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OCTOBER - NOVEMBER, 2019

PHYSICS P510/2 MARKING GUIDE - 2020.

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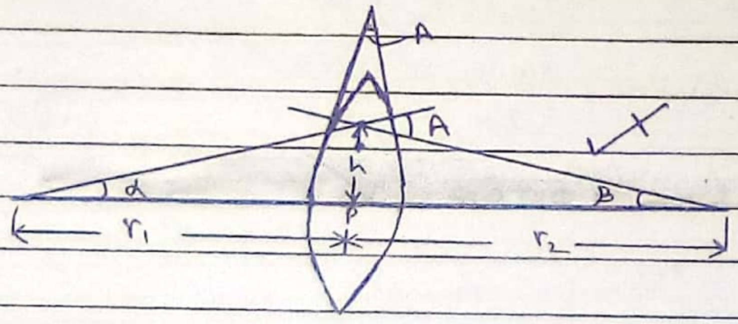
Pg 1

(a) - The Incident ray, the refracted ray and the normal line at the point of incidence all lie in the same plane. ✓

- The ratio of the sine of angle of incidence to the sine of the angle of refraction is a constant for a given pair of media. ✓

(02)

b)(i)

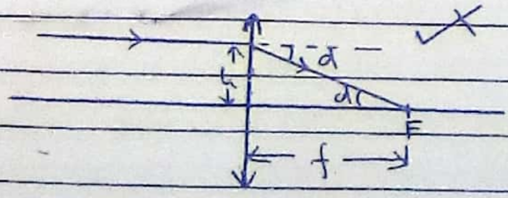


$\alpha + \beta = A$ ✓

but α, β are small angles in radians. ✓

$\tan\alpha \simeq \alpha = \frac{h}{r_1}$ ✓, $\tan\beta \simeq \beta = \frac{h}{r_2}$ ✓

$\therefore A = \frac{h}{r_1} + \frac{h}{r_2}$ ✓



d is a small angle in radian

$\tan d \simeq d = \frac{h}{f}$ ✓

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$d = (n-1)A$

$\frac{h}{f} = (n-1)\left(\frac{h}{r_1} + \frac{h}{r_2}\right)$

$\therefore \frac{1}{f} = (n-1)\left(\frac{1}{r_1} + \frac{1}{r_2}\right)$

(05)

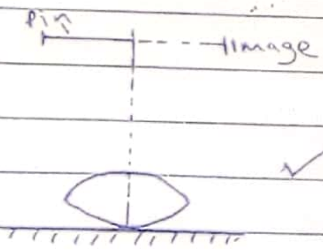
(ii) $\frac{1}{f} = (n-1)\left(\frac{1}{r_1} + \frac{1}{r_2}\right)$

$\frac{1}{f} = (1.5-1)\left(\frac{1}{20} - \frac{1}{25}\right) = 0.5 \times \frac{1}{100}$

$\therefore f = 200\text{ cm}$.

(02)

(C)



(recovered first ½ ticks)

The convex lens is placed on a plane mirror. A pin is clamped horizontally on a retort stand with its tip along the principal axis of the lens. The pin is moved up and down to locate the position where the pin coincides with its image using no parallax method. The distance f_1 of the pin from the lens is measured.

The lens is removed and a small quantity of the specimen liquid is placed on the plane mirror.

(3) Pg3

The convex lens is placed back on top of the liquid and the new position where the pin coincides with its image is located. The distance f_2 of the pin from the lens is measured. f_2 is the combined focal length of the lens and the liquid.

Let f_L be the focal length of the liquid lens.

$$\frac{1}{f_L} = \frac{1}{f_2} - \frac{1}{f_1}$$

but $\frac{1}{f_L} = (n-1)\frac{1}{r}$

The refractive index n of the liquid is calculated from

$$n = \frac{r}{f_L} + 1 \qquad \text{or } n = 1 + \frac{r(f_1 - f_2)}{f_1 f_2}$$

OR $n = \frac{-r}{f_L} + 1$, If r is the radius of curvature of the liquid lens.

(06)

(d)(i) $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$. $m = \frac{v}{u}$. $300 = \frac{v}{u} \Rightarrow \frac{1}{u} = \frac{300}{v}$

$\Rightarrow \frac{1}{3} = \frac{1}{v} + \frac{300}{v}$ $\therefore V = 903\text{ cm}$. (03)

OR $\frac{v}{f} = m+1 \Rightarrow V = (m+1)f = (300+1)\times 3 = 903\text{ cm}$

(ii) $m = \frac{v}{u} \Rightarrow 300 = \frac{903}{u}$ $\therefore u = 3.01\text{ cm}$. (02)

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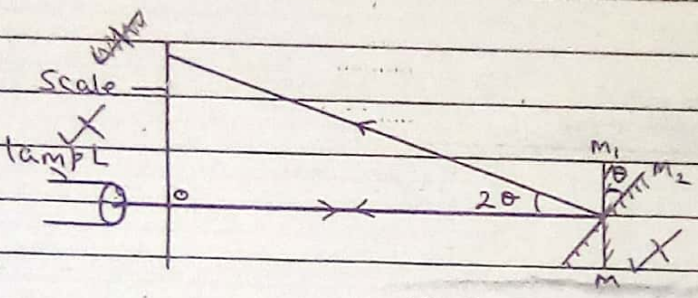
(4)

Pg 4

2(a)(i) - The incident ray, the reflected ray and the normal at the point of incidence all lie in the same plane.

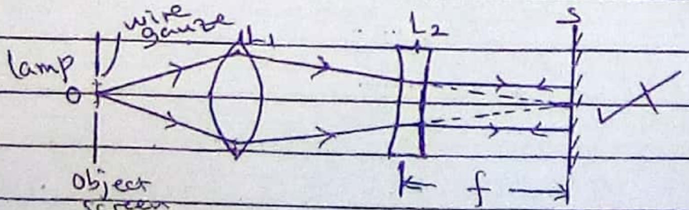
- The angle of incidence is equal to the angle of reflection. (02)

(ii)



Initially light from L incident on M is reflected back to the zero mark. When current is passed through the instrument, the mirror rotates thus rotating the reflected ray such that the spot of light moves over the scale. The angle of rotation of the ray is twice the angle of rotation of the mirror. (04)

(b)



The apparatus is arranged as above. First without L_2, The position of the screen S is adjusted until a sharp image of the wire gauze is formed on it.

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(5)

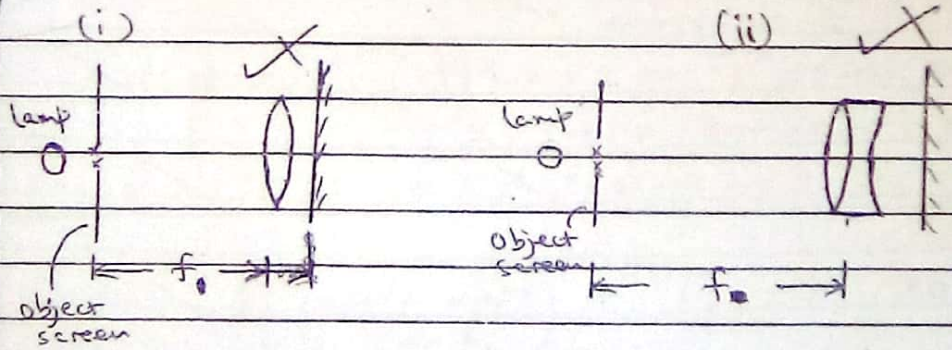
Pg5

The distance L_1S is measured. The concave lens L_2 is now placed in front of L_1, and S is replaced with a plane mirror. The position of L_2 is adjusted until a sharp image of the wire gauze is formed on the object screen. The distance L_1L_2 is measured. The focal length f of L_2 is now calculated from

$$f = L_1S - L_1L_2$$

or $f = L_2S$

Method 2



The apparatus are arranged as in (i). The position of the object screen or lens is adjusted until a sharp image of the wire gauze is formed on the object screen. The distance f_1 between the lens and the screen is measured. The concave lens is now attached to the convex lens and the apparatus arranged as in (ii) above.

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The position of the object screen is adjusted until a sharp image of the wire gauze is ~~formed~~ on the object screen.
The distance ~~of~~ between the screen and the lens combination is measured.
The focal length f_2 of the concave lens is now calculated from

$$\frac{1}{f_2} = \frac{1}{f} - \frac{1}{f_1}$$

(c)(i) $n = \frac{c}{v} = \frac{3.0\times10^8}{2.0\times10^8} = 1.5$

(02)

(ii) $n\sin i = \text{constant}$

$1.5\sin C = 1 \Rightarrow C = \sin^{-1}\left(\frac{1}{1.5}\right) \quad \therefore C = 41.8°$

$r = 60 - 41.8 = 18.2°$

$\sin\theta = 1.5\sin 18.2° \quad \therefore \theta = 27.9°$

allow change of error in n

(03)

1 OR $n = \left[1 + \left(\frac{\sin\theta + \cos A}{\sin A}\right)^2\right]^{\frac{1}{2}}$

$\sin\theta = n\sin(A-C)$
$= n[\sin A\cos C - \cos A\sin C]$
$\sin C = \frac{1}{n} \Rightarrow \cos C = \frac{\sqrt{n^2-1}}{n}$
$\sin\theta + \cos A = \sin A(\sqrt{n^2-1})$

$1.5 = \left[1 + \left(\frac{\sin\theta + \cos 60}{\sin 60}\right)^2\right]^{\frac{1}{2}}$

$\theta = 27.9°$

(03)

(iii) The ray will emerge through face AC. This is because the angle of incidence on the face AC will be less than the critical angle.

(02)

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Pg 7

(d) The eye piece is adjusted until the cross wires appear clearly. The telescope is now turned to face away from the collimator (or a distant object). The length of the telescope is adjusted to focus a distant object. The telescope is now turned to face the collimator. The slit of the collimator is then illuminated and the length of the collimator is adjusted until the image of the slit is formed on the cross wires (or clearly).

receive parallel light

produce || light

(03)

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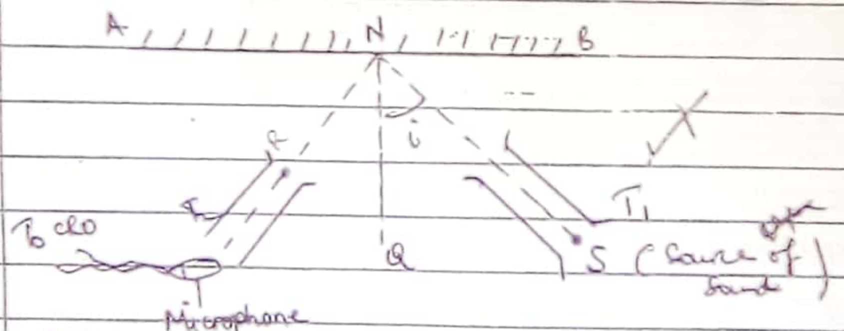
(8)

3 (a)

	Mechanical waves	Electromagnetic waves.
(i)	Require a material medium for propagation	Can travel in a vacuum.
(ii)	Generated due to mechanical vibrations or oscillations	Generated electronically or due to electron transition.
(iii)	moves at relatively low speed. [Has relatively long wavelength]	moves at relatively high speed [Has relatively short wavelength]
(iv)	Propagates by oscillation of particles of the medium	~~Pagat~~ Propagation is due to varying electric and magnetic field.

(any two)

(b)



A line is drawn on a sheet of paper. A normal NQ is drawn on the line AB and another line NS is drawn at a measured angle i. A hard cardboard is placed along AB and a hollow tube is placed along NS. A source of sound is placed at S. Another tube T_2 ~~along AB and a hollow tube is placed along NS.~~ is placed on the opposite side of NQ facing point N.

A microphone connected to the Y-plates of a CRO is placed at the mouth of the tube T_2 and a vertical trace is observed on the screen. The position of the tube T_2 together with the microphone is adjusted by moving them away from NQ until a maximum length of vertical trace is observed on the screen.

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(9)

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Position R is noted. The tubes are removed and a line RN is drawn. The angle RNQ is measured and is found to be equal to i.

(c) (i) When two notes of equal amplitudes and nearly equal frequencies are sounded together, they superpose. When they meet in phase, reinforcement takes place and a loud sound is heard. When they meet completely out of phase, cancellation takes place and a soft sound or no sound is heard. A sound that rises and falls in intensity periodically is heard, which is called beats. (3)

slightly different

- condition
- formation
- result

(ii) The test note is sounded together with a standard note, say a tuning fork. The number of loud sounds occuring per second f_b are counted and recorded together with the frequency f_1 of the tuning fork. Now beat frequency $f_b = f_1 - f_2$ or $f_b = f_2 - f_1$.
To tell which is the correct formula to use one prong of the tuning fork is loaded with plasticine and the procedure repeated and the beats per second counted, f_b'. If $f_b' > f_b$ then the test frequency $f_2 = f_1 + f_b$. (4)

If $f_b' < f_b$, then $f_2 = f_1 - f_b$.

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(d) (i) Speed of car $= \frac{108 \times 1000}{3600} = 30ms^{-1}$.

Wavelength of sound received by the stationary observer

$\lambda' = \frac{V - U_s}{f}$

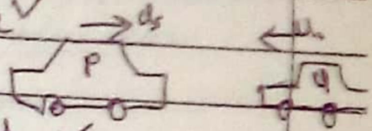
apparent frequency $f' = \frac{V}{\lambda'} = \frac{V}{V-U_s} f$

(3)

$f' = \frac{340}{340-30} \times 256 = 280.8 Hz$

~~Case II observer moving toward the source~~

(ii) Wavelength received by observer in the car $\lambda' = \frac{V-U}{f}$



apparent velocity $V' = V + U_o$

apparent frequency $f' = \frac{V'}{\lambda'} = \left(\frac{V+U_o}{V-U_o}\right) \cdot f$

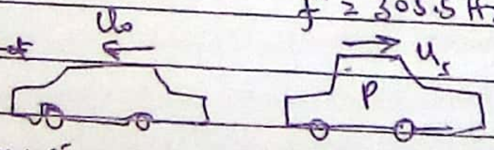
$f' = \left(\frac{340+30}{340-30}\right) \times 256$

(3)

$f' = 305.5 Hz$

(e) ~~Doppler effect~~

Case II:



Observer moving away from the source

apparent velocity; $V' = V - U_o$

apparent wavelength $\lambda' = \frac{V+U_s}{f}$

apparent frequency $f' = \frac{V'}{\lambda'}$

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(11) Pg 11

$$f' = \left(\frac{v - u_o}{v + u_s}\right) f$$

$$f' = \left(\frac{340 - 30}{340 + 30}\right) \times 256$$

$$f' = 214.5\,Hz$$ (3)

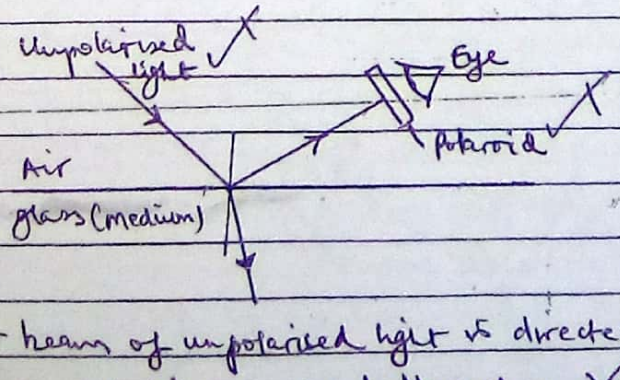
(e) Doppler effect is used in

- rader speed traps to determine the speed of a moving vehicle.
- to determine whether a given star is approaching or receding from earth. (1)
- to determine the speed of a star.
- to determine plasma temperatures.

(any two)

4(i) Ordinary light is one whose electric vibrations are in every plane at right angles to the direction of the light. (1)

(ii) Plane polarised light is one whose ~~vibrations~~ electric vector varies in only one plane perpendicular to the direction of the light ray. (1)



A narrow beam of unpolarised light is directed onto the medium and the reflected light is viewed through a polaroid. Starting with a small angle of incidence, the polaroid is rotated

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about an axis through its plane. The angle of incidence is gradually increased whereby at each angle of incidence the polaroid is rotated. At one angle of incidence, the reflected light gets cut off, from the observer, as the polaroid is rotated. At this point, the reflected light is completely plane polarised.

Q4 (b)(ii) $\tan i_p = n$

$\tan i_p = 2.417$

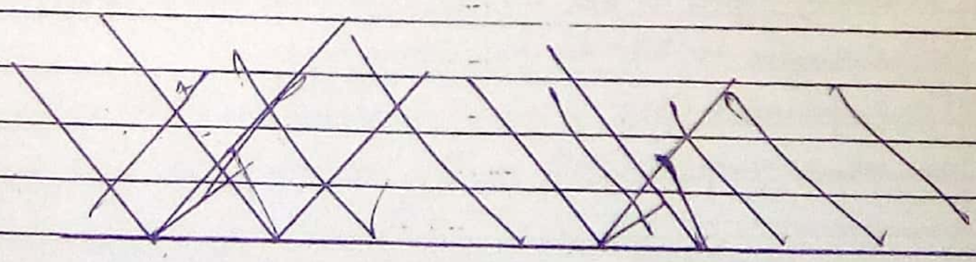
$i_p = 67.5°$

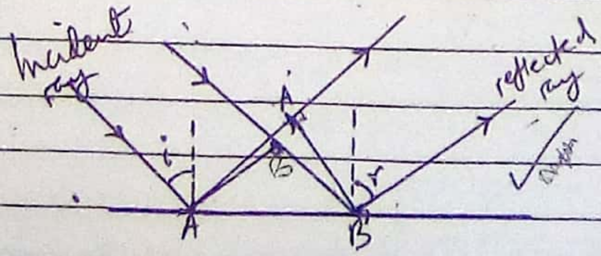
OR polaroid does not refract.

2

(c)(i) Huygen's principle states that every point on the wavefront may be regarded as a source of secondary spherical wavelets which move with the speed of the wave and the new wavefront is the envelope which touches the surfaces of the wavelets.

1





- i r
- incident beam
- reflected beam

Consider a wave front AB incident obliquely onto the reflecting

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(13)

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Surface AB' the new position of the wavefront is determined by taking BB' as the radius of the new secondary wavelet, and A as its centre. ∴ $AA' = ct = BB'$

$\angle BAB' = i \quad \angle A'B'A = r.$ (on diagram)

$\angle ABB' = \angle AA'B' = 90°$

and $\Delta ABB'$ & $\Delta AA'B'$ are congruent

Now $AB = A'B'$ and AB' is common to both Δ

interior angles equal & sides are common

$\Rightarrow \Delta ABB'$ and $\Delta AA'B'$ are congruent.

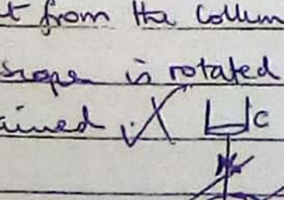
In time t, particle from A moves to A' then (or B moves to B')

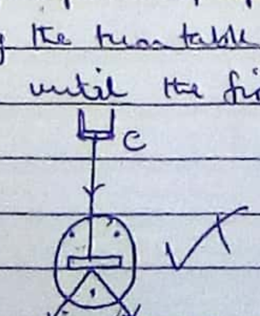
$AA' = ct = BB'$ ... $\sin i = \frac{A'B'}{AB'}$, But $\sin r = \frac{AB}{AB'}$

$\angle i = \angle r.$ ∴ $\angle i = \angle r$ 04

4(d)(i) A diffraction grating is a sheet of glass or polished metal with large number of close parallel equidistant lines ruled on it. 01

(ii) The collimator is adjusted to produce parallel beam, the telescope is adjusted to receive parallel light and the table is levelled. The telescope is turned to receive light directly from the collimator. The grating is placed perpendicular to the light from the collimator. Keeping the turntable fixed the telescope is rotated to one side until the first image is obtained.





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This position T_3 is noted. The telescope is now turned in the opposite direction past T_0 until the 1st image is obtained. This position T_4 is noted. The angle between T_3 and T_4 is measured and the angular position for 1st image θ_1 is calculated from $\theta_1 = \frac{\theta}{2}$.

The wavelength λ is then calculated from

$$\lambda = d\sin\theta_1 = d\sin\left(\frac{\theta}{2}\right)$$

where d is spacing of lines

or $\lambda = d\sin(\theta/2)$

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5(a) (i) Magnetic meridian is the vertical plane in which a freely suspended magnet sets. 01

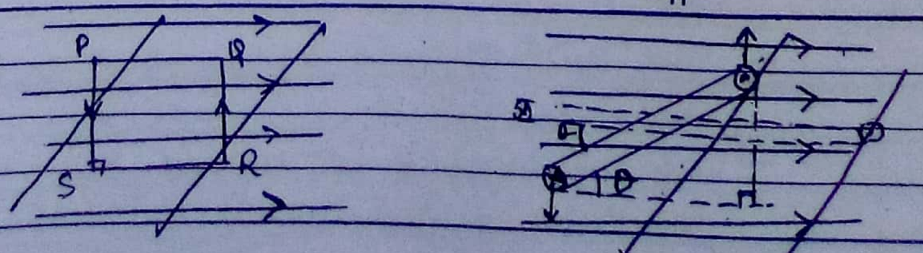
(ii) Angle of dip is the angle between the earth's field intensity and the horizontal. (01)

(b)

The apparatus is arranged as shown above. The search coil is placed in the magnetic meridian such that the pointer of the magnetometer reads zero. Switch K is closed and the pointer readings θ_1, θ_2 are noted. The average deflection is calculated from $\theta = \frac{\theta_1+\theta_2}{2}$. If B_H and B_c are the horizontal component of the earth's magnetic flux density and the magnetic flux density of the coil due to current respectively, then $\frac{B_c}{B_H} = \tan\theta$. (05)

deny ½ if I is not reversed, just in case pointers were not at zero

(c)



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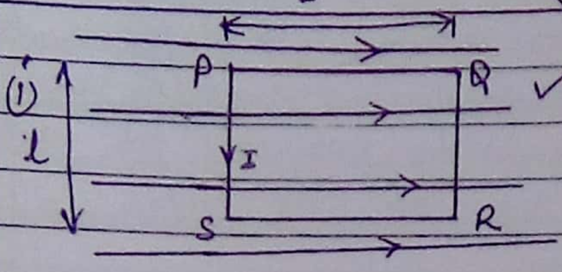
(c) (i)



When current flows in the coil, the force on PQ and RS is zero. The force on side PS = NBIL (outwards). The force on side QR = NBIL (inwards). The two forces constitute a couple which rotates the coil until it is stopped by the hair springs. Let θ be the angle of rotation, then the torque on the coil = Force x perpendicular distance between them.

$= \text{Force} \times b\cos\theta$

$= NBIlb\cos\theta$

$= NBIA\cos\theta$

In equilibrium, the torque set by the hair springs $\tau = k\theta$. Therefore $NBIA\cos\theta = k\theta$

(c)(ii) To turn the above into a moving coil galvanometer, the following should be done.

- The magnetic field should be made radial.
- The coil should be supported on jewelled bearings.
- The coil should be wound on a light conducting frame.

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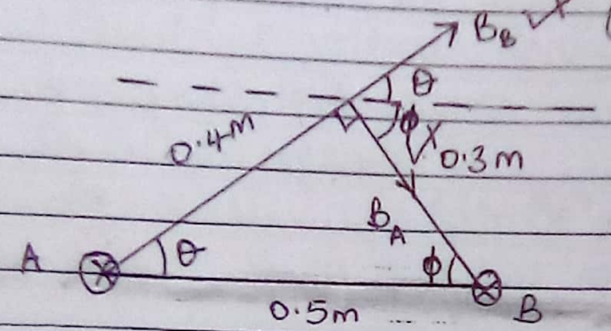
- The frame on which the coil is wound should turn about a soft iron cylinder. ✓✗
- A pointer which can move along a linear scale should be attached to the coil. ✓✗ (02)

Any four.

(d) (i)



✓✗ (Correct direction of the field)

$\cos\theta = \frac{0.4}{0.5} = 0.8$

$\sin\theta = \frac{0.3}{0.5} = 0.6$

$\cos\phi = \frac{0.3}{0.5} = 0.6$

$\sin\phi = \frac{0.4}{0.5} = 0.8$

Using $B = \frac{\mu_0 I}{2\pi a}$ ✓

(06)

$B_A = \frac{4\pi \times 10^{-7} \times 2}{2\pi \times 0.4} = 1.0 \times 10^{-6}\,T$ ✓

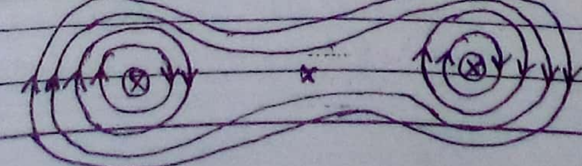
$B_B = \frac{4\pi \times 10^{-7} \times 2}{2\pi \times 0.3} = 1.33 \times 10^{-6}\,T$ ✓

$\cancel{B_A}$ $\vec{B} = \vec{B}_A + \vec{B}_B = \begin{pmatrix} 1.0 \times 10^{-6}\cos\phi \\ -1.0 \times 10^{-6}\sin\phi \end{pmatrix} + \begin{pmatrix} 1.33 \times 10^{-6}\cos\theta \\ 1.33 \times 10^{-6}\sin\theta \end{pmatrix}$ ✓✗

$= \begin{pmatrix} 0.6 \times 10^{-6} + 1.07 \times 10^{-6} \\ -0.8 \times 10^{-6} + 0.8 \times 10^{-6} \end{pmatrix}$

$= 1.67 \times 10^{-6}\,T$ ✓ horizontally to the right. ✓✗

(ii)



✓ (pattern & direction) ✓✗

(01)

x - Neutral point

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6(a) (i) Self-induction is the generation of emf in a coil due to changing current in the same coil. (01)

(ii) Flux ϕ linking a coil is given by
$\phi = BA$; But $B \propto I \Rightarrow \phi \propto I$ (03)
$\therefore \phi = LI$
If the current in the coil changes, then flux linkage also changes. Therefore,
$\frac{d\phi}{dt} = L\frac{dI}{dt}$. The induced emf, $E = -\frac{d\phi}{dt}$

$\Rightarrow E = -L\frac{dI}{dt}$

(b) (i)
Current in the straight wire is $I = \frac{V}{R}$ where R is its resistance since the back emf in it is negligible. When current flows in the coil, a back emf ~~is~~ E_b is induced in it. The resultant voltage is $V - E_b$ such that the resultant current is $\frac{V-E_b}{R}$. Hence current in A is less than that in the straight wire. (02)

(ii) When the distance between A and B is reduced, the magnetic flux linking coil B due to changing current in A increases. The induced emf and hence induced current in the circuit increases. Accordingly the reading of A_2 increases. $(1\frac{1}{2})$

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The induced current in B produces a changing flux in B. This flux opposes the flux produced by the applied voltage in A and so reduces the total flux linking coil A. Back emf induced in coil A reduces and the resultant voltage in the circuit increases. Current through A increases ie reading of A_1 increases. $(1\frac{1}{2})$

(c)(i) Torque, T_{max} = BIAN. Since the coil of a motor is in a radial magnetic field. (03)

$$\Rightarrow B = \frac{\tau}{IAN} = \frac{0.30}{2.5 \times 20 \times 10^{-4} \times 50} = 1.2T$$

(ii) $E = NBA\omega$, but $\omega = 2\pi f = \frac{2400 \times 2\pi}{60}$ (03)

$$\Rightarrow E = 50 \times 1.2 \times 20 \times 10^{-4} \times 80\pi = 30.14V$$

(d)(i) As the coil of the motor rotates in the magnetic field, the core onto which the coil is wound rotates in the magnetic field of the motor. The changing flux linkage the core induces emf in the core. This emf causes current to circulate in the core in such a direction to oppose the rotation of the core. These are eddy currents. (03

(ii) The effect of eddy currents are minimized by laminating the core of the motor. (01

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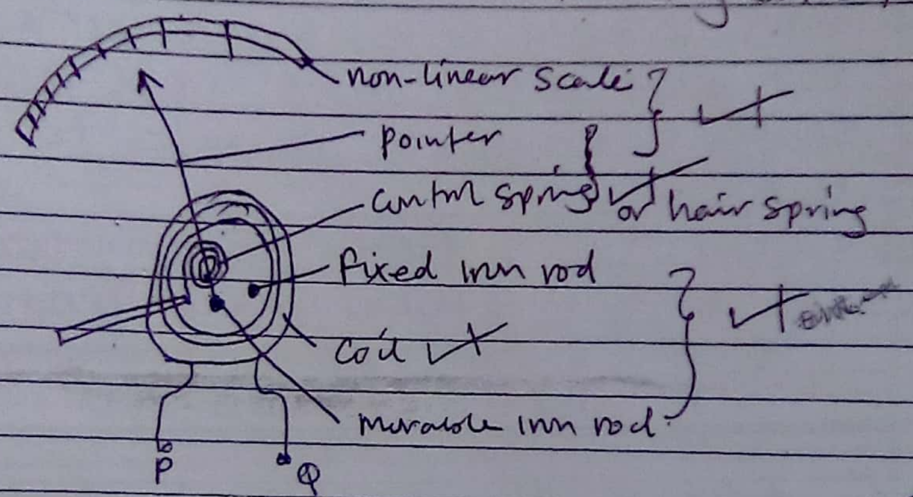
7(a) The root mean square value of an alternating current is the value of direct current which dissipates heat in a given resistor at the same rate as the alternating current (01)

(b)



Current to be measured is passed through the coil. The iron rods get magnetised in the same sense and repel. The movable iron rod is pushed away, and as it moves, the pointer rotates over the scale until it is stopped by the restoring torque of the hair spring. The deflecting torque is proportional to the force of repulsion which is porportional to the square of the current. Hence the deflection $\theta \propto \langle I^2 \rangle$ (05)

(c)(i) $\frac{V_{rms}}{I_{rms}} = \frac{1}{2\pi f c}$ $\quad \frac{I_0}{\sqrt{2}} = I_{rms}$ (02)

$I_{rms} = V_{rms} \times 2\pi f c$

$\Rightarrow I_0 = \sqrt{2} \times V_{rms} \cdot 2\pi f c$

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(21)

$= \sqrt{2} \times 200 \times 2 \times 3.14 \times 50 \times 8 \times 10^{-6}$

$= 0.71\,A$

02

OR

$X_c = \frac{1}{2\pi f C} = \frac{10^6}{2\pi \times 50 \times 8} = 397.9\,\Omega$

$V_0 = \sqrt{2} \times 200 = 282.8\,V$

(04)

$\therefore I_0 = \frac{V_0}{X_c} = \frac{282.8}{397.9}$

$= 0.71\,A$

c(ii) If the frequency of the a.c is increased, the number of times the capacitor charges and discharges in a unit time increases. The quantity of charge flowing in the circuit in a unit time increases. So the current increases

(02)

Explain → how or what the thing takes place

OR

$X_c = \frac{1}{2\pi f C} \Rightarrow X_c \propto \frac{1}{f}$

When frequency f increases, X_c reduces

$I = \frac{V}{X_c}$, $I \propto \frac{1}{X_c}$ Hence current increases.

(02)

$- X_c \propto \frac{1}{f}$

OR - As frequency increases, X_c reduces

- Since $I \propto \frac{1}{X_c}$, then I increases.

(opposes)

Pg 22

22

(d) When a.c flows in the coil, back emf E_b is induced in it.

but $E_b = -L\frac{dI}{dt}$ and for a pure inductor $V = -E_b \Rightarrow V = L\frac{dI}{dt}$.

When $I = 0$ the rate of change of current is maximum $\Rightarrow$ V is maximum.

When current increases to the maximum the rate of change of I $\left(\frac{dI}{dt}\right)$ is zero,

V is zero.

Hence V and I are out phase by phase difference 90°

(04)

(e) $V = V_0 \sin wt$

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

$= \frac{V_0^2 \sin^2 wt}{R}$

$\langle P \rangle = \langle \frac{V_0^2 \sin^2 wt}{R} \rangle$

(02)

$= \frac{V_0^2}{R} \langle \sin^2 wt \rangle$ but $\langle \sin^2 wt \rangle = \frac{1}{2}$

$\therefore \langle P \rangle = \frac{V_0^2}{2R}$

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7(f) Power supplied by a.c = 3 x power supplied by dc

$$\left(\frac{I_o}{\sqrt{2}}\right)^2 R = 3I_d^2 R$$

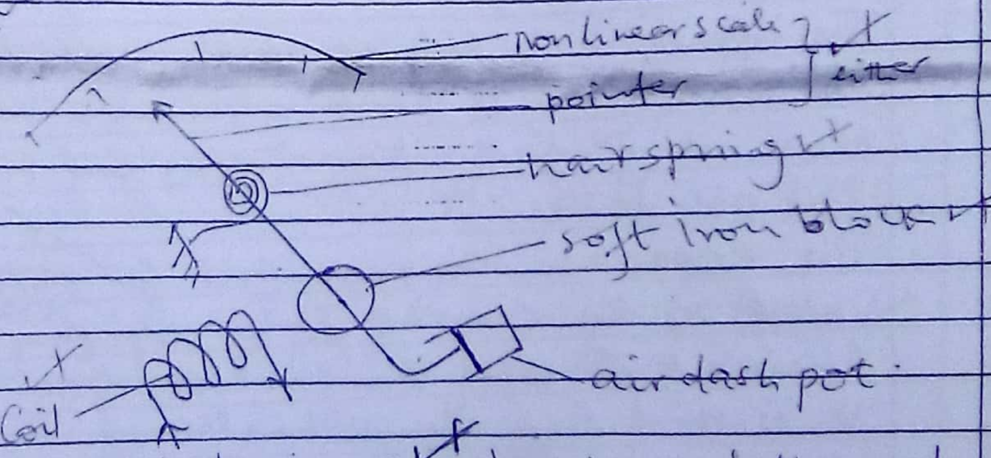
$$\frac{I_o^2}{2} = 3 \times 2^2$$ 02

$$I_o^2 = 3 \times 2^2 \times 2$$

$$I_o = 4.9A$$

20

(b) alternative



05

current to be measured is passed through the coil. The coil magnetises and attracts the soft iron block. As the block turns, the pointer rotates over the scale until it is stopped by the restoring torque of the hair spring. The deflection torque is proportional to the force of attraction. Hence deflection $\theta \propto I^2$

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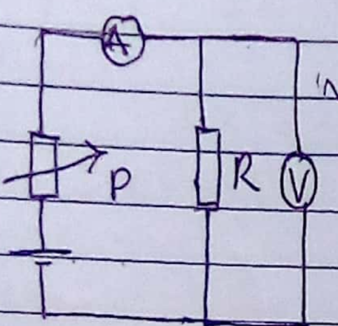
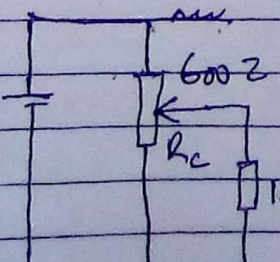
8(a) Potential difference: This is the work done to move 1C of a charge from one point to another in an electrical circuit. (01)

b(i)



The apparatus is set up as shown above. The Rheostate is set to a suitable value and the reading of the Ammeter (A) and voltmeter (V) are taken.
The experiment is repeated for different values of the current I by adjusting the Rheostat P and the corresponding pd V is read from the voltmeter 04
A graph of I against V is plotted.
A straight line graph through the origin is obtained, implying that $I \propto V$ and hence, this verifies Ohm's law.

(ii)



$R_c = \frac{1}{3} \times 600 = 200\Omega$

Effective resistance in parallel is R

$\frac{1}{R} = \frac{1}{100} + \frac{1}{200}$

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$\Rightarrow R = \frac{200}{3} = 66.7\Omega$

Total resistance $R_T = 400 + \frac{200}{3}$

$= 466.7\Omega$

P.d across the parallel connection

$IR = V \Rightarrow I = V/R = \frac{12}{466.7} = 0.026A$

$\therefore$ P.d $V = IR = 0.026 \times 66.7$

$= 1.714V$

04

$\therefore$ Energy $= \frac{V^2}{R}t$

$= \frac{1.714^2}{100} \times 10 = 0.294J$

or $V_1 = \frac{V \times R_1}{R_1 + R_2} = \frac{12}{466.7} \times \frac{200}{3}$

$= 1.714$

8(c) When current flows through a conductor, the conduction electrons collide with atoms in their Lattice positions. The ~~electron~~ lose some of their K.e to the atoms. The atoms thus vibrate with large amplitude which manifest as increase in temperature or increase in internal energy of atoms.

04

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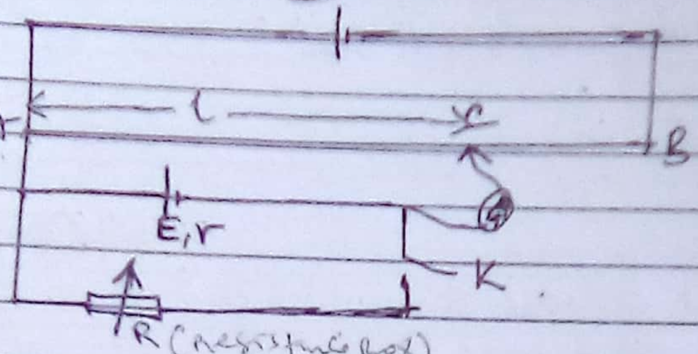
(26)

Pg 26

8(d)



upper working downward

Case 1

The set up is as above with K open. The Jockey is tapped along wire AB until when G shows no deflection. The balance length l_0 is noted. For a given value of resistance R, K is closed, and the new balance point is located and the new balance length l is noted. The experiment is repeated for other values of R and the balance lengths recorded in a table together with $\frac{1}{l}$ and $\frac{1}{R}$.

A graph of $\frac{1}{l}$ against $\frac{1}{R}$ is plotted and the slope S determined.

r is calculated from $r = S l_0$.

(7)

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Case II (28) Pg 27

For a given value of R, K is closed and the jockey is tapped at different points along AB ~~until~~ where G shows no deflection. The balance length L is noted. The experiment is repeated for other values of R and the results ~~recor~~ recorded in a table including values of $\frac{1}{L}$ and $\frac{1}{R}$. A graph of $\frac{1}{L}$ against $\frac{1}{R}$ is plotted and the slope S

and intercept, c on $\frac{1}{L}$ axis are determined. (07)

Internal resistance r is determined from $r = S/c$

Case III

In Case a student doesn't repeats the experiment, the candidates loses 2 marks'

~~The set up is as shown above with K open~~

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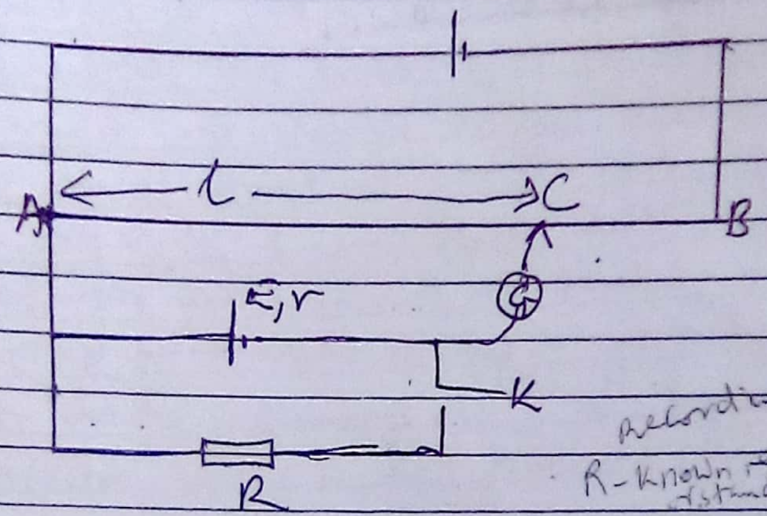
Case [9]



The set up is as above with K open. The ~~jockey~~ ~~is~~ tapped along the wire AB, until the galvanometer G shows no deflection. The balance length l_0 is noted. ~~Fi~~ Switch K is then closed and the new balance point is located and the new balance length l is noted.

r is obtained from $r = R\left(\frac{l_0}{l} - 1\right)$

5

06

$l_0/l = \frac{1}{R} \cdot r + 1$

- Repeat
- Plot a graph of l_0/l against $\frac{1}{R}$, slope s calculated
- ~~straight line~~ internal resistance $r = s$

02

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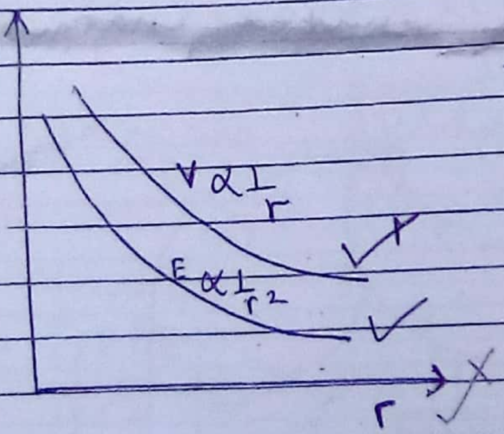
30

9(a)(i) Electric field intensity is the force acting on 1C of positive charge at a point in electric field. 01

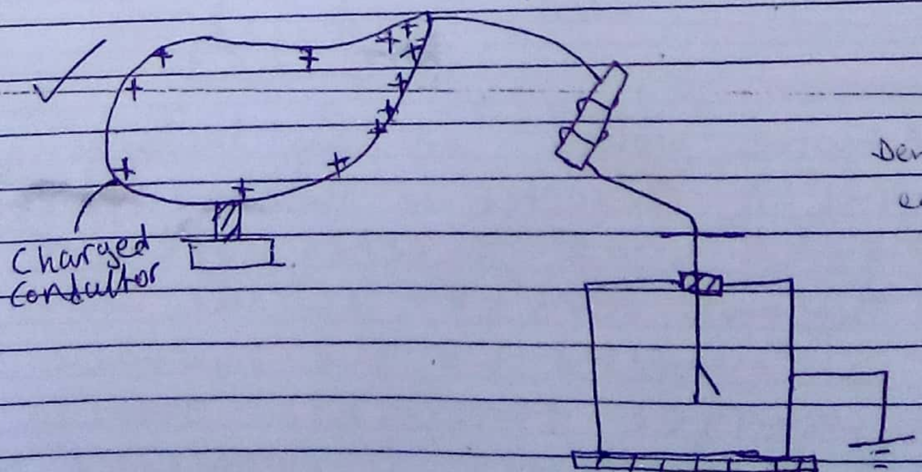
(ii) Electric potential is the work done to transfer 1C of positive charge from infinity to a point against the electrostatic field. 01

(b)



- Accept when axis interchanged
- V shd be above E
- For sphere used (1½) penalise ½ one

c



Deny ½ if earthing is not there.

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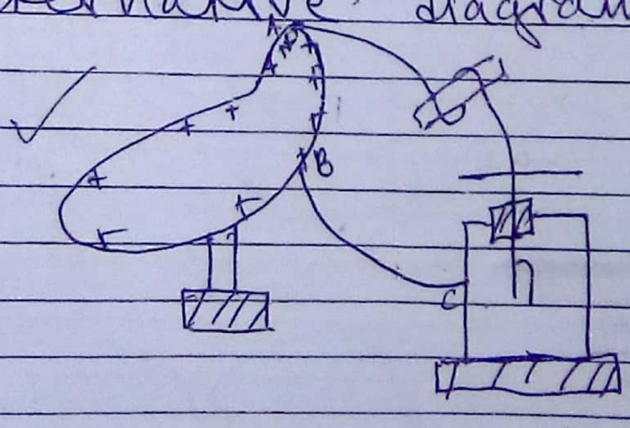
(31)

- A wire wound on an insulating rod is connected to the cap of neutral gold leaf electroscope
- The free end of the wire is moved over the surface of the conductor
- The divergence of the leave remains the same as the wire is moved from one point to another on the surface of a conductor
- The potential is constant over the a pear-shaped charged conductor

OK

Alternative diagram.



- no earthing must be ~~done~~

- A wire wound on an insulating rod is connected to the cap of neutral gold leaf electroscope
- The free end A ~~of~~ of the wire is connected to the surface of charged conductor. ~~The lea~~
- Another wire is connected to the conductor ~~to~~ and to point C

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32

on the electroscope. The leaf collapses.

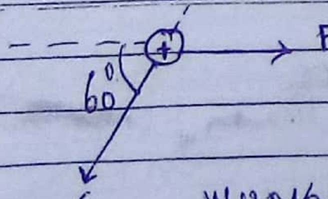
- The end A is tapped at different points on the conductor. The leaf remains collapsed.
- This implies that the p.d between any two points on the conductor is zero thus the potential is constant at all points on its surface. 04

d(i) work done from A to B is 0, No work done since points A and B are at same potentials 02

(ii) $E = \frac{V}{d}$

$= \frac{100}{10 \times 10^{-3}}$

$= 1 \times 10^{4}\ Vm^{-1}$



$F = EQ$

$= 1 \times 10^{4} \times 2 \times 10^{-6}$

$= 0.02\ N$

work done along BC $= (0.02 \cos 60) \times 10 \times 10^{-3}$

$= 1.0 \times 10^{-4}\ J$

04

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Alternative

$E = \frac{V}{d}$ $E = \frac{100}{10 \times 10^{-3}} = 1 \times 10^{4}\ Vm^{-1}$

$d' = 10 \cos 60$
$= 5mm$ therefore point C is at potential 100V

i.e $V_C = 100V$, $V_B = 50V$

$dV_B = V_C - V_B$
$= 100 - 50$
$= 50V$

work done $= dV_B \times Q$
$= 50 \times 2 \times 10^{-6}$
$= 1.0 \times 10^{-4}\ J$ 04

e (i) The alpha-particle loses K.E as it approaches the Nitrogen nucleous and this is transferred to electrostatic potential energy in the field. At some point all the kinetic energy of alpha-particle is lost and it is repelled back by Nitrogen nucleous. 02

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(34)

Pg 33

alternative

The repulsion between the charges retards the motion of the alpha-particle. At some point the velocity of the particle become zero. Thus the repulsion causes the particle to reverse direction. 02 ma

(ii) $K.e = \frac{1}{2}mv^2$ $\quad$ $e.p.e = \frac{KQ_1Q_2}{r}$

At closest distance

$K.e = e.p.e$

$\frac{1}{2}mv^2 = \frac{KQ_1Q_2}{r}$

$$V^2 = \frac{2 \times 3.2 \times 10^{-19} \times 11.2 \times 10^{-19} \times 9 \times 10^9}{6.8 \times 10^{-27} \times 9.4 \times 10^{-15}}$$

$V = 1.0 \times 10^7 ms^{-1}$ (04 m)

alternative for $\varepsilon_0 = 8.85 \times 10^{-1}$

$K.e = \frac{1}{2}mv^2$. $\quad e.p.e = \frac{KQ_1Q_2}{r}$

$K.e = e.p.e \Rightarrow \frac{1}{2}mv^2 = \frac{QQ}{4\pi\varepsilon_0 r}$

$\therefore v^2 = \frac{Q_1Q_2}{2\pi\varepsilon_0 mr} = \frac{3.2 \times 10^{-19} \times 11.2 \times 10^{-19}}{2\pi \times 8.85 \times 10^{-1} \times 9.4 \times 10^{-15}}$

$v = 31.76 ms^{-1}$

(04 ma

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35

10 (a)(i) capacitance is the ratio of the magnitude of charge on either plate of the capacitor to p.d across its plate. 01

(ii) ~~Q = CV~~

$C = 4\pi\varepsilon_0 r$

$= 4\pi \times 8.85 \times 10^{-12} \times 7.5 \times 10^{-2}$

$= 8.34 \times 10^{-12}$ F

$Q = CV$

$= 8.34 \times 10^{-12} \times 9 \times 10^{3}$

$= 7.5 \times 10^{-8}$ C (03 marks)

OR

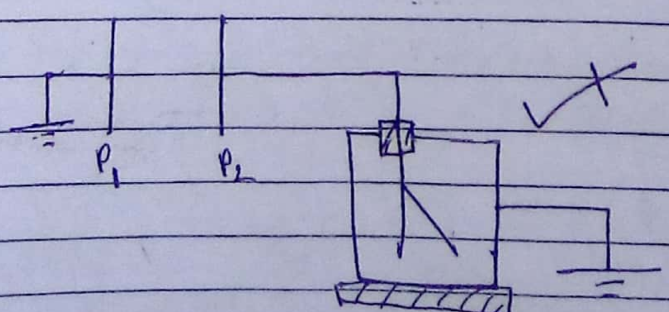
$V = \frac{Q}{4\pi\varepsilon_0 r}$

$Q = 4\pi\varepsilon_0 r V$

$= 4\pi \times 8.85 \times 10^{-1} \times 7.5 \times 10^{-2} \times 9000$ (03 marks)

$= 7.5 \times 10^{3}$ C.

(b)



~~P1 and P2 are metal plates~~
~~Plate P2 is charged and divergence of the leaf is noted.~~

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P_1 is more away from P_2 and divergence of leas is seen to increase

This means that p.d has increased from $C = \frac{Q}{V}$ & V increases then C has reduced $\therefore C \alpha \frac{1}{d}$

(04)

(c) $Q = CV$

$= \frac{\varepsilon_0 A}{d} V$

$= \frac{8.85 \times 10^{-12} \times 5 \times 10^{-4} \times 6}{2 \times 10^{-3}}$

$= 1.33 \times 10^{-11} C$

03

or

$Q = \frac{\varepsilon_0 A V}{d}$

$= \frac{8.85 \times 10^{-1} \times 5 \times 10^{4} \times 6}{2 \times 10^{-3}}$

$= 1.33C$

OR $C = \frac{\varepsilon_0 A}{d} = \frac{8.85 \times 10^{-1} \times 5 \times 10^{-4}}{2 \times 10^{-3}} = 0.22125F$

~~$Q = CV = 0.22125 \times 6 = 1.3275C$~~

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37

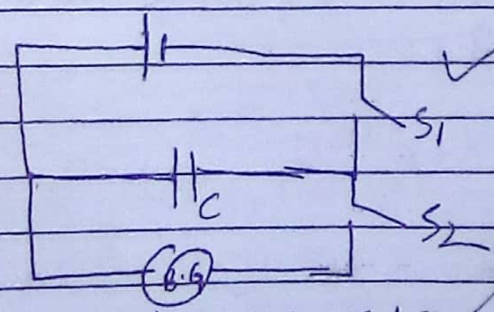
d when a conductor is placed between the plates negative charges are conducted to positively charged plate neutralising charge on it. Hence the capacitor becomes discharged.

03

e (i) Relative permittivity is the ratio of permittivity of the material to permittivity of free space

01

(ii)



A capacitor with air between the plates is connected as above. switch S_1 is closed and after a short time it is opened. S_2 is closed and the 1st deflection θ_0 of B.G is noted. ~~S_2 is opened~~. The test insulator is placed between the plates and S_1 is closed. After a short time S_1 is opened and S_2 is closed. The 1st deflection θ_d of B.G is noted.
Relative permittivity ε_r is found from
$\varepsilon_r = \theta_d / \theta_0$

05