G.C.E A / L Examination March - 2018

Conducted by Field Work Centre, Thondaimanaru

In collaboration with

FWC

Provincial Department of Education Northern Province

Grade:- 13 (2018)	***Physics***	***Marking Scheme***

	I	II	III	IV	V
1	4	3	2	1	4
2	5	4	4	3	2
3	2	5	3	4	5
4	3	2	3	3	3
5	2	2	2	2	2
6	5	2	1	2	5
7	4	3	5	3	1
8	4	3	2	1	1
9	5	3	2	1	5
10	5	2	1	1	2

Part 1 (M.C.Q)	100
Part 11 - A (St. Essay	40
Part 11 . B (Essay)	60
Total	200
Final	$\frac{200}{2} = 100$

Part II A

(1) (a) i) $d = \frac{L}{N}$ 1

ii) 100 1

(b) i) 0.01 mm 1

ii) $\frac{0.41 + 0.41 + 0.42 + 0.40 + 0.42}{5}$

$= 0.412$ mm

$d_{average} = 0.41$ mm 1

iii) zero error $= -0.03$ mm

∴ corrected reading $= 0.41 + 0.03$

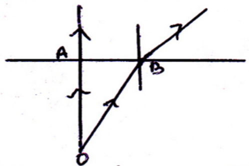
$= 0.44$ mm 1

iv) diameter of the spring (x) 1

Vernier callipper 1

v) $V = \pi \frac{d^2}{4} \cdot \pi x N$ 2

(2) (a) (i)



Drawing the paths — 1

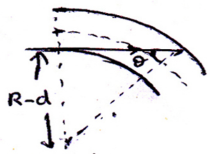
(ii) will undergo TIR — 1

(iii) ${}_{2}n_{1} = \frac{n_1}{n_2}$ — 1

(iv) $\frac{n_1}{n_2} = \frac{1}{\sin\theta_c}$; ${}_{2}n_{1} = \frac{1}{\sin\theta_c}$ — 1

(b) (i) 1.5

(ii)



$\sin\theta = \frac{R-d}{R+d}$ — 1

(iii) will decrease continuously — 1

(iv) No ray will escape when $\theta \geq \theta_c$ — 1

$\sin\theta \geq \sin\theta_c$

$\frac{R-d}{R+d} \geq \frac{1.44}{1.5}$

$\frac{R-d}{R+d} \geq 0.96$ $R \geq 490$ mm

$R_{min} = 490$ mm — 1

(v) For each application and the corresponding advantage — 1+1

(3) a) Instrument - Thermometer
apparatus - Stirrer } — 1

b) Heat the tube (using bunsen burner) and dip the open end in a vessel containing mercury and allow it to cool (for a short period) — 1

c) water vapor will be present if water is used instead .... — 1

(accept any other suitable answer)

d) In order to ensure the temperature of the dry air is same that of the water bath ... — 1

e) (i) selection of two points that intersects the grid } 1

gradient = 0.1 cm $°C^{-1}$ 1

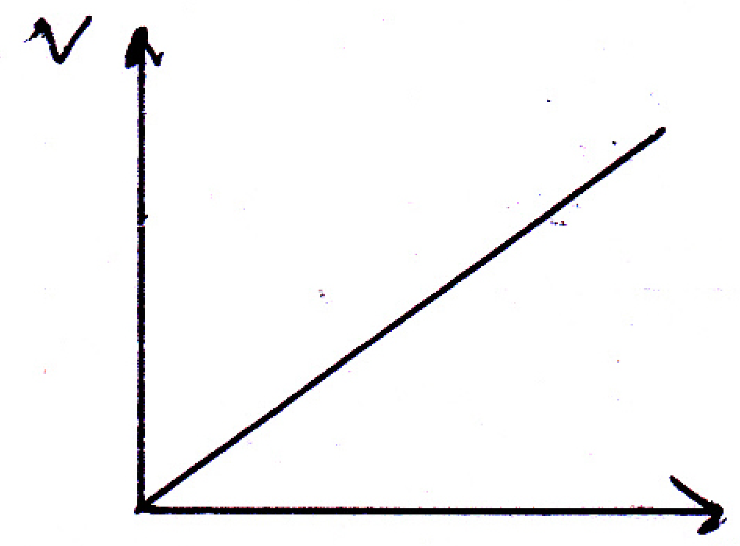
(ii) $0.1 = \frac{27}{x} \Rightarrow x = 270°C$ (To find the intercept) 1

Absolute zero temperature = $-270°C$
(Accept $-265 \rightarrow -275°C$)

(iii) reason: Volume is assumed to be proportional to the length (of air column)

property: uniform internal cross section / diameter 1

iv)



1

f) To increase the sensitivity of the tube /
To obtain a good distribution of experimental points 1

(4) (a) E_1 – should provide constant current, 1

PQ – possesses uniform cross sectional area/ thin wire with uniform diameter / uniform resistive wire 1

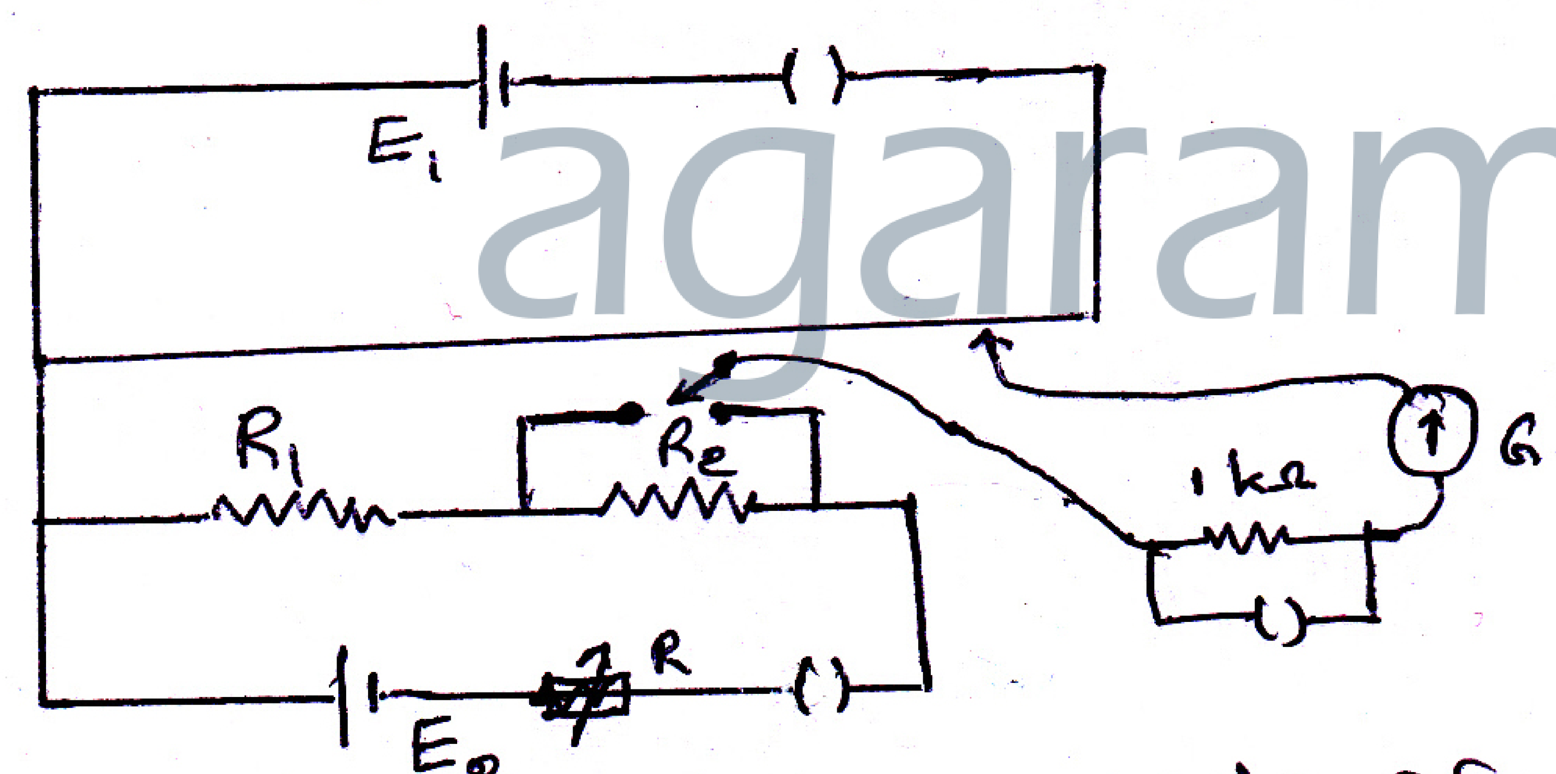
1

(b) (i) X 1

(ii) $\frac{V_1}{V_2} = \frac{R_1}{R_1+R_2}$ 1

(c) (i) in order to protect the galvanometer 1

(ii)



1

(iii) by touching the two ends of the potentiometer and check whether the deflections of the centre zero galvanometer are in the opposite directions } 1

d (i) $\frac{R_1}{R_1+R_2} = \frac{l_1}{l_2}$; $\frac{l_2}{l_1} = 1 + \frac{R_2}{R_1}$ 1

(ii) by changing the resistance of the resistance box; R 1

(iii) gradient of the l_2 vs l_1 graph is $1 + \frac{R_2}{R_1}$

$1 + \frac{R_2}{R_1} = 1.5$

$\frac{R_1}{R_2} = 2$ 1

Page 2

Part II B Essay

(5) (a) (i) $\tau = Fr$ ---------- 1

$\tau = I\alpha$ α - angular acceleration ---------- 1

$\alpha = \frac{Fr}{\frac{1}{2}Mr^2} = \frac{2F}{Mr}$ ---------- 1

(ii) Since the torque is same as before in a(i) $\alpha = \frac{2F}{Mr}$ 1

(b) (i) $\Sigma\tau = 0$, condition for equilibrium

If T is the tension in the rope then

$T \times 0.1 = 200 \times 0.8$ ---------- 1

$T = 1600$ N ---------- 1.

(ii) less than that calculated ----------

(c) (i) New tension in the rope $= 3200$ N (force doubled)

weight of the boat $= 3200$ N ---------- 1

mass of the boat $= 320$ kg ----

(ii) minimum work done = gain in P.E $= 320 \times 10 \times 2$

$= 6400$ J ---------- 1

(d)(i) If the tension in the rope is T', ---------- 1

$400 \times 0.8 = T' \times 0.1 + \tau_{frictional}$

$= T' \times 0.1 + 4$

$T' = 3160$ N ----------

Frictional force acting on the boat $= 3160$ N ------ 1.

(ii) angular speed of the cylinder, $\omega = \frac{v}{r} = \frac{0.2}{0.1} = 2$ rad s^{-1} 1.

∴ Total power loss against friction and frictional torque $= \tau\omega$ ----- 1

$= 400 \times 0.8 \times 2$

$= 640$ W ------ 1.

Can use $F.V + \tau_f\omega$ alternatively

(iii) angular deceleration $\alpha = \frac{\tau}{I} = \frac{4}{\frac{1}{2} \times 100 \times 0.1^2} = 8$ rad s^{-2}... 1

using $\omega = \omega_0 + \alpha t$

$0 = 2 - 8.t$

$t = 0.25$ s ---------- 1

comes to rest in 0.25 s ----

(6) (i) Stating any 3 differences between P and S waves { All ---- 2; Any two (1)

(ii) (a) ; Direction of propagation of wave and the direction of vibration are parallel to each other. 1+1

(iii) $D_1, D_2, P_3, D_4, D_5, D_6, D_7, D_8$ (or in the reverse order) 1

(iv) direct pulse - 0.4 s }

reflected pulse - 0.6 s } 1

(v) Speed = 3 km s^{-1} 1

$MX + XD_8 = 3 \times 0.6 = 1.8$ km ---------- 1

$MD_8 = 3 \times 0.4 = 1.2$ km

Contd

if thickness of the rock is d, $d = \sqrt{Mx^2 - (\frac{MD_8}{2})^2}$

$= \sqrt{0.9^2 - 0.6^2} = 0.3\sqrt{3^2-2^2} = 0.3\times\sqrt{5}$

$= 0.672$ km (0.62 – 0.72 km) — 1

(vi) $A = V_p^2 \rho$

$= 3000^2 \times 2700 = 2.43 \times 10^{10}$ kg s^{-2} m^{-1} $= 2.43\times10^{10}$ Pa — 1

(Do not award this mark if unit is wrong)

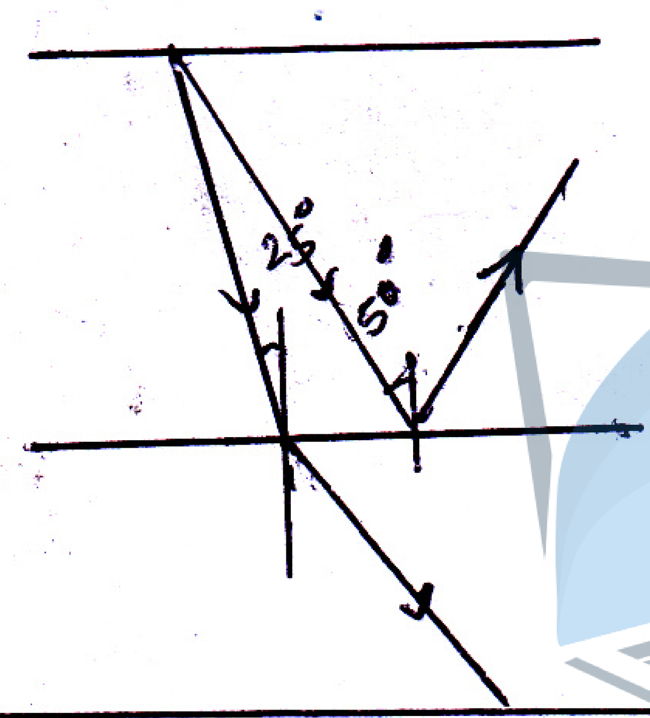
(vii) rock sample may have irregular boundary / the rock boundary not horizontal / sample is not homogeneous / wave encountering intermediate different layer (accept any other possible answers) — 1

(b) (i) refractive index of the second medium (vel. 5 km s^{-1}) w.r.to the rock medium $= 3/5 = 0.6000$ — 1

critical angle C is given by $\sin C = 0.6$ — 1

$C = 37^\circ$.

(ii)



1+1

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(7) A - Proportional limit
B - Elastic limit
C - Breaking point — All correct 2, Only 2 ①

Distinguishing A and B — 1

(a) (i) Young's modulus of steel, $Y_s = \frac{3\times10^8}{1.5\times10^{-3}} = 2\times10^{11}$ N m^{-2} — 1

Young's modulus of copper, $Y_c = \frac{2\times10^8}{2\times10^{-3}} = 1\times10^{11}$ N m^{-2} — 1

(ii) For steel wire,
max^m load (without exceeding proportional limit),
$F_1 = 3\times10^8 \times 0.8\times10^{-6} = 240$ N — 1

For copper wire,
max^m load (without exceeding proportional limit)
$F_2 = 2\times10^8 \times 0.8\times10^{-6} = 160$ N — 1

(iii) Maximum load on the composite wire $= 160$ N. — 1

(b) Force on a wire, $F = \frac{AYe}{l}$

Each wire is extended by 1 mm (to identify) — 1

$F = \frac{0.8\times10^{-6} \times 2\times10^{11} \times 1\times10^{-3}}{2} = 80$ N — 1

Contd

Weight to be placed at the centre $= 4 \times 80\ N = 320\ N$.

mass $= 32$ kg 1

(e) (i) Let the forces acting on the steel and copper wires are F_s and F_c respectively.

$F \propto AY$ (e & l same for each)

$\dfrac{F_s}{F_c} = \dfrac{0.8 \times 2 \times 10^{11}}{2.4 \times 1 \times 10^{11}} = \dfrac{2}{3}$ 1

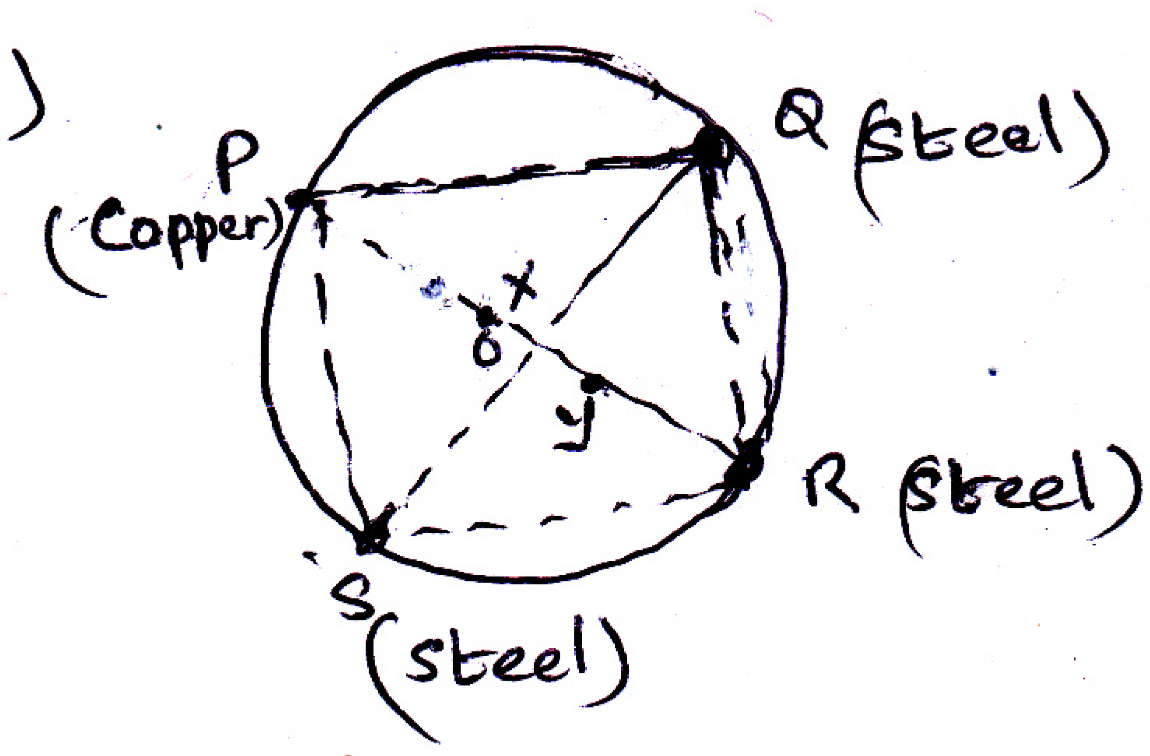
(ii) Force acting on the copper wire $F_c = \dfrac{2.4 \times 10^{-6} \times 1 \times 10^{11} \times 1 \times 10^{-3}}{2}$

$= 120\ N$

Tension on one of the steel wires $= \dfrac{2}{3} \times 120 = 80\ N$ 1

$\therefore$ Total weight $= 120 + 3 \times 80 = 360\ N$

(iii)



Resultant of the tensions due to 3 steel wires passes through y, such that $Oy = \frac{1}{3}$ OR $= 2.5$ cm

Resultant of all four wires acts at X. (Mark X on the diagram) 1

$\dfrac{PX}{XY} = \dfrac{240}{120} = 2$

$PX = \dfrac{2}{3} \times PY = \dfrac{2}{3} \times 10 = 6.67$ cm 1

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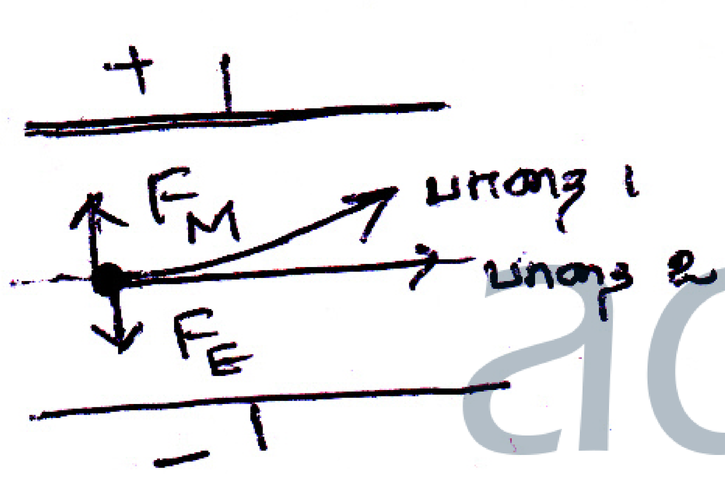
(8) (a) (i)



For denoting F_E and F_M 1+1

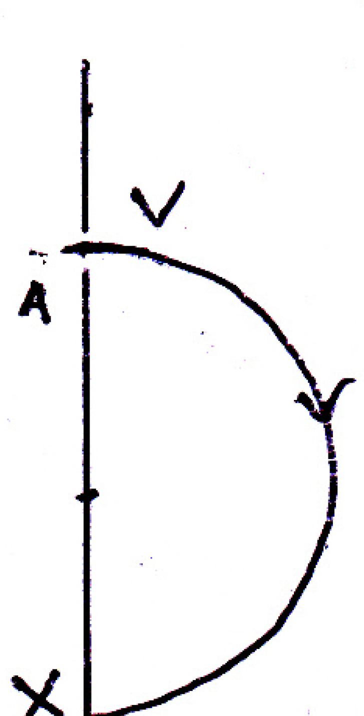
(ii) 1. } 2. } For drawing paths 1 and 2 1+1

(iii) For undeviated particle, $F_E = F_M$

$qE = BqV \Rightarrow V = \dfrac{E}{B}$ 1

(b) (i) circle | Part of a circle. Magnetic force is always perpendicular to the path of the particle. 1

(ii)



1

1

(iii) V, No work is done by the magnetic field

(iv) Magnetic force $= B_0 qV$

centripetal acceleration $= \dfrac{V^2}{r}$ r - radius

Using $F = ma$, $B_0 qV = m\dfrac{V^2}{r}$ for LHS and RHS 1+1

$r = \dfrac{mV}{B_0 q} = \dfrac{x}{2} \Rightarrow x = \dfrac{2mV}{B_0 q} = \dfrac{2mE}{B_0 qB}$

Q8 Contd.

(c) (i) M_1 ---------- 1

(ii) For isotope with mass M_1, $AX = \dfrac{2 M_1 E}{B_0 q B}$

M_2, $AY = \dfrac{2 M_2 E}{B_0 q B}$ ---------- 1

Separation $xy = AX - AY$

$d = \dfrac{2(M_1 - M_2) E}{B_0 q B}$ ---------- 1

(iii) $d = \dfrac{2(M_1 - M_2) V}{B_0 q B}$ ---------- 1

$= \dfrac{2 \times (6.17 \times 10^{-26} - 5.87 \times 10^{-26}) \times 500}{2 \times 10^{-3} \times 1.6 \times 10^{-19}}$

$= 9.375 \times 10^{-3}$ m ---------- 1

(C9) (A) (a) (i) $R = \dfrac{\rho l}{A}$ ---------- 1

ρ - Resistivity
l - length
A - cross sectional area
} ---------- Any 2 ---------- 2 (1)

(ii) $V = Al$ = constant ---------- 1

$R = \dfrac{\rho l}{V/l} = \dfrac{\rho l^2}{V}$ ---------- 1

$\therefore R \propto l^2$

(b) (i) length of the wire could be increased and hence the change in resistance will be significantly high ---------- 1 1

(ii) 8×0.075 m $= 0.60$ m ---------- 1

(iii) $R = \dfrac{\rho l}{A} = \dfrac{5 \times 10^{-7} \times 0.6}{\pi \times (0.02 \times 10^{-3})^2} = \dfrac{75}{\pi} \times 10 = 239\ \Omega$ ---------- 1

(iv) $239 \propto 0.600^2$

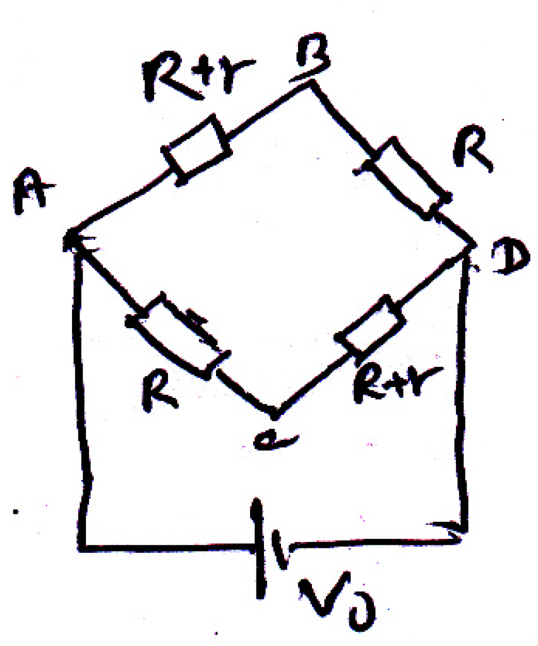
change in resistance $\Delta R \propto 2 \times 0.600 \times 0.001$ ---------- 1

$\dfrac{\Delta R}{239} = \dfrac{2 \times 0.001}{0.600} = \dfrac{1}{300}$

$\therefore \Delta R = 0.800\ \Omega$ ---------- 1

(C) i. 0 V ---------- 1

ii.



Potential drop across A and B $= \dfrac{V_0 \cdot (R+r)}{R+r+R}$ ---------- 1

Potential drop across A and C $= \dfrac{V_0 \cdot R}{R+R+r}$ ---------- 1

$\therefore$ P. drop across B and C $= \dfrac{V_0 (R+r)}{2R+r} - \dfrac{V_0 R}{2R+r} = \dfrac{V_0 r}{2R+r}$

$\therefore$ Voltmeter reading $= \dfrac{V_0 r}{2R+r}$

Q9.A Contd

*Least count of the voltmeter = 0.01 V

Least count of the voltmeter corresponds to 0.01 V

Minimum change in resistance corresponds to

$\frac{V_0 r_{min}}{2R + r_{min}} = 0.01$. $V_0 = 10$ V, $R = 239\ \Omega$ 1

1

$\therefore r_{min} = 0.48\ \Omega$

B (a) (i) I–V characteristics of a zener diode 2

denoting V_z (Zener breakdown voltage) 1

p.d across the device = 10 V

$\therefore$ p.d across R = 12 − 10 = 2 V

Current through R, $I_R = I_{Load} + I_z$

$= \frac{10}{100} + \frac{10}{1000}$ A = 0.11 A 1

$\therefore R = \frac{2}{0.11} = 18.18\ \Omega$ 1

(ii) If the voltmeter is assumed to function when Voltage (supply) increases to 15 V the current through R would be $I_r = \frac{5}{18.18} = \frac{5}{200/11} = 275$ mA 1

The current through the load = 100 mA

current through zener = 175 mA 1

This is impossible (max^m current = 65 mA)

(iii) Maximum allowed current through R is

$(I_R)_{max} = 100 + 65$ mA 1

$= 165$ mA.

maximum p.d across R is $(V_R)_{max} = \frac{165}{1000} \times \frac{200}{11}$

$= 3$ V 1

$\therefore$ Maximum of the source voltage = 10 + 3 = 13 V 1

(b) (i) $V_{R_1} = 6 - 0.6 = 5.4$ V. 1

(ii) Base current $I_B = \frac{5.4}{R_1} = \frac{5.4}{100 \times 10^3} = 5.4 \times 10^{-5}$ A

$= 54\ \mu A$ 1

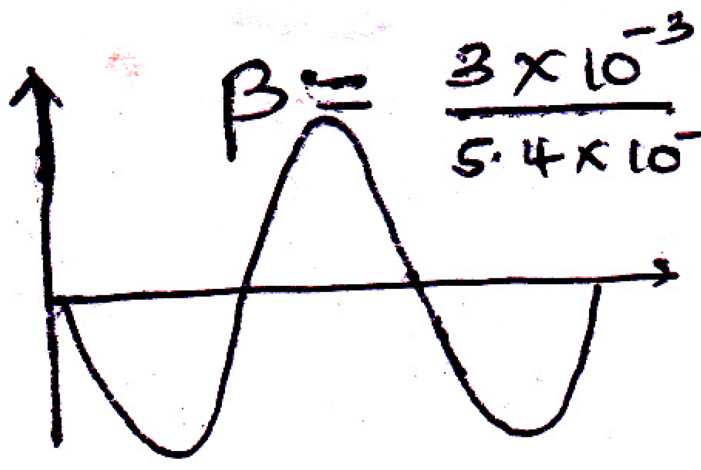
(iii) Current gain $\beta = \frac{I_c}{I_B}$ 1

$V_{R_2} = 6 - 3 = 3$ V

$I_c = \frac{3}{R_2} = \frac{3}{1 \times 10^3}$ A $= 3 \times 10^{-3}$ A (3 mA) 1

$\beta = \frac{3 \times 10^{-3}}{5.4 \times 10^{-5}} = 55.6$ 1

(iv)



(Note the change in phase + increased amplitude) 1

10 (a) (i) $P = P_0 + \frac{Mg}{A}$ 1

(ii) Pressure at 27°C $= 1\times10^5 + \frac{12\times10}{25\times10^{-4}} = 1.48\times10^5$ Pa 1

(iii) Pressure remains constant $\therefore \frac{V}{T} = \text{const}$

1. $\frac{Ah}{300} = \frac{Ah'}{330}$ h' - new height at 57°C 1

2. h = 20 cm ; h' = 22 cm 1

$\Delta W = P\Delta V$

$= 1.48\times10^5 \times 2\times25\times10^{-6}$ 1

$= 7.4$ J

3. $n = \frac{PV}{RT} = \frac{1.48\times10^5 \times 25\times20\times10^{-6}}{25/3 \times 300} = 0.0296$ mol 1

4. $\frac{P_{27}}{300} = \frac{P_{57}}{330}$

$\frac{1.48\times10^5}{300} = \frac{P_{57}}{330}$ 1

Pressure at 57°C is 1.628×10^5 Pa 1

If the load that brings the piston to its original position is M', $\frac{M'g}{A} = 1.628\times10^5 - 1\times10^5$

$= 0.628\times10^5$ N m^{-2}

$M' = \frac{0.628\times10^5 \times 25\times10^{-4}}{10} = 15.7$ kg

$\therefore$ additional load = 15.7 − 12 = 3.70 kg

(b) (i) Pressure inside the vessel $= 1\times10^5 + \frac{25\times10}{25\times10^{-4}}$

$= 2\times10^5$ Pa 1

(ii) temperature corresponds to this pressure = 130° C 1

(iii) Yes. Since the pressure in the region surrounding water becomes equals to svp of water. 1

(c) (i) 8000 Pa.

(ii) $R.H = \frac{\text{s.v.p at dew point}}{\text{SVP at air temp}} \times 100\,\%$

$50 = \frac{\text{svp at dew point}}{8000} \times 100$

s.v.p. at dew point = 4000 Pa

dew point temp = 26° C