P510/2
PHYSICS
Paper 2
2½ hours

MASAKA DIOCESAN EXAMINATIONS BOARD

JOINT MOCK EXAMINATIONS 2024

Uganda Advanced Certificate of Education

PHYSICS

Paper 1

2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES

*Answer **five** questions, taking at least one from each of sections A, B, C and D but not more than one question should be chosen from either A or B.*

Assume where necessary

Acceleration due to gravity g	=	$9.81 m\ s^{-2}$
Speed of light in a vacuum c	=	$3 \times 10^{8} m\ s^{-1}$
permeability of free space μ_0	=	$4\pi \times 10^{-7} H\ m^{-1}$
Permittivity of free space ε_0	=	$8.88 \times 10^{-12} F\ m^{-1}$
The constant $\frac{1}{4\pi\varepsilon_0}$	=	$9 \times 10^{9} F' m$

SECTION A:

1. (a) Define the following as applied to optical instruments

   (i) Near point ring. (01 mark)

   (ii) Eye ring. (01 mark)

(b) (i) Describe the structure and mode of operation of astronomical telescope not in normal use. (03 marks)

ii) In normal adjustment, the angular magnification of astronomical telescope is $\frac{f_0}{f_e}$ show that its angular magnification increases by the ratio of $(1 + \frac{f_e}{D})$ when not in normal adjustment. (04 marks)

(c) A point object is placed in front of thin converging lens L_1 of focal length 3 cm at distance of 3.6 cm. A second thin converging lens L_2 of focal length 16 cm is placed coaxial with lens L_1 and 26 cm from it on the side remote from the object.

   (i) Find the position and magnification of final arrangement. (05 marks)

   (ii) Explain why the above arrangement is not suitable for a compound microscope in normal use for a normal eye. (01 mark)

(d) Describe an experiment to determine the focal length of diverging lens by using a concave mirror. (05 marks)

2. (a) (i) Define **principal focus of a lens.** (01 mark)

   (ii) Show that the least distance between object and real image formed by converging lens is $4f$ where f is the focal length of the lens. (04 marks)

(b) Describe an experiment to determine the minimum deviation of light caused by a glass prism by using optical pins and involve graphical analysis. (05 marks)

(c) A thin equi-convex lens of glass of refractive index 1.5 with radius of curvature 24 cm is placed on a horizontal plane mirror. When the space between the lens and the mirror is filled with a liquid. A pin held 40 cm vertically above the lens coincides with its own image. Calculate;

   (i) the power of the lens (02 marks)

   (ii) critical angle of liquid-air boundary. (03 marks)

(d) i) What is meant by **chromatic aberration**? (03 marks)

   (ii) State properties of lenses used in an achromatic doublet. (02 marks)

SECTION B:

(a) (i) Distinguish between **pitch** and **loudness of sound**. (02 marks)

(ii) Describe an experiment to show that sound obeys the laws of reflection. (05 marks)

(b) (i) What is meant by **Doppler effect** in waves? (01 marks)

(ii) A stationary observer is in front of vertical wall. A police car moving at 20 ms^{-1} sounds a siren of frequency 1000 Hz as it recedes the observer and approaches the vertical wall. Find the beat frequency of sound hard by the observer (take speed of sound in air as 340 ms^{-1}). (04 marks)

(c) Describe an experiment to determine end correction of an open pipe. (05 marks)

(d) Two loud speakers A and B producing sound of slightly different frequencies faced each other. A boy moves along the line joining the two speakers. Explain what the boy observes. (03 marks)

(a) What is meant by **diffraction?** (01 mark)

(b) Explain using Huygen's principle the diffraction pattern produced by a single slit. (06 marks)

(c) Light of wave length 5×10^{-7}m falls on a grating with 600 lines per mm. Determine the highest order of diffraction that can be observed. (04 marks)

(d) (i) Explain what is meant by the plane of polarization of light? (02 marks)

(ii) A liquid of refractive index 1.3 is used to produce polarized light by reflection. Find the angle of incidence on the liquid surface. (03 marks)

(b) State three uses of polarized light. (02 marks)

SECTION C:

5. (a) Define magnetic flux linkage and its S.1 unit. (02 marks)

(b) (i) Write down expression for magnetic flux density due to circular coil. (01 mark)

(ii) Draw magnetic field patters around a circular coil. (02 marks)

(c) Explain why a piece of metal carrying current placed in solenoid carrying current experiences force. (03 marks)

(d) (i) Derive the expression for the force per unit length between two parallel straight current carrying conductors. (04 marks)

(ii) Describe absolute method of measuring current. (05 marks)

(e) A conducting disc of radius 0.04 m with its plane perpendicular to the field of density 0.2 T rotates at 120 revolutions per minute. Find e.m.f induced between the disc and its rim.

6. (a) (i) What is meant by **eddy current**? (03 marks)

(ii) Explain one practical application of eddy currents. (04 marks)

(b) (i) Given that an alternating current $V = V_0 \sin 2\pi f t$ is connected across an inductor. Show that voltage leads current by $\frac{\pi}{2}$. (04 marks)

(c) (i) Describe the structure and mode of operation of moving iron meter repulsive type. (05 marks)

(ii) State two advantages of the A.C meter in (c) (i) over ordinary moving coil ammeter. (01 mark)

7. (a) Distinguish between **self-induction** and **mutual induction**. (02 marks)

(b) Describe the structure and mode of operation of **steep up transformer**. (04 marks)

(c) A search coil 50 turns and radius 0.5 m is arranged such that its plane is perpendicular to the magnetic meridian. The coil connected a balistic galvanometer of sensitivity 5.7×10^4 rad C^{-1} and resistance 100 Ω. When the coil is rotated through 180^0 about the vertical axis, the balistic galvanometer deflects through 0.8 rads. Find:

(i) the horizontal component of the Earth magnetic flux density. (03 marks)

(ii) the resultant magnetic flux density of the Earth if the angle of dip is 70^0. (03 marks)

(d) (i) Explain why sparks are produced between the contacts of the switch in an inductive circuit when the switch is closed and re-opened. (02 marks)

(ii) Explain how sparks in (d) (i) reduced. (02 marks)

SECTION D:

8. (a) (i) Explain what is meant by **action at point**. (03 marks)
(ii) State two practical applications of action at a point. (01 mark)

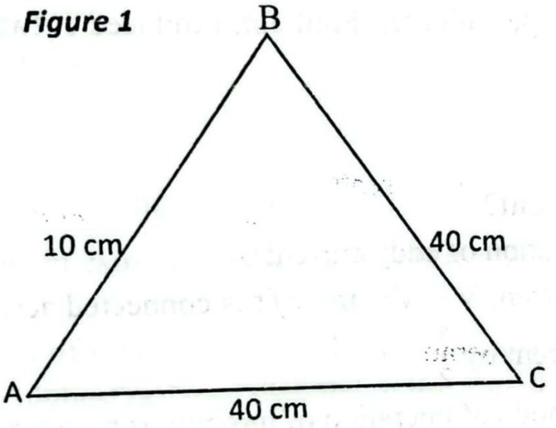
(b) (i) Draw a graph showing variation of electric field intensity due isolates point charge. (02 marks)

(ii) Prove that $\Phi = \frac{Q}{\varepsilon_0}$ where Φ is electric flux, Q is charged and ε_0 is permittivity of free space. (04 marks)

(b) Explain what is observed when positively charged body is slowly brought near the cap of negatively changed gold lead electro scope. Assume the body has a large charge than gold leaf electroscope. (03 marks)

(c) Charges of -20 μC and +20 μC are placed at points A and B as shown in Figure 1.

Figure 1



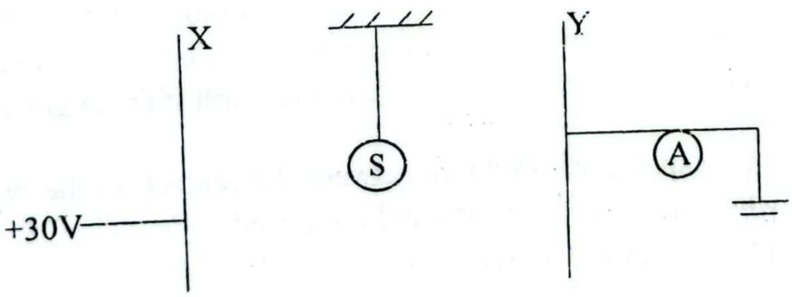
Find electric field intensity at C hence find the magnitude force acting on charge of 60 pC when placed at C

9. (a) (i) Define **nano farad**. (01 mark)
(ii) Draw electric field pattern due to charged parallel plate capacitor. (02 marks)

(b) Explain what happens when a conductor is inserted between plates of a charged capacitor. (02 marks)

(c) Describe an experiment to determine **dielectric constant** by using vibrating reed switch circuit. (04 marks)

(d) Figure 2 shows a parallel plate capacitor of plates X and Y. Plate Y is earthed and Y is connected to positive potential of +30V. The distance of separation between the plates is 10 mm the plates have area of 0.00045 m^2.



i) Explain why a small uncharged metal sphere suspended between the plates oscillates continuously between the plates. (03 marks)

ii) Find the capacitance of the capacitor. (02 marks)

iii) If the sphere makes 50 oscillations per second find the reading of ammeter A. (06 marks)

(e) Two capacitors of 2μF and 3μF are charged to 50 V and 100 V respectively. The capacitors are then disconnected from the batteries and then they are connected together. Find:

(i) the common p.d between the capacitors. (02 marks)

(ii) the energy stored in the 2μF capacitor after connecting them together. (02 marks)

10. (a) (i) Define **temperature coefficient** of resistance of a conductor. (01 mark)

(ii) Explain why temperature coefficient of resistance for conductors is positive. (03 marks)

(b) i) Describe an experiment to determine **electrical resistivity** of wire by using meter bridge. Involve graphical analysis in your explanation. (05 marks)

(ii) State the precautions taken when performing experiment in (b) (i) above. (01 mark)

(c) (i) Outline the principle of potentiometer. (03 marks)

(ii) State the advantages of potentiometer as p.d measuring instrument. (01 mark)

(d) Figure 3 shows a potentiometer with slide wire AB of uniform resistance 4Ω and length 100cm. D is driver cell of negligible internal resistance. E is a cell of e.m.f 1.5V when k_1 open the balance length AJ is 60cm.

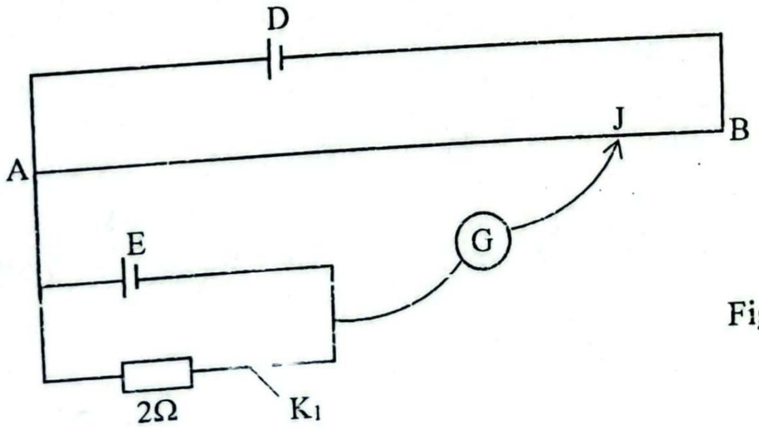


Figure 3

(i) If the internal resistant of E is 1.4 Ω, find the balance length AJ when K_1 is closed. (03 marks)

(ii) e.mf of D (03 marks)

*** END ***

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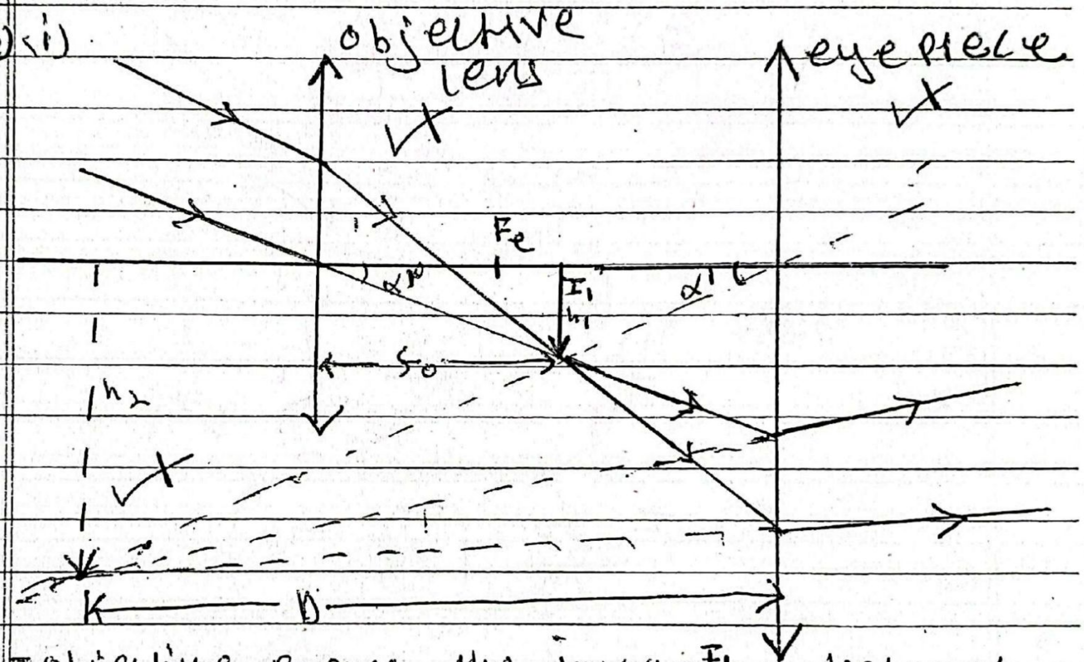
PHYSICS P510/2

1(a) (i) Near point is the point at which the object or image can be seen in it's greatest detail. ✓ 01

(ii) Eye ring is the image of objective formed by eye piece. ✓ 01
(Do not accept when one uses the word position)

(b)(i)



- objective forms the image I_1 of distant object at its focal point F_o. ✓
- I_1 is between the eye piece and its focal point F_e. I_1 acts as a real object for the eyepiece ~~thereby final image is formed~~ which is magnified and virtual is formed at near point. ✓

(03 marks)

(ii) $\tan \alpha = \frac{h_1}{f_0}$ and $\tan \alpha^1 = \frac{h_2}{D}$

For small angles in radians

$\tan \alpha \simeq \alpha = \frac{h_1}{f}$ and $\tan \alpha^1 \simeq \alpha^1 = \frac{h_2}{D}$

$$M = \frac{\alpha^1}{\alpha}$$

$$= \frac{h_2}{D} \div \frac{h_1}{f_0}$$

$$= \frac{h_2}{h_1} \times \frac{f_0}{D}$$

But $\frac{h_2}{h_1} = \frac{-D}{f_e} - 1$

$$\therefore M = \frac{f_0}{D}\left(\frac{-D}{f_e} - 1\right)$$

$$= -\frac{f_0}{f_e}\left(1 + \frac{f_e}{D}\right)$$

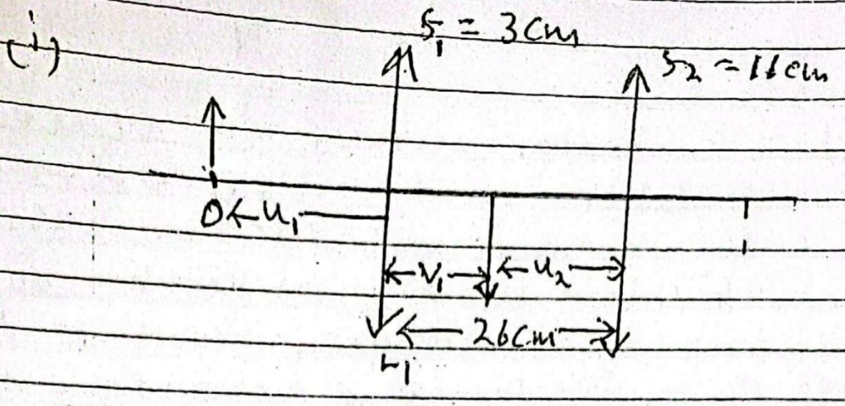
But $M^1 = \frac{f_0}{f_e}$

$$\therefore \frac{M}{M^1} = 1 + \frac{f_e}{D}$$

thus M ased by the ratio of $1 + \frac{f_e}{D}$.

04

(i)



Action of L_1

$\frac{1}{f_1} = \frac{1}{u_1} + \frac{1}{v_1}$ $\quad \frac{1}{3} = \frac{1}{3.6} + \frac{1}{v_1}$ $\quad v_1 = 18cm$

$\cancel{u_2 = v_1}$ $\quad u_2 = 26 - 18$
$= 8cm$

Action of L_2

$u_2 = 8cm$

$\frac{1}{f_2} = \frac{1}{u_2} + \frac{1}{v_2}$

$\frac{1}{16} = \frac{1}{8} + \frac{1}{v_2}$

$v_2 = -16cm$

$m = \frac{v_1}{u_1} \times \frac{v_2}{u_2}$ 02

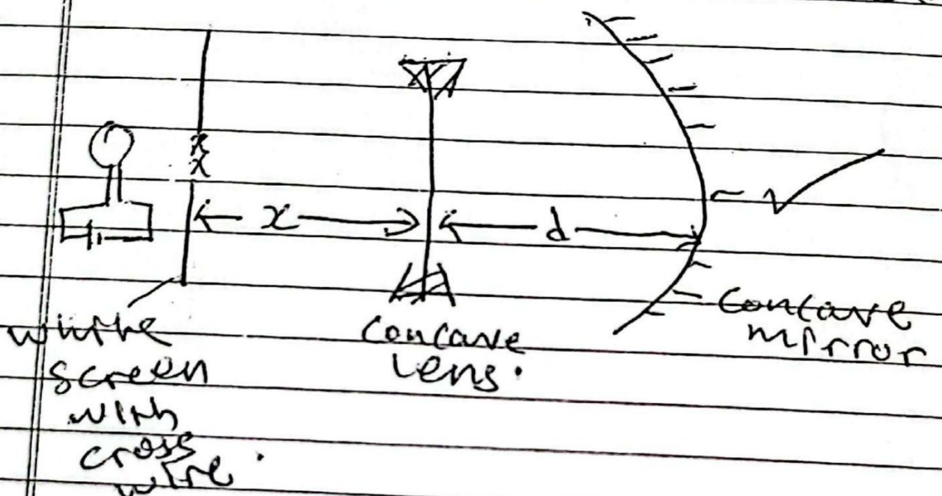
$= \frac{18}{3.6} \times \frac{-16}{8}$

$= 10$

(ii) In microscope, for normal adjust; final image must be at near point which is at distance of 25cm. Therefore the above arrangement is not suitable since final image is at 16 cm from eye piece.

01

d A concave mirror is placed in holder and it's position is adjusted until the sharp image of distant object is formed on the screen. the distance f between the screen and the mirror is measured.



- A concave mirror is arranged coaxially with concave lens as shown above.

The position of the lens is adjusted until a sharp image of cross wires is formed on the white screen.

- Distances x and d are measured
- Focal length of the lens is given by $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$

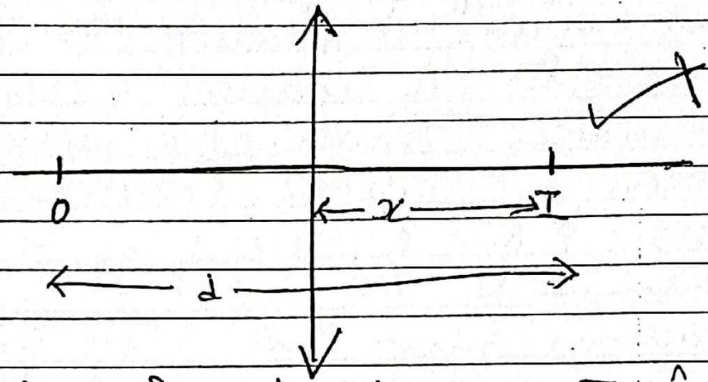
where $u = x$ and $v = -(2f - d)$

If student uses a concave mirror of known r or f let him miss 01 then

05

2(a)(i) Principal focus is the point on principal axis where all ray close and parallel to it, ~~concav verg~~ converge or appear to diverge after refraction by the lens. 01

(ii)



If O is object and I is image then $u = d - x$ $v = x$

$$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$$

$$\frac{1}{d-x} + \frac{1}{x} = \frac{1}{f}$$

$$\frac{1}{f} = \frac{d}{x(d-x)}$$

$$x^2 - dx + df = 0$$

For real roots

$$b^2 \geq 4ac$$

$$(-d)^2 \geq 4 \times 1 \times df$$

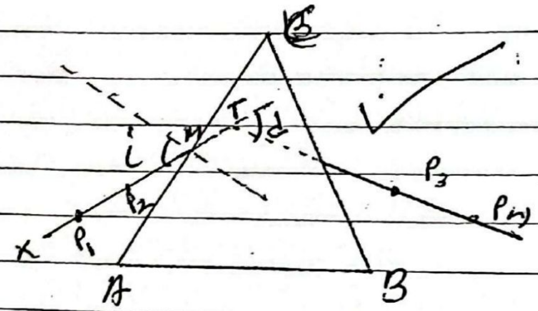
$$d \geq 4f$$

Therefore for real image the least distance between O & I should $= 4f$

04

05

6b



- A prism is placed on ~~plain~~ sheet of paper and its out line ABC is traced. it is removed from paper and a normal line is drawn on AC
- Line XM is drawn such that it makes angle i with the normal.
- prism is placed back and two pins P_1 and P_2 fixed on XM.
- ~~looking~~
- looking thr the side BC two pins P_3 and P_4 are fixed along such that they appear, to be in straight line with images of P_1 and P_2
- The prism and pins are removed the lines drawn thr. pins marks $P_1 P_2$ and $P_3 P_4$ to meet at T
- The $\angle d$ is measured
- experiment is repeated for other values of i. results are tabulated. A graph of d vs i is plotted.
- The least value of d is determ from the graph & it is minimum deviation.

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

$\frac{1}{f} = (1.5-1)\left(\frac{1}{24} + \frac{1}{24}\right)$

$f = 24 cm$

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

$= \frac{1}{24 \times 10^{-2}}$

$= 4.17 D$

02

(ii) $\frac{1}{f} = \frac{1}{f_L} + \frac{1}{f_g}$

$\frac{1}{40} = \frac{1}{f_L} + \frac{1}{24}$

$\cancel{\frac{1}{f_L}}$ $f_L = -60 cm$

$\frac{1}{-60} = (n_L - 1)\left(\frac{1}{-24} + \frac{1}{\infty}\right)$

-0.0167 $n_L = 1.4$

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

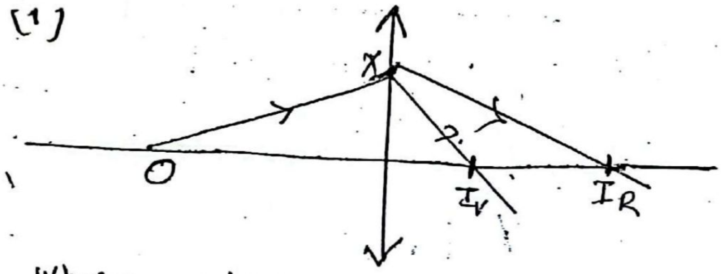
$\sin c = \frac{1}{1.4}$

03

0.714 $c = 45.6°$

8

d (i)



when white light from object, O is incident on a lens it's dispersed into coloured ~~lights~~ light ~~leading to~~ rays. The lens has different refractive indies for different coloured rays thereby they are deviation by different amounts and different images are formed at different positions. The ~~et~~ image formed is deformed and has coloured edges which is refered to as chromatic aberration.

(ii) - It should be made up of two lens of which one is convex and another concave.

- The lens should be of different materials (or different refractive index)

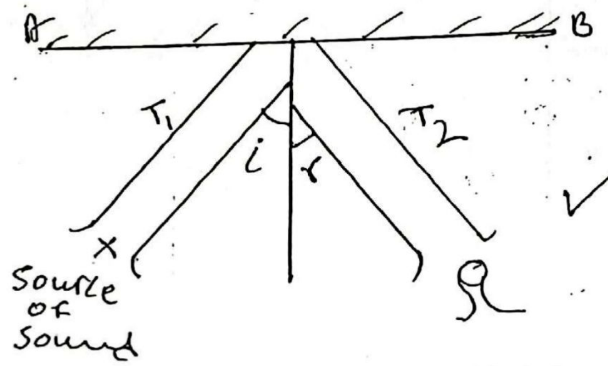
02

3(a)(i) Pitch ~~loudness~~ Loudness

Pitch	Loudness
- Sharpness of softness of sound	Amount of sound energy entering the ear per second
- directly proportional to the freq of sound	depends on the amplitude of sound note

02

(ii)



- A line AB is drawn on white sheet of paper and a normal is drawn on AB.
- A hard board is placed vertically along the line AB
- tube T_1 is placed and an angle i with normal and Tube T_2 is placed at an r with the normal.
- A source of sound is placed at open end X of T_1 and a microphone connected to C.R.O with time base off is placed at open end of T_2.
- ~~The position of T_2 is~~
- The angle r of T_2 is adjusted until max; vertical trace is observed on the screen.

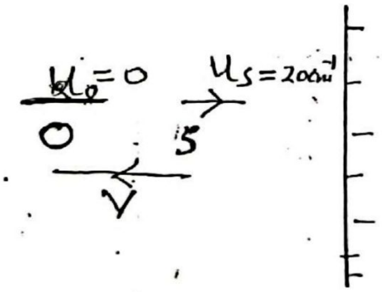
1.80

- the values of i and r are noted
- It is obsververed that $i = r$ which showed that sound obeys laws of reflection

(05 marks)

b(i) Doppler effect is apparent change in frequence and wave length of the wave when there is ~~appear~~ relative motion between the source and observer 01

ii



incident sound.

$\lambda_a = \frac{V + U_s}{f}$ $f_a = \frac{V - 0}{\lambda_a} = \left(\frac{V}{V + U_s}\right) f$

$f_a = \left(\frac{340}{340 + 20}\right) 1000$

reflected sound (assume source has been reflected)

$\lambda'_a = \frac{V - U_s}{f}$ $f'_a = \frac{V}{\lambda'_a} = \left(\frac{V}{V - U_s}\right) f$

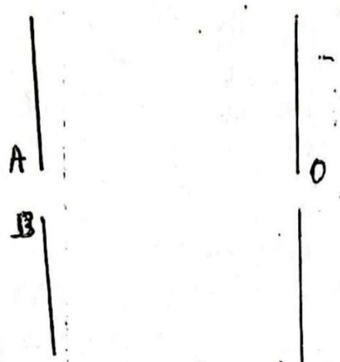
$f'_a = \left(\frac{340}{340 - 20}\right) \times 1000$

$f_b = f'_a - f_a = (\quad\quad) = 118.06Hz$

04

4(a) Diffraction is the spreading of waves beyond their geometrical boundaries leading to interference
01

(b)



- consider straight wave front incident on a narrow slit AB.
- Each point on the wavefront in the gaps acts as secondary source of wavelet that propagate in the forward direction.

At O each wavelet, there is another wave which has travelled equal path lengths and so all wavelets are in phase
Constructive interference occurs and this is the position of the central bright band which is out wards from O.
An increasing number of waves arrive out of phase and hence the bright band reduces in intensity.
Between the bright bands, all corresponding wavelets arrive out phase and interfere destructively forming dark band
06

c $d = \frac{1}{600} \times 10^{-3} = \frac{1}{60000}$

$\sin\theta = \frac{n\lambda}{d}$

But $\sin\theta \leq 1$

$n \times 0.5 \times 10^{-6} \times 60000 \leq 1$

$n \leq 3\frac{1}{3}$

$n_{max} = 3$

08

d(i) Plane of polarization of light is plane in which the elbric vector of polarised light varies.

(ii) $\tan i_p = n$ $\tan i_p = 1.3$ $i_p = 52.4^0$

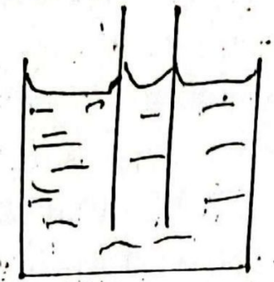
02

e - Stress analysis
- Determination of concentration of sugar in solution

02

11

C Vibrating tuning fork — C NB if one uses



- water is poured into the beaker and an open pipe is deeped into water such that very small air space is left on top.
- A vibrating tuning fork of frequency f is placed at open end of the tube.
- The tube is gradually pulled out of water until first loud sound is ~~heard~~ produced
- The air ~~co~~ length L in the tube is measured.
- The above procedures are repeated ~~until the~~ by using diffrent tuning forks of diffrent frequencies f.
- results are tabulated including $\frac{1}{f}$. A graph of $\frac{1}{f}$ vs L is plotted and intercept C on L axis is determine which is end correction.

05

12

9444

d since the ~~H~~ two speakers produce sound notes of slightly different frequences ~~and move in~~ beats are produced.

- when two sound notes meet in phase constructive interference occurs and boy hears loud sound.
- when notes meet out of phase destructive interference occurs and boy hears soft sound.
- Therefore the boy ~~is~~ hears periodic rise and fall in intensity of the sound.

03

5(a) This total of the product of magnetic flux density and area of the coil perpendicular to the field. ✓

* weber is the magnetic flux threading out the coil of area $1m^2$ perpendicular to the magnetic field of it. ✓

(b)(i) $B = \frac{\mu I N}{2r}$ ✓

where μ = permeability of medium surrounding the coil

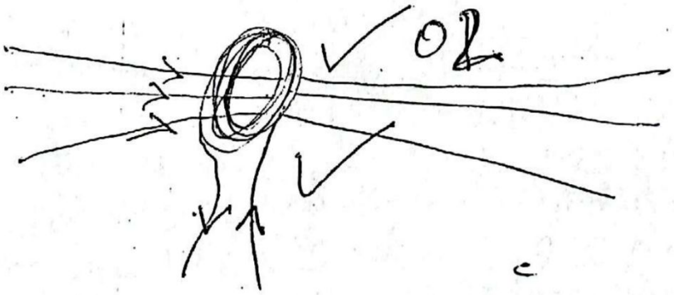
I = current flowing through the coil

N = no of turns of the coil

r = radius of the coil

Give ½ if symbols not defined.

(ii)

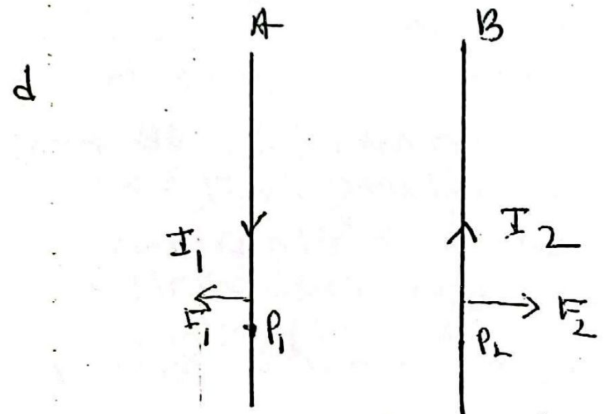


c - when currents flow through the metal and solenoid magnetic fields are built ~~arou~~ around them. ✓

- The fields interact. ✓

- ~~Thereby~~ on one side of the metal, there is a weak resultant magnetic field intensity and other side a strong magnetic field intensity. The magnetic force acts on the metal from ~~resp.~~ side of strong field to side of weak field.

03



- magnetic flux density B_a at point P_2 due to current I_1, $B_a = \frac{\mu_0 I_1}{2\pi d}$
- Force F_2 per unit length acting on B, $F_2 = B_a I_2$

$\therefore F_2 = \frac{\mu_0 I_1}{2\pi d} I_2$

$\therefore$ force

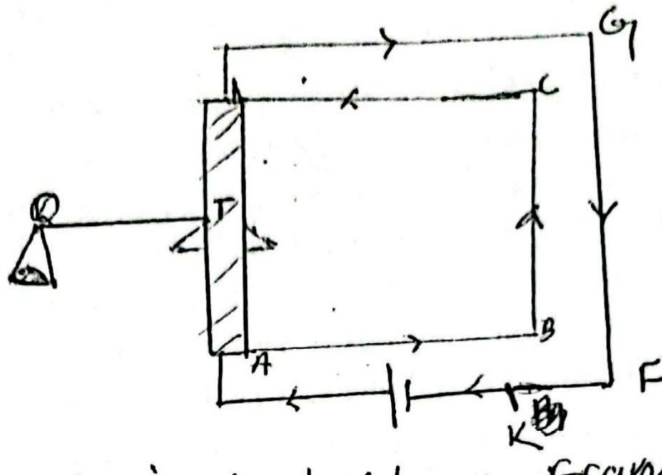
- magnetic flux density B_b at point P_1 due to current I_2

$$B_b = \frac{\mu_0 I_2}{2\pi d}$$

- force F_1 acting on A

i) $F_1 = F_2 = F = \frac{\mu_0 I_1 I_2}{2\pi d}$.

(ii)



- ABCD is conducting frame such that DT = AB
- with no current flowing the zero screw is adjusted until the frame is balancing.
- the switch K is closed and the side BC is repelled down wards
- masses are added to scale pan until the frame balance horizonta again.
- The value masses m on the pan is noted
- the BC = l of the side CB of the frame together with distance d between BC and FG are noted.
- The current I is determine from $I = \sqrt{\frac{2\pi m d g}{\mu_0 l}}$.

05

e $E = \pi r^2 f B$
$= \pi \times 0.042^2 \times \frac{120}{60} \times 0.2$
$= 0.002201 V$

03

20

6(a) (i) conductors are made up of free moving electrons. when conductor is placed in changing magnetic field, magnetic force acts on the electrons. This force displaces ~~me~~ them in ~~par~~ particular direction inducing positive charge in area when they have ~~bee~~ been displaced. The positive charge attracts more electrons to flow. This way a current circuits in the conductor. This current is refered to as eddy current.

03

(ii) - eddy currents are used in damping moving coil galvanometer.
- when the coil rotates the eddy currents are induced in the core.
- The eddy currents produce an opposing magnetic field which opposes the rotation of the coil
- This damping helps the pointer to settle at a point quickly thus eddy are good accurate ready of the values.

03

(b)(i) During the 1st $\frac{1}{4}$ of the cycle current passing through the coil rises to the max and back e.m.f is induced in the coil.

The work is done against back e.m.f thus energy is ~~withdrawn~~ with drawn from the source and stored in the coil as magnetic field.

During second $\frac{1}{4}$, current reduces to zero and the magnetic fields in the coil collapses and the coil returns the energy to the source.

In 3rd quarter, energy is with drawn from the source and kept in the coil

During 4th quarter, energy is taken back to the ~~coil~~ source.

Thereby the net ~~for~~ energy stored in the coil is zero so it is ~~what~~ wattless component.

03

(ii) $V = V_0 \sin 2\pi f t$

$E_b = -L\frac{dI}{dt}$

and $V = -E_b$

$\therefore V = L\frac{dI}{dt}$

$L\frac{dI}{dt} = V_0 \sin 2\pi f t$

(i) $dI = \frac{V_0}{L}\sin 2\pi f t$

$I = \int \frac{V_0}{L}\sin 2\pi f t \, dt$

$= \frac{V_0}{2\pi f L} \times -\cos 2\pi f t$

18

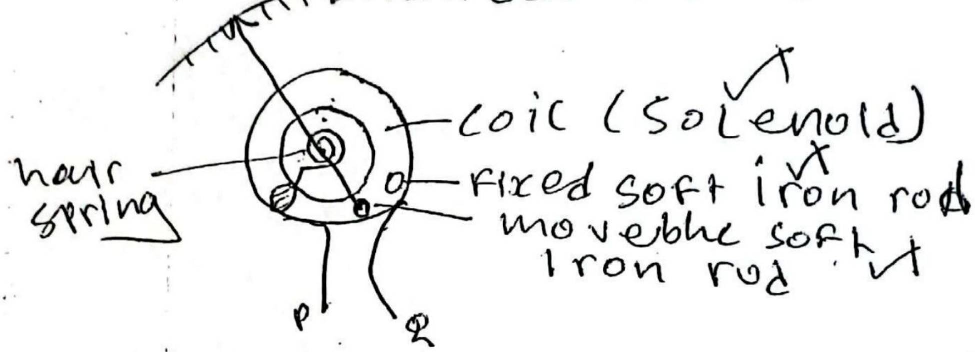
But $-\cos 2\pi f t = \sin(2\pi f t - \frac{\pi}{2})$

and $I_0 = \frac{V_0}{2\pi f L}$

$I = I_0 \sin(2\pi f t - \frac{\pi}{2})$ --(ii)

from (i) and (ii)
v leads I by $\frac{\pi}{2}$ 04

c



- The current to be measured is passed through the coil.
- whatever direction of current, the the irod rods get ~~magnetised in~~ magnetised in the same sense.
- The rods repell each and moveable rod is ~~retted~~ repelled away, the pointer attached to it deflects over the scale until it is stopped by restoring ~~toquete~~ torque in hair spring.
- The force of replusion is proportional to the average value of sq current in ~~txt~~ coil.

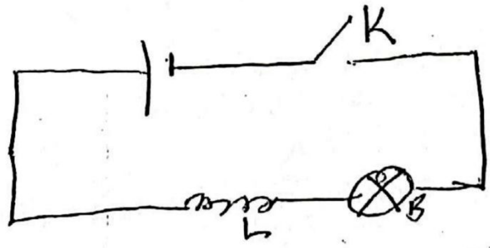
Thereby the deflection of the pointer is proportional to the average value of sq current i.e. $\theta \propto \langle I^2 \rangle$
Thus the scale is non linear

(ii) - can measure both A.C and d.C
- cannot be damaged by big currents ~~and~~

7(a) self induction is process where ~~H~~ e.m.f is induced in the same coil due to change of current in the same coil while mutual induction is process where e.m.f is induced in the coil due to change of current in near by coil.

02

ii

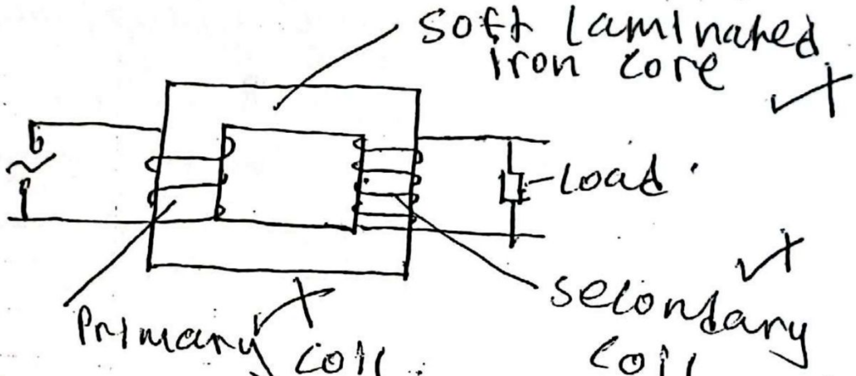


- A pure inductor, bulb B and battery are connected in series
- Switch K is closed.
- The bulb will first give dim light and then it's brightness increases to the max.
- This is because when K is closed current flows through the coil which causes change in magnetic flux in it

This induces back e.m.f ~~induces~~ in the coil that ~~opposeses~~ opposes the flow of current hence the coil gives out dim light.

- After some time, the rate of change of magnetic flux reduces to zero and back e.m.f reduces to zero.
- Thereby more current flows through the bulb and bulb gives out light of increased brightness.

(b)



- when an alternating voltage is connected to primary coil it produces an alternating current in it.
- This produces an alternating magnetic flux in the primary core which induces back e.m.f E_b $\quad E_b = -N_p\frac{d\phi}{dt}$

But $V_p = -E_b$

$$= N_p\frac{d\phi}{dt} \quad \text{---(i)}$$

- The changing magnetic flux in the core links the secondary coil inducing e.m.f V_s in secondary coil.

$V_s = -N_s \frac{d\phi}{dt}$ — (ii)

from (i) and (ii)

$\frac{V_p}{V_s} = -\frac{N_p}{N_s}$

since ~~N_p and V_p~~ $N_s > N_p$

then $V_s > V_p$ thereby the transformer is step up.

c (i) $B_H = \frac{KR\theta_H}{2AN}$

$K = \frac{1}{5.7 \times 10^4}$

$B_H = \frac{100 \times 0.8}{5.7 \times 10^4 \times 2 \times \pi \times 0.5^2 \times 50}$ 03

$= 1.79 \times 10^{-5} T$

(ii) $B_H = B \cos D$ 03

$B = \frac{1.79 \times 10^{-5}}{\cos 70} = 5.23 \times 10^{-5} T$

(d)(i) when the switch is closed and re opened, there is rapid drop in the current which causes large change in flux in the coil.
This causes large p.d between the switch contacts; large electric field intensity ionises air between the contacts.
when negatively charged ions meet positively charged ions they discharge each other violently hence sparks are produced.

02

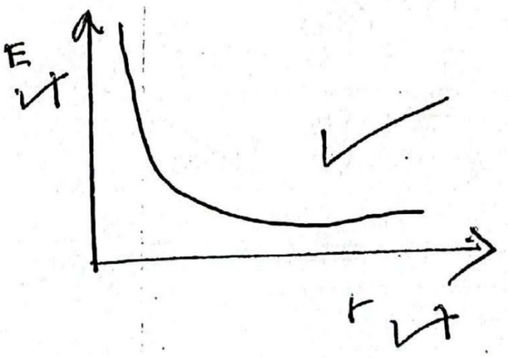
(ii) A capacitor is connected across the contact of the switch. when switch is closed the capacitor charges and when re opened it discharges which reduces the rate at which current reduces.
small electric field intensity is produced thus no ionisation that occurs. thus sparks are not produced.

02

8(a)i) There is high concentration of charge at sharp points of charged conductor which causes high charge density at sharp points This cause high electric field intensity that causes ionisation of air around sharp points of charged conductor.
The ions of charge opposite that of conductor are attracted to the sharp points.
They neutrise ~~the~~ some charge at ~~some~~ sharp points of the conductor.
This way the conductor apparently and gradually looses its charge.
This loss of charge is refered to as corona discharge. 03

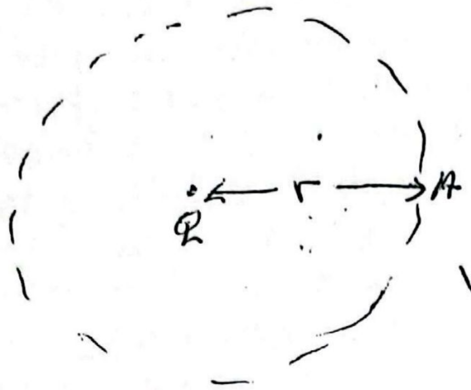
(ii) It is used in ~~corona~~ ligtning conductor
It is used in van de graass generator. 01

b(i)



02

(iii)



Electric field intensity at A $E = \frac{KQ}{r2}$

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

The surface area A of the sphere $A = 4\pi r2$

$$\phi = E \times A$$

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

$$= \frac{Q}{\varepsilon_0}$$

04

c when positively charged body is brought near the cap of negatively charged ~~one~~ electroscope more electrons are attracted from both the plate and the leaf, thus ~~making~~ ~~them more~~ reducing the charge on them. Thereby the divergence of the leaf reduces.

As the charged body moves closer to the cap, the charge on both leaf and the plate further reduces until they are completely discharged thus the leaf collapses.

when the body further moves close to the cap the leaf and plate ~~both~~ become positively charged hence the leaf diverges again.

03 ~~04~~

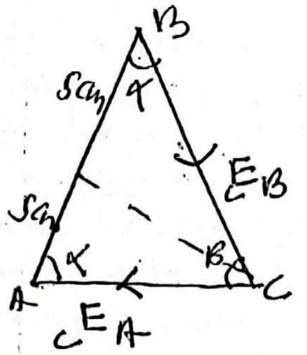
d $E = \frac{KQ}{r^2}$

${}_cE_A = \frac{9 \times 10^9 \times 20 \times 10^{-6}}{0.4^2}$ from c to A

$= 1.125 \times 10^6 \ NC^{-1}$

${}_cE_B = \frac{9 \times 10^9 \times 20 \times 10^{-6}}{0.4}$ from B to C

$= 1.125 \times 10^6 \ NC^{-1}$



$\cos\alpha = \frac{5}{40}$

$\alpha = 82.8^\circ$

$B = 14.4$

$E_x = E_{CB}\cos 14.4 + -{}_cE_A \cos 82.8$

$= 1.125\times10^6(\cos 14.4 - \cos 82.8)$

$= 9.49\times10^5\ N\,C^{-1}$

$E_y = -{}_cE_B \sin 82.8$

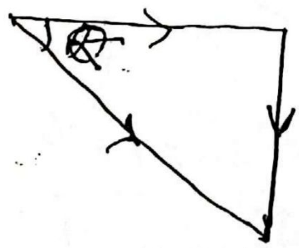
$= -1.125\times10^6 \sin 82.8$

$= -1.12\times10^6\ N\,C^{-1}$

$E_C = \sqrt{(9.49\times10^5)^2 + (-1.12\times10^6)^2}$

$= 1.12\times10^6\ N\,C^{-1}$

1.25×10^{12}



$\tan\theta = \frac{1.12\times10^6}{9.49\times10^5}$

$\theta =$

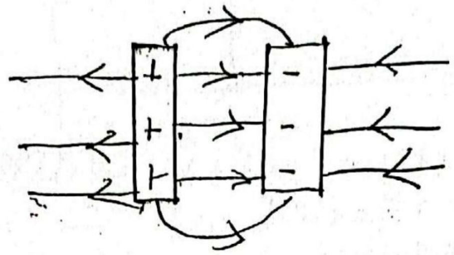
$F = E_C \times 60\times10^{-12}$

$=$

$=$ N

9(a) (i) nano farad is capacitance of capacitor when a charge of 1n C is on either plates of the capacitor and a p.d of 1 V is across its plates.

(ii)



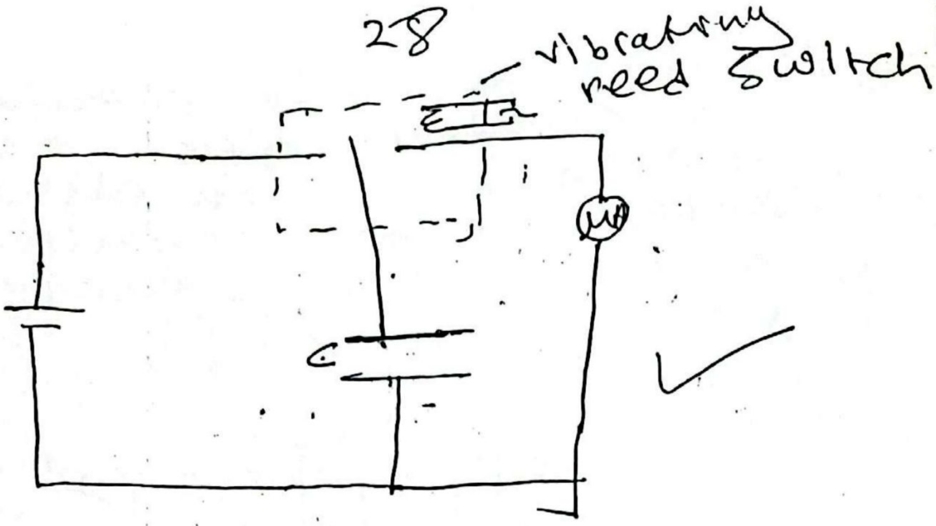
02

(b) - when a conductor is inserted between plates of charged capacitor, negative plate is connected to positive plate.

- Electrons flow from negative plate to positive plate to discharge the positive charge.
- The p.d between the plates reduces as charge on plates reduces and it becomes zero when ~~th~~ capacitor is completely discharged.

28

c

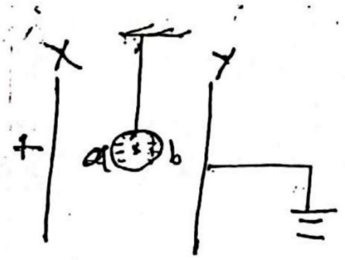


- A capacitor with a dielectric is connected at C.
- the switch is closed and micro ammeter reading I_o is noted
- the dielectric is ~~[illegible]~~ inserted between the plates of the capacitor
- The new micro ammeter reading I_d is noted.
- dielectric constant ε_r is determined from

$$\varepsilon_r = \frac{I_d}{I_o}$$

04

d (i)



when uncharged sphere s is ~~suspended~~ in plates, negative and positive ~~charge~~ ~~is~~ charges are induced at a and b respectively.

e $C_1V_1 + C_2V_2 = V(C_1 + C_2)$

(i) $2\times10^{-6} \times 80 + 3\times10^{-6} \times 100 = V(2\times10^{-6} + 3\times10^{-6})$

$V = 80V.$ 02

(ii) $E = \frac{1}{2}CV^2$

$= \frac{1}{2} \times (2\times10^{-6}) \times 80^2$ 02

$= 6.4\times10^{-3}$ J

10 (a)(i) Temperature coefficient of resistance is the fractional change in resistance of ~~ach~~ conductor at 0°C per degree celsius rise in temp of conductor.

(ii) ~~Ex~~
- Conductors are made of free moving electrons and stationary atoms.
- when temp of conductor is increased, atoms vibrate about their fixed position with higher amplitude.
- This narrows the spaces between the atoms.
  This reduces number of electron and charge flowing.
- The ~~current~~ ~~it~~ reduces which shows increase in the resistance.
  Therefore t.c.r ~~is~~ positive

03.

s experiences attractive and ~~replusive~~ repulsive forces since a is close to x plate and b, then attractive force is greater than repulsive force thus s moves towards X.

when ~~it~~ s makes contact with X charge of a is ~~neutral~~ discharged and then s is repelled to Y.
when it makes contact with X positive charge in s is discharged and s goes back to its original position by its momentum.
The process repeats its self

03

(ii) $C = \frac{\varepsilon A}{d}$

$= \frac{8.85 \times 10^{-12} \times 0.0045}{10 \times 10^{-3}}$

$= 3.9825 \times 10^{-11} F$

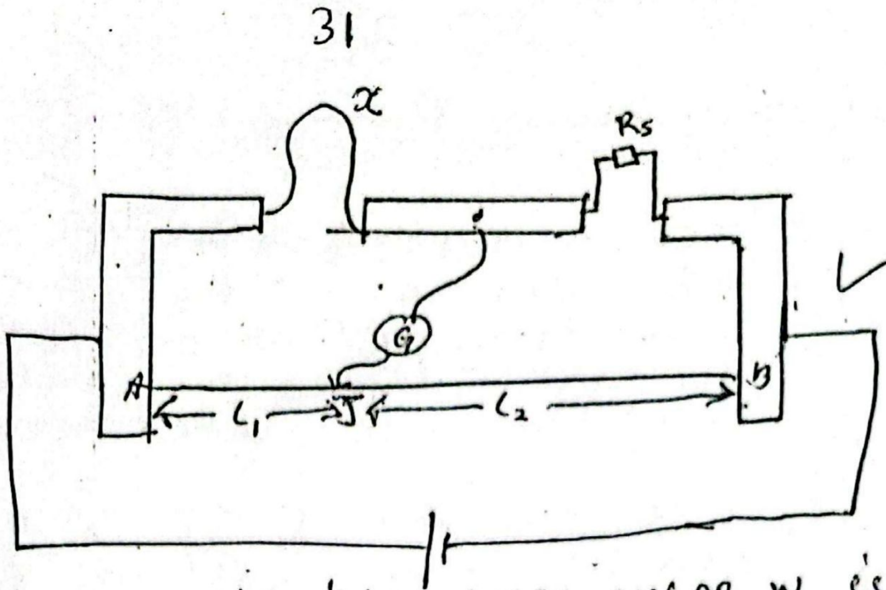
02

(iii) $c = \frac{I}{fV}$

$I = 3.9825 \times 10^{-11} \times 50 \times 30$

$= 5.97 \times 10^{-8} A$

02



- The diameter d of test wire w is measured.
- The length x of test wire is connected in L.H.G and standard resistor R_s is connected in R.H.G of the bridge.
- The jockey J is tapped along slide wire AB until the galvanometer G shows no deflection.
- The balance length L_1 and L_2 are measured.
- The resistance R of the wire is determined from
  $R = \frac{l_1}{l_2} R_s$
- The above procedure is repeated for other values of x and results are tabulated.
- A graph of R vs x and its slope S is determined
- The electrical resistivity ρ is determined from
  $\rho = \frac{S \pi d^2}{4}$ 03

(ii) The jockey should be tapped ~~off~~ not slided on slide wire

- After measuring l_1 and l_2 the wire and R_s are interchanged and ~~average~~ mean values of balance length are determined.
- The R_s ~~cho~~ used should cause the balance point to be close to mid point of AB

any two

c(ii) - can measure very small p.d s

- cannot be destroyed by big ~~vo~~ p.d.
- It is more accurate.

any two

d $$r = R_s\left(\frac{l_0}{l_1} - 1\right)$$

$$1.4 = 2\left(\frac{60}{l_1} - 1\right)$$

03

$$l_1 = 35.29\text{cm}$$

33

(ii) $E = k l_0$

$1.5 = K \times 60$

$K = 0.025\ V cm^{-1}$

$$i_p = \frac{E_D}{R_{AB}}$$

$$= \frac{E_D}{4}$$

$$K = i_p \times \frac{R_{AB}}{l_{AB}}$$

03

$$0.025 = \frac{E_D}{4} \times \frac{4}{100}$$

$E_D = 2.5\ V$