If removes ash and dust from smoke.

To keep the environment clean. Any one 01

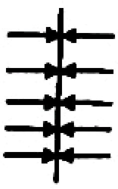
(b) yes. modern devices are able to eliminate more than 99% of the ash and dust from smoke. 01

(ii) Negative (-) Potential 01

(iii) For safety , To prevent etectric shocks

To prevent electricity leakages. Any one 01

(iv)



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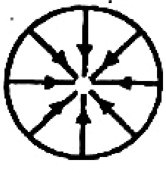


01

(v) Yes, there is a current due to the motion of ions electrons between the wire and the cylinder. 01

(vi) To prevent overloading the plant.

To avoid blocking the outgass channel of the plant

To avoid bake - pressure on the outlet channel

Hot gasses move up rather than down any one 01

(vii) To allow dirt particles / pollutants to get stick onto the outer wall,

To drow. to accelerate dirt particles/ pollutants / negative ions. electrons towards the outer wall)

To produce negative ions from dirt particles.

Make use of the electrons generated around the wire in order to ionise dirt particles

(To earn this mark the answer of part (ii) should be correct)

(viii) electron achieves a higher acceleration 01

Both electron and O_2^- ions experience the same force but mass of the electron is less than that O_2^- ion is heavier than the electron. 01

(ix) Due to (i) cosmic rays

(ii) Radioctivity/ Radioactive elements / (α / β / γ rays)

or lighting

or corona discharge due to pointed objects under high electric field (from thunder clouds)

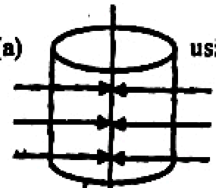
or charging due to frictional motion 01

(x) $V = \frac{5\lambda}{2\pi\varepsilon_0}$

$90 \times 10^3 = 18 \times 10^9 \times 5\lambda$

$\lambda = 10^{-6}\ Cm^{-1}$

(xi) (a)



using gauss theorem $[EA = \frac{Q}{\varepsilon}]$

$E \times 2\pi r = \frac{\lambda}{\varepsilon_0}$ or $E \times 2\pi r l = \frac{\lambda l}{\varepsilon_0}$ 01

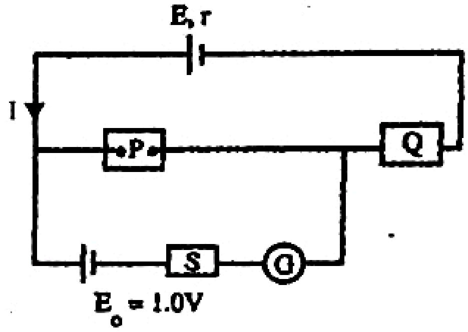
(b) $E = \frac{\lambda}{2\pi\varepsilon_0 r}$

$E = \frac{18 \times 10^9 \times 10^{-6}}{10^{-3}}$

$E = 1.8 \times 10^7\ Vm^{-1}$

(This value is greater than the breakdown valtage of 3 x 10 Vm^{-1})

05. (a)



(i) when the current through the galvonomoter is zero

$E = I(P + Q + r)$ - (1)

$E_0 = IP$ (2)

$\frac{E}{E_0} = \frac{P+Q+r}{P}$ eq (1)

$P = 20\Omega$ and $Q = 17\Omega$

$\frac{E}{1.0} = \frac{20+17+r}{20}$ eq (2)

$P = 40\Omega$ and $Q = 35\Omega$

$\frac{E}{1.0} = \frac{40+35+r}{40}$ eq (3)

Alternative method

current through P, $I = E_0/p$ 01

$E - Ir = I(P + Q)$ 01

$E = \frac{1}{20} r = \frac{1}{20} \times 37$ eq (2) 01

$E - \frac{1}{40} r = \frac{1}{40} \times 75$ eq (3)

from eq (2) and eq (3)

$\frac{37+r}{20} = \frac{75+r}{40}$

$74 + 2r = 75 + r$

$r = 1\Omega$

$(r \pm 0.2)\Omega$

eq(3) ⇒ $E = \frac{75+1}{40}$

$E = \frac{76}{40}$

E=1.9V

$(E \pm 0.1)V$ 01

(ii) When P is replaced with a Nicrome wire of resistance R and Q = 53

eq(1) ⇒ $\frac{1.9}{1.0} = \frac{R+53+1}{R}$

$1.9R = R + 54$

$0.9R = 54$

$R = 54 / 0.9$

R = 60Ω

$(R \pm 1)\Omega$ 01

Resistivity ρ is given by

$\rho = \frac{RA}{l}$ or $R = \rho \frac{l}{A}$ 01

$\rho = \frac{60 \times (3 \times 10^{-7})}{10}$ 02 (one mark corred unit)

$\rho = 1.8 \times 10^{-6}\ \Omega m$

$(\rho \pm 0.1 \times 10^{-6})\Omega m$

Current througt the nicrome wire is given by

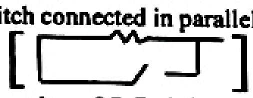
$I = \frac{E_0}{R} = \frac{1.0}{60}$

$I = 0.017A$ or $I = (17 \pm 1)mA$ 01

$(0.017 \pm 0.001)A$

(iii) To protect the galvonometer and standard cell from excess current. 01

Variable resistance / resistance box / rheostat / high resistance with a switch connected in parallel or shown in a diagram

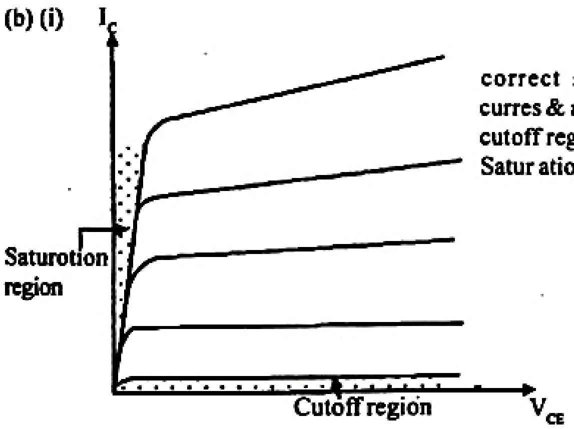


01

With high value of S find the rough balance point, Then reduce S 01

or short circuit S to find the blance point a ccurately. 01

(b) (i)



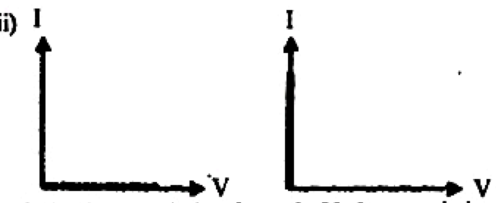
correct shape of curres & axes 01

cutoff region 01

Satur ation region 01

(ii) I_B OR Base current or I_B values marked along with the above curves 01

(iii)



I - V characteristic of an open switch

I - V characteristic of an closed switch

Open switch characteristic resembles that corresponding of cutoff region & closed characteristic resembles that corresponding to saturation region. (or shown on the graphs) 01

(iv) Output voltage $V_0 = 0$ (or 0.1v) 01

Collector current $I_C = \frac{5}{500}$ or $\frac{5-0.1}{500}$

$I_C = 10^{-2}$ A or 10mA or 9.8mA

(v) $\beta I_B = 50 \times 300 \times 10^{-6}$

$= 15mA$ 01

$\therefore I_C < \beta I_B$

(vi) $I_C = \beta I_B$

Assume that the transister operates in the active region

when $R_C = 200\ \Omega$

Then $I_C = 50 \times 300 \times 10^{-6}$

$= 15 \times 10^{-3} A$ (15mA)

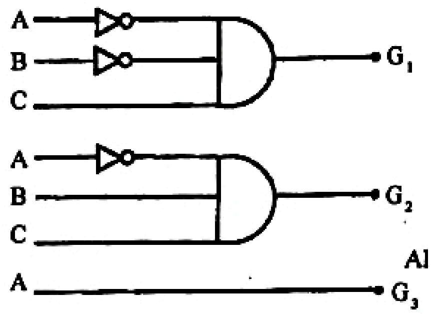
$\therefore$ Voltage across $R_C = 15 \times 10^{-3} \times 200$

$= 3V$ 01

$\therefore$ Collector voltage V_C (V_{CE}) = 5 - 3 = 2V >>0 (or 0.1V) 01

$\therefore$ Transistor operates in the active region.

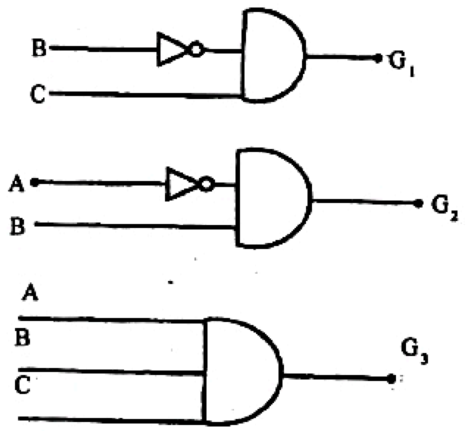
(vii)



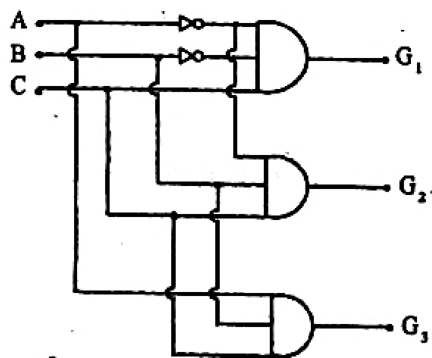
All correct 02

Any one 01

OR



OR



06. (a) (i) $\frac{\theta}{t}$ - Rate of flow of heat OR heat flow Per second or unit time 01

$\frac{\theta_1 - \theta_2}{d}$ Temperature gradient

Temperature difference per unit length 01

(ii) Under steady state condition and axial flow 01

(iii) A - Surface Area at the bottom surface of the ice layer.

∴ Volume of the ice corresponding to a thickness of 1mm.

$= A \times 1 \times 10^{-3}$ 01

∴ mass of the ice $= A \times 1 \times 10^{-3} \times 900$ ($AV\rho = m$) 01

If t is the time taken of grow the 1mm thick layer then

$$kA\frac{(\theta_2 - \theta_1)}{d} \times t = mL$$

$$A \times \frac{2 \times 50}{50} \times t = A \times 1 \times 10^{-3} \times 900 \times 3.6 \times 10^5$$ 01

$t = 45$ hrs or 1.62×10^5 S 01

(iv)(1) In order to stop the growth of the ice layer heat should be supplied at the same rate at which heat flows out through the ice layer.

The rate at which heat should be provided

$$\text{Per unit area} = K\frac{(\theta_2 - \theta_1)}{d}$$

$$= \frac{2 \times 50}{50}$$

$$= 2\ Wm^{-2}$$

(2) Net rate of out word flow of heat $= 2 - 0.5$

$= 1.5$ 01

Amount of heat flows out per unit Area in 2 days

$= 1.5 \times 2 \times 24 \times 3600$ 01

$= 1 \times \ell \times 900 \times 3.6 \times 10^5$ 01

($Q = mL$)

(l - is the thickness of the ice layer grown in 2 days)

$$\therefore l = \frac{1.5 \times 2 \times 24 \times 3600}{900 \times 3.6 \times 10^5}\ m$$

$= 0.8$mm

(OR total thickness of the ice layer after 2 days = 50.000 8m)

(b) (i) (1) Right on top of the longer leg 01

(2) The required weight should compress the longer leg by d = 0.1mm (0.0001m)

$$\therefore \text{Required weight } F = \frac{yAd}{l} \text{ or } F = \frac{yAd}{l+d}$$

$$F = \frac{(2.0 \times 10^{11})(1.0 \times 10^{-4}) \times (0.1 \times 10^{-3})}{1.0}$$

$F = 2000$N

(ii) (1) In order to keep the stand top Horizontial, each shorter leg must be compressed by the same amout (e) Then the longer leg must be compressed by an amount (e + d)

$$\therefore \text{force on each Short legs } F = \frac{yAe}{l}$$

$$F = \frac{(2.0 \times 10^{11}) \times (1 \times 10^{-4})e}{1.0}$$

$$F = 2.0 \times 10^7\, e \quad \text{——} \ (1)$$

$$\therefore \text{force on longer leg } F' = \frac{yA(e+d)}{l+d} \quad \text{or } F' = \frac{yA(e+d)}{l}$$

$$F' = \frac{(2.0 \times 10^{11}) \times (1.0 \times 10^{-4})(e + 0.0001)}{1.0 + 0.0001}$$

$$F' = 2.0 \times 10^7 (e + 0.0001) \quad \text{——} \ (2)$$

Considering forces in the vertical direction,

$3F + F' = W$ 01

using (1) eq and (2)

$3 \times (2.0 \times 10^7 \times e) + 2.0 \times 10^7 \times (e + 0.0001) = 4000$ 01

$4 \times 2.0 \times 10^7 e = 4000 - 2000$

$$e = \frac{2000 \times 10^7}{8}$$

$e = 250 \times 10^7$ m

decrease in length $e = 0.000025$m (0.025mm) of short leg 01

decrease in length $= (e + d) = 0.000125$m (0.125mm) of long leg 01

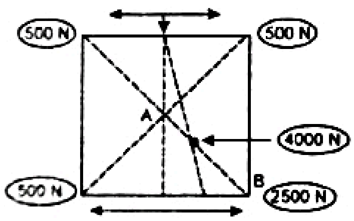
(2) eq (1) $F = (2.0 \times 10^7) \times (0.000025) = 500$V

∴ reaction on each smaller leg by the floor = 500N 01

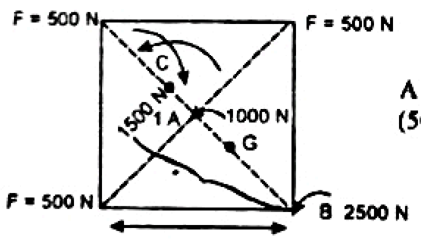
eq (2) $F' = (2.0 \times 10^7) \times (0.000125) = 2500$N

∴ reaction on longer leg by the floor = 2500N 01

(3)



There fore the weight of 4000W should be kept at the centre of AB 02



A ≅ 2000N

(500 + 500 + 500 + 500) N