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UGANDA NATIONAL EXAMINATIONS BOARD

DRAFT

Subject: PHYSICS

Paper code: PS10/2

Level: PLE UCE UACE

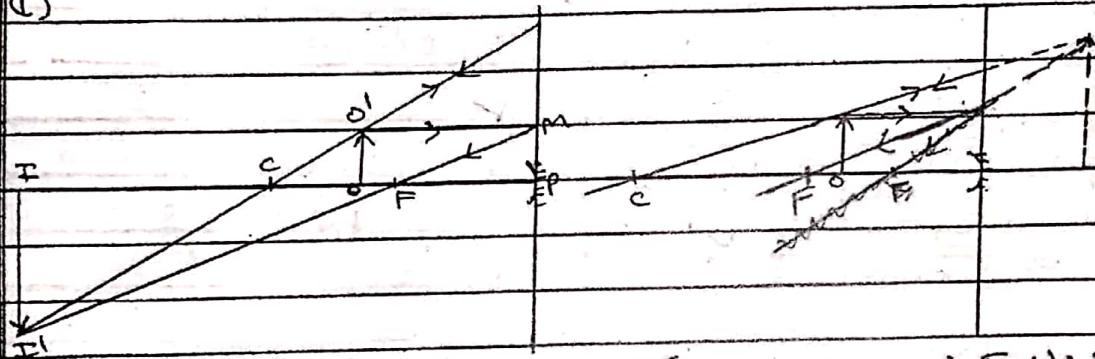
Year: 2023

(1)

1. (a) - The incident ray, the reflected ray, the normal, all at the point of incidence lie in the same plane.
- The angle of incidence is equal to the angle of reflection. ✓

(02)

(b) (i)



- Real images are formed by intersection of real rays while virtual images are formed by apparent intersection of rays. ✓
- Real images can be formed on the screen while virtual images cannot. ✓
- Real images are formed in front of the mirror while virtual images are formed behind the mirror. (04)
- Real image is upright, - Virtual is inverted



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DRAFT

Subject:

Paper code:

Level: PLE UCE UACE

Year:

b) (ii) From ΔS OCO' and CII',

$$\frac{OC}{CH} = \frac{OO'}{H' H_1} - (1) \quad \checkmark$$

from Ds FPM and FII.

$$\frac{FP}{FI} = \frac{MP}{FI} - (2) t$$

$$\text{But } MP = OO' \Rightarrow \frac{OC}{CF} = \frac{PF}{IF}$$

$$\text{Also, } OC = CP - OP$$

$$CI = IP - CP, \quad IF = IP - PF$$

$$\therefore \frac{CP - OP}{IP - CP} = \frac{PF}{IP - PF}$$

$$\Rightarrow \frac{r-f}{v-r} = \frac{f}{v-f}, \quad \text{but } r=2f$$

$$\therefore \frac{2f-u}{v-2f} = \frac{f}{v-f} \Rightarrow (2f-u)(v-f) = (v-2f)f$$

$$2vf - 2f^2 - uv + uf = vf - 2f^2$$

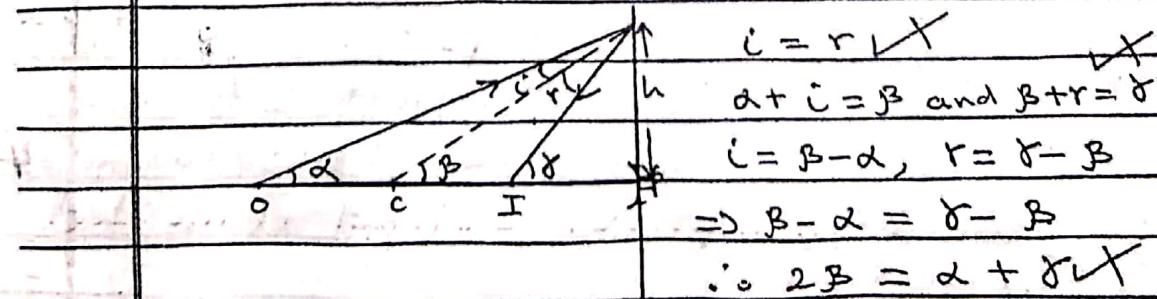
$$vf - uv + uf = 0$$

$$vf + uf = uv^t \text{, dividing through by } uvf,$$

$$\frac{1}{u} + \frac{1}{v} = \frac{1}{t}, \checkmark$$

(54)

Method 2



For small angles measured in radians,

$$\alpha \approx \tan \alpha = \frac{h}{op}, \beta \approx \tan \beta = \frac{h}{cp}, \gamma = \tan \delta = \frac{h}{ip}$$

$$\frac{2h}{cP} = \frac{h}{OP} + \frac{h}{TP} \Rightarrow \frac{2}{r} = \frac{1}{u} + \frac{1}{v}, \text{ but } r = 2f \text{ (why)}$$

$$\frac{2}{2+} = \frac{1}{1+} + \frac{1}{1+} \Rightarrow \frac{1}{1+} = \frac{1}{1+} + \frac{1}{1+}$$

٦٤)



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DRAFT

Subject:

Paper code:

Level: PLE UCE UACE

(3)

Year:

1. (c)

$$m = \frac{v}{u} = -3, v = -3u \quad \text{Mark}$$
$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v} \cancel{+} \quad f = \frac{r}{2} = \frac{30}{2} = 15\text{cm}$$
$$\frac{1}{15} = \frac{1}{u} - \frac{1}{3u} \quad \cancel{\frac{1}{3u}}$$
$$\frac{1}{15} = \frac{3-1}{3u} \Rightarrow \frac{2}{3u} = 15 \quad \therefore u = 10\text{cm.}$$

(03)

method 2

$$r = 30\text{cm}, m = 3$$

$$m = \frac{v}{u} = 3 \Rightarrow v = 3u \quad \text{Mark}$$

$$r = 2f \Rightarrow f = 15\text{cm} \checkmark$$

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v} \cancel{+} \Rightarrow \frac{1}{15} = \frac{1}{u} - \frac{1}{3u} \quad \cancel{\frac{1}{3u}}$$

$$\frac{1}{15} = \frac{3-1}{3u} \Rightarrow 3u = 30 \quad \therefore u = 10\text{cm} \checkmark$$

(03)

method 3

$$\frac{1}{m} = \frac{u}{f} - 1 \cancel{+}, f = \frac{r}{2} = \frac{30}{2} = 15\text{cm}$$

$$m = \frac{v}{u} = -3 \quad \cancel{\frac{v}{u}}$$

$$-\frac{1}{3} = \frac{u}{15} - 1 \quad \cancel{\frac{u}{15}}$$

$$u = 10\text{cm.} \checkmark$$

(03)



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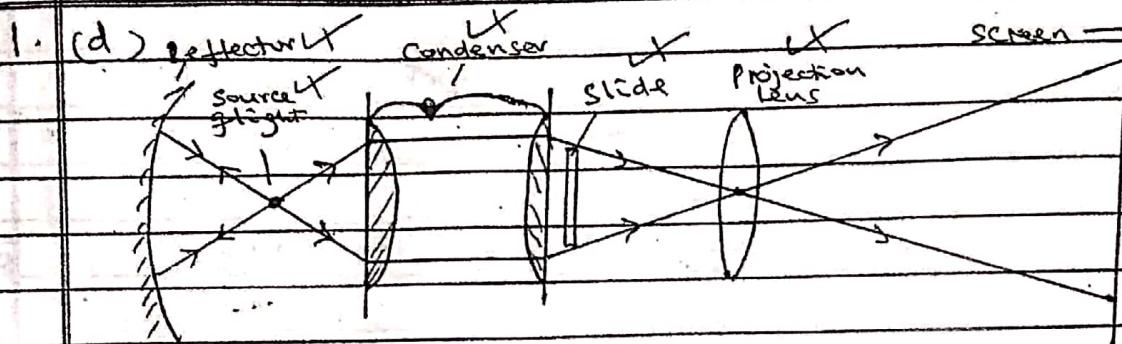
Subject:

Paper code:

Level: PLE UCE UACE

(4)

Year:



(any four)

- The source provides light which is reflected by the concave reflector.
- The condenser concentrates light on the slide.
- The projection lens focuses a magnified image on the screen.

(04)

$$(e) m = \frac{300}{5} = 60, \frac{1}{u} = 60, u = \frac{2400}{60} = 40 \text{ cm}$$

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v} \quad \frac{1}{40} + \frac{1}{2400}, f = 39.3 \text{ cm}$$

(03)

$$m = \frac{3+3}{5+10} \times 5 \times 10^2 = 300/5$$

method 2

$$m = \frac{300}{5} = 60, v = 24 \text{ m} = 2400 \text{ cm}$$

$$\frac{1}{f} = m + 1$$

$$\frac{2400}{f} = 60 + 1$$

$$f = 39.3 \text{ cm}$$

(03)



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DRAFT

Subject: PHYSICS

Paper code: PS7012

Level: PLE UCE UACE

Year: 2023

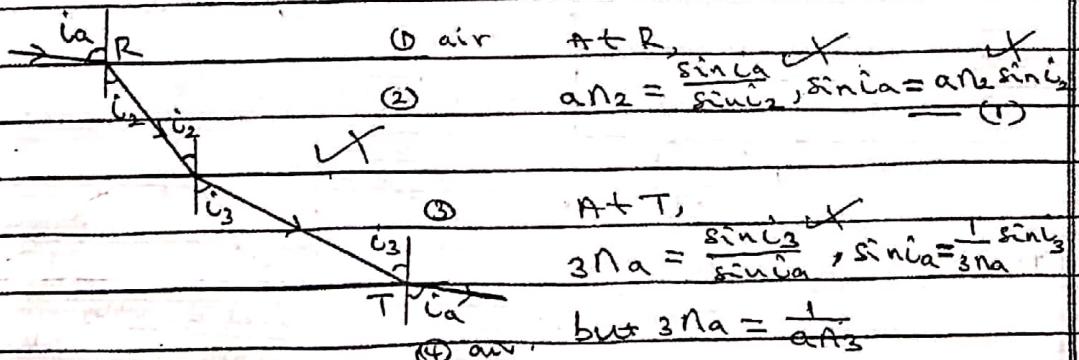
(5)

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

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

(ii) Refractive index of a medium is the ratio of the sine of angle of incidence to the sine of angle of refraction for a ray travelling from a vacuum or air to a medium. OR it is the ratio of the speed of light in a vacuum or air to the speed of light in a medium.

(b) consider a ray travelling through different media as shown



$$\therefore \sin i_2 = n_3 \sin i_3 - (2) \text{ ✓}$$
$$\sin i_2 = n_2 \sin i_2 = n_3 \sin i_3 \text{ ✓ } n_a = 1, n_2 = n_2, n_3 = n_3.$$
$$\therefore \sin i_2 = n_2 \sin i_2 = n_3 \sin i_3. \therefore n \sin i = \text{constant.} \text{ (3)}$$



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Subject: PHYSICS

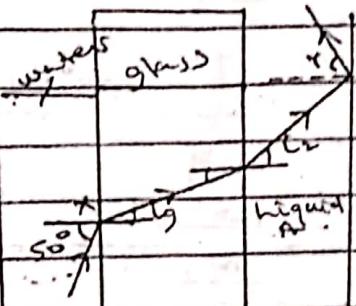
Paper code: P570/2

Level: PLE UCE UACE

(6)

Year: 2023

(c)



Using $n_1 \sin i = n_2 \sin r$ ✓
At point X, $n_1 \sin i = n_2 \sin r$ ✓

$$1.33 \sin 50^\circ = 1.5 \sin i$$

$$\sin i = 1.33 \sin 50^\circ / 1.5$$

$$1.5 \quad i = 42.78^\circ$$

$$i = 42.78^\circ$$

$$\text{At } B, 1.5 \sin 42.78^\circ = 1.25 \sin r, r = 54.59^\circ$$

$$\text{but } r = i, r = 54.59^\circ$$

(05)

method 2

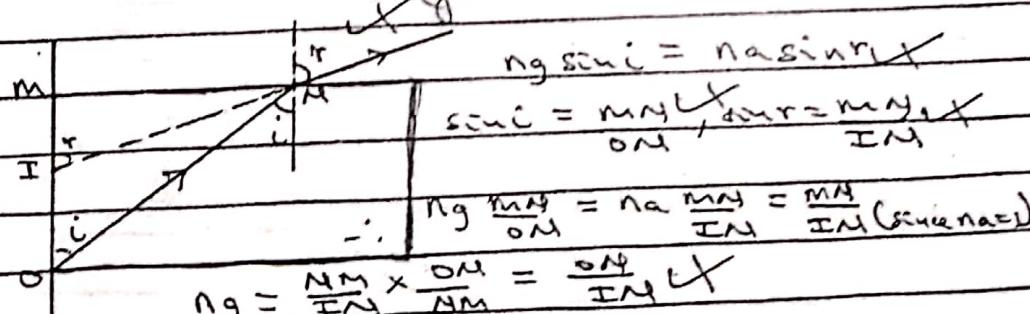
$$n_1 \sin i = n_2 \sin r$$

$$1.33 \sin 50^\circ = 1.25 \sin r, r = 54.59^\circ$$

$$\text{but } r = i, r = 54.59^\circ$$

(05)

(d)



$$ng \sin i = na \sin r$$

$$\sin i = m \frac{OM}{ON}, \sin r = n \frac{IM}{IN}$$

$$\therefore ng \frac{OM}{ON} = na \frac{OM}{IN} = \frac{OM}{IN} \quad (\text{given } a = n)$$

$$ng = \frac{NM}{IN} \times \frac{OM}{NM} = \frac{OM}{IN}$$

since i and r are small angles in radians,

$OM \approx OM$ and $IN \approx IN$

$$\therefore ng = \frac{OM}{IN} = \frac{\text{real depth}}{\text{apparent depth}}$$

(04)



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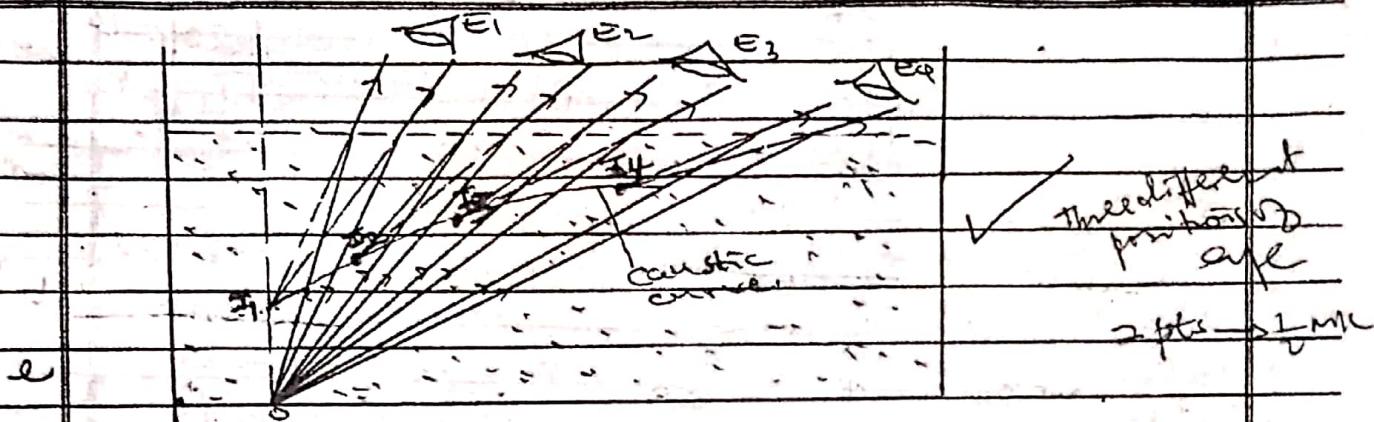
Subject: PHYSICS

Paper code: PS1012

Level: PLE UCE UACE

Year: 2023

(7)



Light from the object O_1 is refracted away from the normal as it emerges from the water surface, and the object appears displaced to I_1 .

As the eye moves away from E_1 , the angle of incidence increases hence the angle of refraction, leading to greater apparent displacement.

The position of the image therefore moves along the curve as the eye moves away from E_1 . (04)

or The object thus appears to be

Moving closer to the surface



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DRAFT

Subject:

Paper code:

Level: PLE UCE UACE

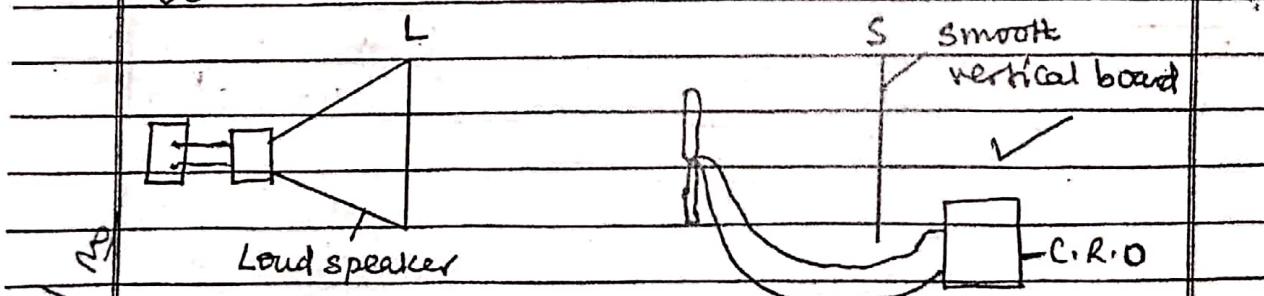
(8)

Year:

QUESTION 3

3(a) i) When two waves of equal frequency, ^{Accept identical} _{wave} equal wavelength and equal amplitude travelling in the same medium in opposite directions meet, they superpose. Where they arrive in phase, reinforcement takes place and maximum amplitude (intensity) is observed. This position is the antinode. Where they meet out of phase, cancellation takes place and amplitude (intensity) is zero. This position is the node. ⁽⁰⁴⁾

(ii)



The apparatus is set up as shown above. The generator is switched on and the x-plates switched off. The length of the trace on the screen is observed. If it changes with time, the position of the board is varied until the length of the trace remains constant. The frequency f of the generator



UGANDA NATIONAL EXAMINATIONS BOARD

DRAFT

Subject:

Paper code:

Level: PLE UCE UACE

(9)

Year:

is recorded. ✓ Keeping the positions L and S by the loud speaker and the vertical board fixed, the microphone is moved until a position where the trace reduces to a dot (or reaches maximum). This position A is noted. ✓ The microphone is further moved in one direction until the trace again reduces to a dot (or reaches maximum). The new position, B by the microphone is noted. ✓ The distance, L between A and B is measured. ✓ The velocity v_s of sound in air is calculated from $v = 2fL$ ✓ (05)

(b) It is used in radar speed traps to measure the velocity v_s of vehicles. ✓

Microwaves are sent from the gun towards approaching vehicles and get reflected. ✓ The machine detects the frequency of the reflected waves, determines the beat frequency and calculates the speed of the vehicles. ✓ (03)

(c) .

v - velocity of the wave

u - velocity of the train

f - frequency of the waves



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DRAFT

Subject:

Paper code:

Level: PLE UCE UACE

(10)

Year:

The apparent wavelength of the waves received by the observer, $\lambda' = \frac{v-u}{f}$

The apparent speed received by the observer due to echo, $v' = v+u$

The apparent frequency of the waves received, $f' = \frac{v'}{v-u}$

(04)

$$f' = \frac{v'}{\lambda'}$$

$$= \frac{(v+u)f}{v-u}$$

(c) (ii) The apparent wavelength of the waves received $\lambda' = \frac{v+u}{f}$

The apparent speed of the waves received $v' = v-u$

The apparent frequency $f' = \frac{(v-u)f}{v+u}$

$$\Rightarrow f' = \frac{(330-25) \times 980}{330+25} = 842 \text{ Hz}$$

(04)

$$\text{OR } f' = \frac{(340-25) \times 980}{340+25} = 845.7 \text{ Hz}$$

$$\text{OR } f' = \frac{(v-25) \times 980}{v+25}$$



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DRAFT

Subject:

Paper code:

Level: PLE UCE UACE

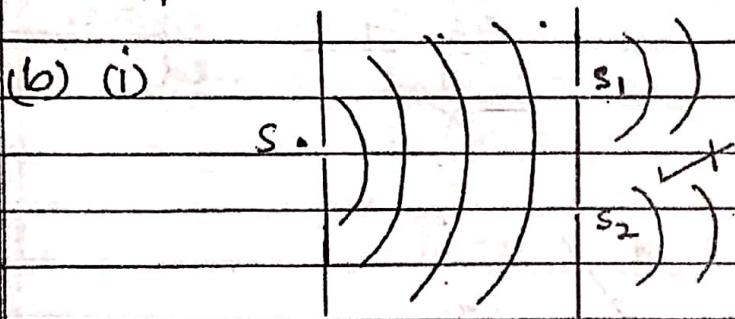
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(11)

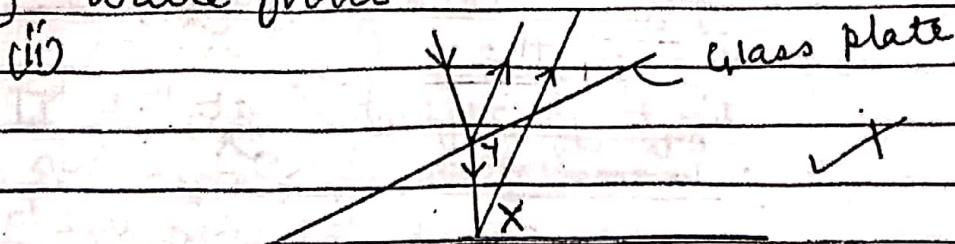
QUESTION 4

(a) Coherent sources are sources of waves ✓
which have

- equal frequency and equal wavelength ✓ Verify
- equal or nearly equal amplitude ✓ (03)
- which superpose with constant phase relationship. ✓ Created from same source



Consider wavefronts diffracting through ✓
Slit, S. Slits S₁ and S₂ are equidistant ✓
from S. The wavefronts diffracting through (02)
S₁ is from the same wavefront as
that diffracting through S₂. Therefore
Sources S₁ and S₂ are created by division
by wave front. ✓



Consider a thin beam of light incident
almost normally on an air wedge above.



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DRAFT

Subject:

Paper code:

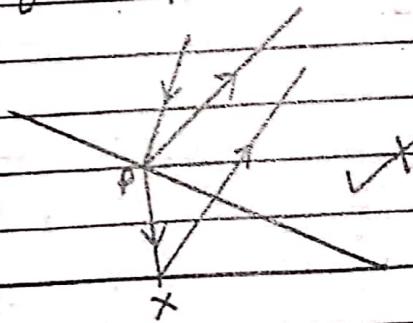
Level: PLE UCE UACE

(12)

Year:

It is partly reflected by the bottom surface of the upper slide at Y and partly transmitted into the air film. The transmitted light is reflected by the top surface of the lower glass slide at X. (102)
X and Y are sources created by division by the same wave energy. Since wave energy is proportional to the square of the amplitude, the sources are formed by division of amplitude.

(c) (i)



Monochromatic light is made incident almost normally onto the upper glass slide. It is partly reflected at the bottom surface of the upper glass slide and partly transmitted through the air film. The transmitted light is reflected at the top surface of the lower glass slide. The two wave trains meet above the air wedge and interfere. Where they meet with path difference equal to an



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DRAFT

Subject:

Paper code:

Level: PLE UCE UACE

(13)

Year:

integral multiple of a full wavelength a dark band is formed. Where they meet with geometrical path difference equal to an odd multiple of half wavelength a bright band is formed. This is because reflection at the top surface of the lower plate occurs at boundary with a denser medium and hence the wave suffers a phase change of 180° equivalent to travelling an extra path length of $\frac{\lambda}{2}$. A series of straight alternate dark and bright fringes are formed which is an interference pattern. (05)

(ii) t-diameter of wire, x-fringe separation
from $\frac{\Delta x}{2t} = \frac{\lambda s}{\lambda s} \Rightarrow t = \frac{\lambda s}{2 \cdot \Delta x}$

$$\text{But } \Delta x = \frac{5.0 \times 10^{-3}}{20} \text{ m}$$

$$\Rightarrow t = \frac{500 \times 10^{-9} \times 10.0 \times 10^{-2}}{2 \times 5.0 \times 10^{-3}}$$

$$\Rightarrow t = 1.0 \times 10^{-4} \text{ m}$$

(d) (iv) constructive interference is said to occur when two light waves superpose in phase to form a bright band.



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DRAFT

Subject:

Paper code:

Level: PLE UCE UACE

(14)

Year:

destructive interference is said to occur when two light waves superpose to form a dark band. ✓

Test slide

(d)(ii)

cover
one
surface
(or
any
part)

Standard flat slide

The test slide is placed in contact with a standard flat slide to form an air wedge. Monochromatic light is directed almost normally onto the wedge, and interference patterns formed are viewed from above. If regular fringes parallel to the line of contact is observed, the test slide is flat. Any areas showing irregular patterns correspond to the areas on the surface that are not flat. ✓

* Accept Newton's ring expt/method 20



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DRAFT

Subject:

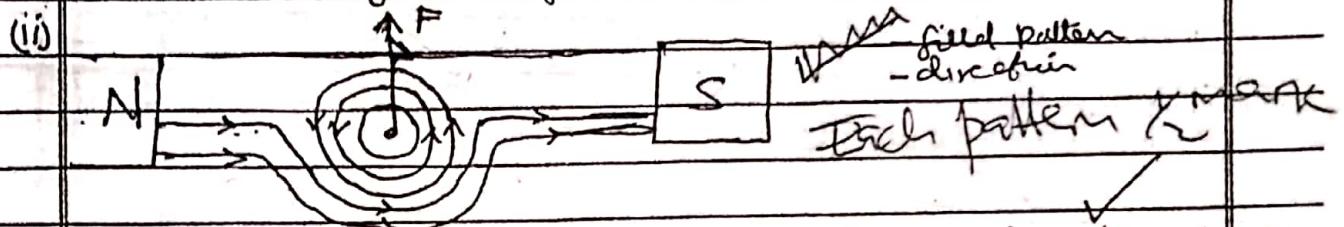
Paper code:

Level: PLE UCE UACE
SECTION C

Year:

(15)

- 5(a) Magnetic field line: Direction of the path which an isolated N-pole of a magnet would take when placed in magnetic field. ✓



Magnetic field due to current in the wire interacts with the applied field to form the resultant pattern which is stronger on the lower side and weaker on the upper side. A force therefore develops which acts such a direction as to move the wire from direction of strong to weak field. ✓

(b) Mechanical power = Electrical power ✓

$$\text{Mechanical power} = FV \quad \checkmark$$

$$\text{Electrical power} = EI \quad \text{but } E = BLV \quad \checkmark$$

$$\therefore FV = BLV \cdot I \quad \checkmark$$

$$\Rightarrow F = BIL \quad \checkmark$$

(c) $B = \frac{\mu_0 I}{2\pi r} \quad \checkmark$

(ii) $B_B - B_A = 0 \Rightarrow B_B = B_A$

$$\frac{\mu_0 x s}{2\pi(x+0.2)} = \mu_0 \times 3 \quad \begin{matrix} \checkmark \\ \text{Substitution} \end{matrix}$$

$$x = 0.3 \text{ m} \quad \checkmark$$

13



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DRAFT

Subject:

Paper code:

Level: PLE UCE UACE

(16)

Year:

$$\text{OR } B \quad A \quad B_1 + B_2 = 0 \quad \text{at } x$$

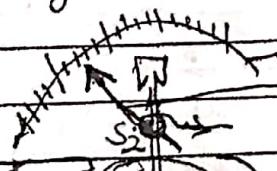
$$S_A \quad \sqrt{3}A \quad \Rightarrow B_1 = -B_2$$

$$\frac{5\mu_0}{2\pi(0.2-x)} = \frac{3\mu_0}{2\pi(x)} \quad \text{Substituting}$$

$$x = 0.3 \text{ m}$$

The Neutral Point is 0.3 m from wire of 3A to the right of the wire

(d) i)



- Linear scale
 - Pointer
 - N-S
 - hair spring
 - Coil
 - soft iron core
 - jewel bearing
 - cylindrical soft iron core
 - linear scale
 - pointer
 - N-S - pole pieces of permanent magnet
 - S1, S2 - hairsprings
 - (Very Q)
- The current to be measured is let in and out by the hair springs. The coil experiences a magnetic torque $\tau = BANI$ and turns together with the pointer until they are stopped by the restoring torque of the hair spring $\tau = KO$. At this point $BANI = KO \Rightarrow \theta = \frac{BNAI}{K}$
- Since NBA is constant $\theta \propto I$ hence linear Scale.

(iv) The coil is made heavier to increase the period of oscillation. (any 2)

- The suspension is made fine to reduce rigidity and increase sensitivity
- The coil is wound on insulating former to minimise damping due to eddy currents



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DRAFT

Subject:

Paper code:

Level: PLE UCE UACE

17

Year:

(a) Magnitude of induced emf is proportional to the rate of change of magnetic flux linkage. ✓

- The direction of the induced emf is such as to oppose the change causing it. ✓ 2

(ii) Let total flux linking the N turns of the coil be $N\phi$ (if -ve m.m.f.)

$$\text{Induced emf } E = -N \frac{d\phi}{dt} \quad (\text{Davy's law})$$

$$\text{Induced current } I = \frac{E}{R} = -\frac{N}{R} \frac{d\phi}{dt} \quad \text{but } I = \frac{dQ}{dt}$$

$$\Rightarrow dQ = -\frac{N}{R} d\phi \quad 4$$

When the flux changes from ϕ_1 to ϕ_2 ,

$$\text{then } Q = \int_{\phi_1}^{\phi_2} \frac{N}{R} d\phi = -\frac{N}{R} (\phi_2 - \phi_1)$$

$$Q = \frac{N}{R} (\phi_1 - \phi_2)$$

(b) - The coil is made heavier to increase the period of oscillation. ✓

- The suspension is made fine to reduce rigidity and increase sensitivity. ✓ (any two) 4

- The coil is wound on insulating former to minimize damping by eddy currents. ✓ ✓ ✓

$$(c) B at the centre of Solenoid = \mu_0 n I = 4\pi \times 10^{-7} \times 500 \times 5 = 3.142 \times 10^{-3} T \quad 3$$

$$B = \theta R \Rightarrow \theta = B \alpha NA = \frac{3.142 \times 10^{-3}}{R} \times 4 \times 2000 \times 6 \times 10^{-4} \quad 13$$



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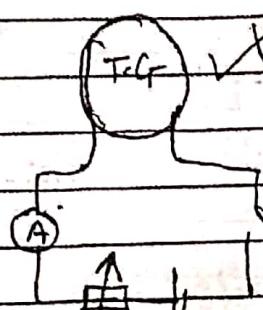
Level: PLE UCE UACE

(18)

Year:

$$\theta = 1507.97 \text{ divisions}$$

(d)



A deflection magnetometer is mounted in a search coil to form a tangent galvanometer when switch K is connected in a circuit as shown.

The coil is placed vertical and perpendicular to the horizontal component of the field intensity. Switch K is closed and the deflection θ_1 and θ_2 of the tangent galvanometer is recorded. The average deflection θ is recorded together with the ammeter reading. The experiment is repeated for other values of I and the results recorded in a table including values of $\tan \theta$. A graph of $\tan \theta$ against I is plotted and the slope S is determined.

$$H_n = \frac{N}{2RS} \quad \text{OR} \quad B_H = \frac{\mu_0 N}{2RS}$$

Where N and R are Number of turns and radius of the coil respectively.

The reverse switch method, ~~for deflection~~ ~~is noted~~ ~~07~~

$$- \theta, \theta_1 \& \theta_2$$

$$- B_H = \frac{\mu_0 N I}{2\pi R^2}$$

- The coil ~~is closed~~ ~~I~~ & ~~R~~ ~~are noted~~ ~~07~~
- ~~X~~ is closed ~~is noted~~ ~~07~~
- Deflection θ is noted ~~07~~
- Reverse θ is noted ~~07~~
- Average θ is noted ~~07~~
- $H_n = \frac{NI}{2\pi R^2}$



UGANDA NATIONAL EXAMINATIONS BOARD
DRAFT

Subject: PHYSICS

Paper code: P510/2

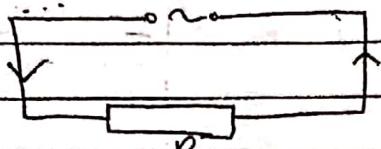
Level: PLE UCE UACE

(19)

Year: 2023

- 7(a) Reactance is the non resistive opposition to the flow of alternating current in a circuit. (Capacitor or inductor) (1)
(ii) Frequency is the number of cycles made by the current per second. [Note: cycles not oscillations]. (1)

(b)



$$I = I_0 \sin \omega t$$

$$\text{Instantaneous Power dissipated } P = I^2 R \checkmark$$

$$\text{Instantaneous Power } P = I_0^2 \sin^2 \omega t R \checkmark$$

$$\langle P \rangle = \langle I_0^2 \sin^2 \omega t R \rangle \checkmark$$

$$= I_0^2 R \langle \sin^2 \omega t \rangle$$

$$\text{but } \langle \sin^2 \omega t \rangle = \frac{1}{2} \checkmark$$

$$\langle P \rangle = \frac{1}{2} I_0^2 R \checkmark$$

Let I_{rms} be the steady current that dissipates heat in the resistor at the same rate as the a.c. them.

$$\langle P \rangle = I_{\text{rms}}^2 R \checkmark$$

$$I_{\text{rms}}^2 R = \frac{1}{2} I_0^2 R \checkmark$$

$$I_{\text{rms}}^2 = \frac{I_0^2}{2}$$

$$I_{\text{rms}} = \frac{I_0}{\sqrt{2}} \checkmark$$

(4)



UGANDA NATIONAL EXAMINATIONS BOARD

DRAFT

Subject: Physics

Paper code: PS10/2

Level: PLE UCE UACE

20

Year: 2023

7(c)

$$I_{rms} = \frac{V_{rms}}{X_L}$$

$$\text{but } V_{rms} = \frac{V_0}{\sqrt{2}} \text{ and } X_L = 2\pi f L$$

$$\text{hence } I_{rms} = \frac{V_0}{\sqrt{2} \cdot 2\pi f L}$$

$$X_L = 2\pi f L$$

$$= \frac{N \cdot \pi \cdot 20}{157 \cdot 0.0796}$$

$$= 0.1273 \text{ A}$$

$$I_{rms} = I_0 / \sqrt{2}$$

$$I_{rms} = \frac{200}{20 \times 50 \times 0.5 \times \sqrt{2}}$$

$$= \frac{0.1273}{\sqrt{2}}$$

$$= 0.09003 \text{ A}$$

$$I_{rms} = 0.09003 \text{ A}$$

(3)

(d) The bulb lights continuously.

This is because, when switch K is closed the capacitor charges and discharges continuously and in so doing, current flows.

(2)

(ii) The brightness of the bulb increases. This is because the capacitance increases, the reactance reduces and the current in the circuit increases. When the current increases, the brightness also increases.

Accept & uses ✓
QCN ITSES ✓

(iii) The brightness of the bulb reduces. This is because reducing frequency increases reactance in the circuit thus reducing current making the bulb go dim.

Accept Q = CN
if Q = CN \Rightarrow ITSES

(2)

- Average discharge I decreases ✓
- Brightness decreases.



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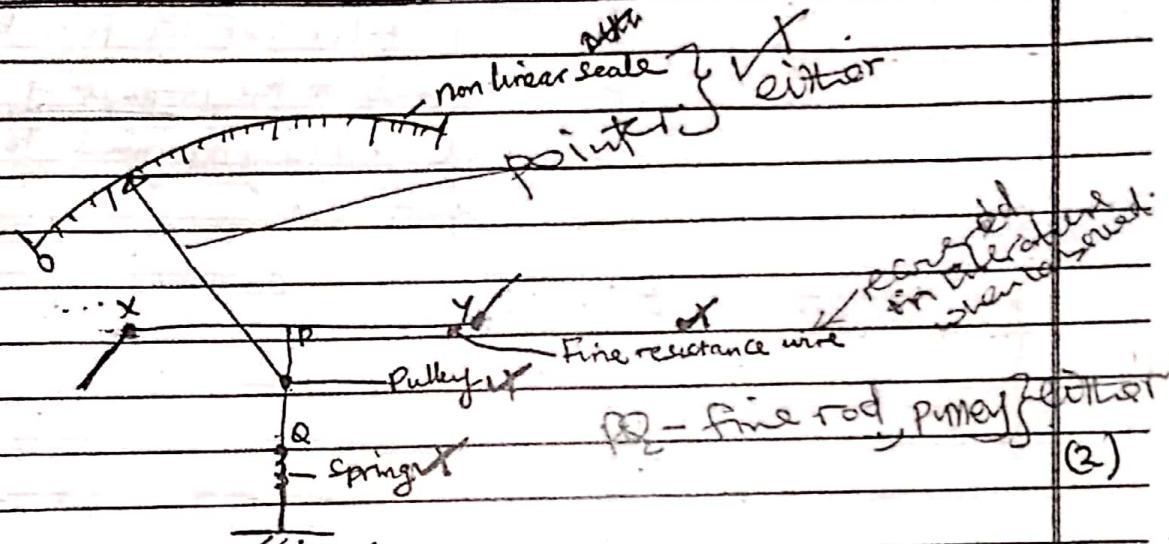
Paper code: PS10/2

Level: PLE UCE UACE

Year: 2023

(21)

7(e)



Current to be measured is passed through the fine resistance wire XY as shown above. The wire hangs up, expands and sags! ✓
The sag is taken up by the fine rod PQ which rotates the pulley as it moves, causing the pointer to turn over the scale. ✓
The deflection of the pointer is proportional to the sag. Hence the deflection is proportional to the square of the average current. ✓
(3)



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Subject: Physics

Paper code: P510/2

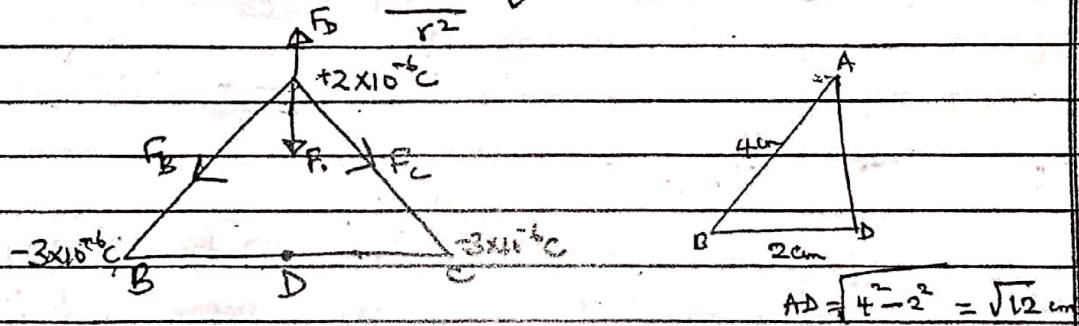
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22

Year: 2023

8 (a) Coulomb's law of electrostatics states that the force between two point charges is directly proportional to the product of the magnitude of the charges and inversely proportional to the square of their distance apart. (1)

(ii) Electric force $F = k \frac{Q_1 Q_2}{r^2}$ ✓



$$F_B = 9 \times 10^9 \times 3 \times 10^{-6} \times 2 \times 10^{-6} = 33.75 N \quad X$$
$$(4 \times 10^{-2})^2$$

$$F_C = 9 \times 10^9 \times 3 \times 10^{-6} \times 2 \times 10^{-6} = 33.75 N \quad X$$
$$(4 \times 10^{-2})^2$$

Let Q be the charge at D.

$$F_D = 9 \times 10^9 \times Q \times 2 \times 10^{-6} \quad X$$
$$(\sqrt{12} \times 10^{-2})^2$$

Horizontally, the resultant force is zero. X



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Subject: Physics

Paper code: PS10/2

Level: PLE UCE UACE

(23)

Year: 2023

Vertically,

$$F_B \cos 30 + F_C \cos 30 = F_D$$

$$\text{but } F_B = F_C$$

hence

$$\frac{9 \times 10^9 \times Q \times 2 \times 10^{-6}}{(\sqrt{12} \times 10^{-2})^2} = 2 \times 33.75 \cos 30 \quad \checkmark$$

$$Q = \frac{2 \times 33.75 \cos 30 \times (\sqrt{12} \times 10^{-2})^2}{(9 \times 10^9) \times 2 \times 10^{-6}}$$

$$Q = 3.89 \times 10^{-6} \text{ C.} \quad \checkmark$$

(5)

(b) (i) Capacitance is the ratio of the magnitude of charge on either plate of the capacitor, to the potential difference between the plates. \checkmark

(1)

$$(ii) f = 50 \text{ Hz} \quad V = 25 \text{ V} \quad I = 10 \times 10^{-6} \text{ A.}$$

$$I = Qf.$$

$$I = CVf.$$

$$C = \frac{I}{fV}$$

$$C = \frac{10 \times 10^{-6}}{50 \times 25} = 8 \times 10^{-9} \text{ F.} \quad \checkmark$$

(3)



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Subject: Physics

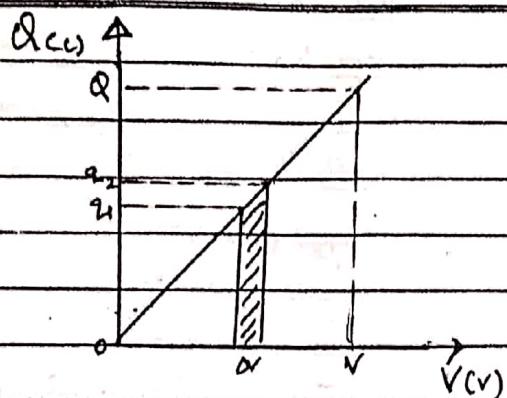
Paper code: P510/2

Level: PLE UCE UACE

Year: 2023

24

8c(i)



(4)

(ii) Energy = Area under graph ✓

$$\text{Area under graph} = \frac{1}{2} d V \checkmark$$

$$\text{but } d = cv \checkmark \text{ and } c = \frac{EA}{d} \checkmark$$

$$\text{also } V = Ed \checkmark$$

$$\text{Therefore } d = \frac{EAEd}{d} = EA^2$$

$$\text{Energy} = \frac{1}{2} EA^2 \cdot Ed$$

$$= \frac{1}{2} E^2 A^2 d$$

$$\text{Volume} = A \times d \checkmark$$

$$\text{Energy per unit volume} = \frac{\frac{1}{2} E^2 A^2 d}{Ad} \checkmark$$

$$= \frac{1}{2} E^2 \checkmark$$

(4)



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Subject: Physics

Paper code: P510/2

Level: PLE UCE UACE

Year: 2023

(25)

8(d) A dielectric is an insulating material placed between the plates of a capacitor. ✓ (1)

d(ii) When a dielectric is placed between the plates of a charged capacitor, its molecules get polarized. ✓ Charges inside the insulator cancel each other's effect and those on the sides remain. ✓ An electric field intensity develops between the two surfaces in opposition to the applied field. ✓ The resultant electric field intensity between the plates is thus reduced. ✓

From $E = \frac{V}{d}$ where V is the pd between the plates and d is the plate separation, V reduces, but $C = \frac{Q}{V}$ therefore when V reduces, C increases. ✓ (4)

OR

— polarization ✓

— sides of dielectric acquire charges opposite to adjacent plates ✓

— positive charge lowers negative potential of adjacent plate. ✓

— negative charge lowers positive potential of adjacent plate ✓

— pd between plates reduces ✓

— $C = \frac{Q}{V}$ ✓

— ~~as V reduces C increases~~

Conductor discharges at
apparent loss of charge,
sharp points due to
conductor



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A conductor loses charge

v) leakage

(2) Corona discharge; Happens only when the potential is high enough to ionise air near sharp point

Subject: PHYSICS

Paper code: PS1012

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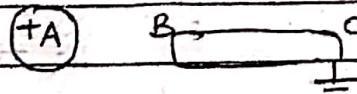
26

Year: 2023

Q9a (i) The material is lowered onto the cap of a neutral gold leaf electroscope using an insulating thread. The leaf of the electroscope is seen to diverge. The material is then earthed. If the leaf collapses then the material is a conductor. If it remains diverged, the material is an insulator.

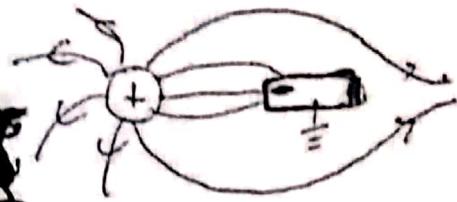
(ii) There is always a high charge concentration on sharp points on a charged conductor. The electric field intensity around the sharp points is therefore high. Air around the sharp point is therefore ionised and charge similar to that on the conductor is repelled while that of opposite charge is attracted and neutralised. This loss of charge is referred to as Corona discharge.

b



Negative charge is induced on the surface of the conductor at B. The potential at A is the sum of potential due to charge at A and charge at B (or neighbouring charges). Since the potential due to charge at B is negative, the resultant potential is lower.

04



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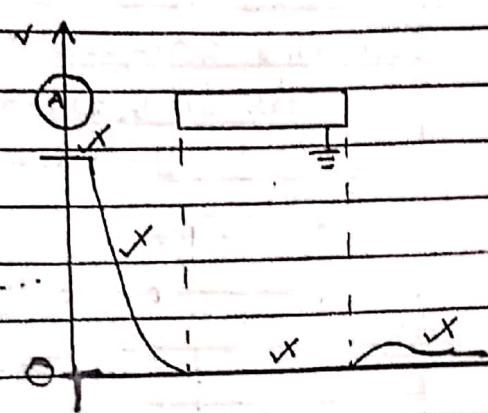
Level: PLE UCE UACE

Year: 2023

(27)

9C

i

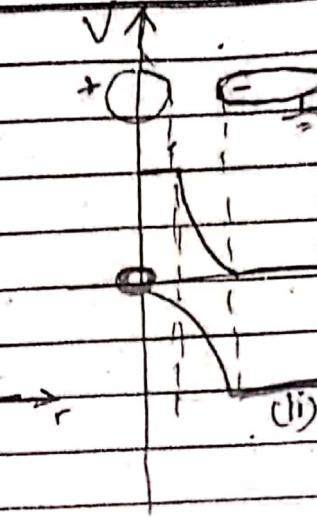


ii



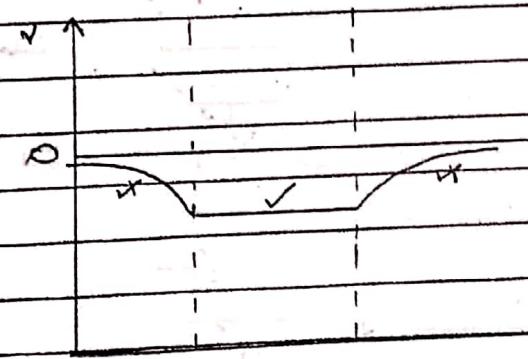
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iii



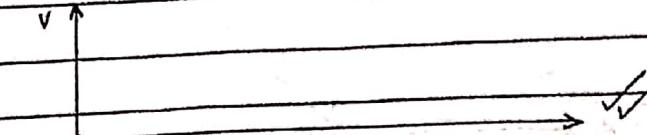
01

ii



02

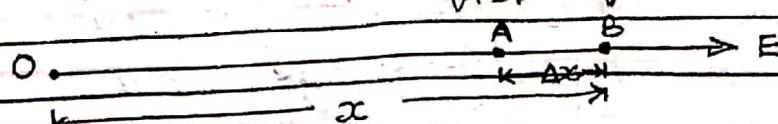
or



d i

$V + \Delta V$

V



Consider the positions A and B in an electric field. The Potential at B is V and at A is $V + \Delta V$. kJ or kJ done to transfer 1C of positive



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Subject: Physics

Paper code: PS10/2

Level: PLE UCE UACE

(28)

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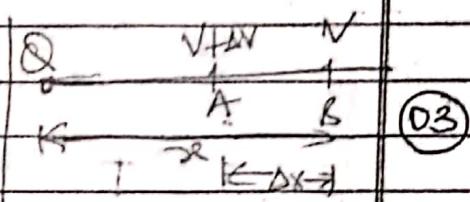
Charge from B to A is $(V + \Delta V) - V = \Delta V$
But workdone to move the charge a small distance Δx towards o is $E_x \times (-\Delta x)$
 $= -E \Delta x$

$$\therefore \Delta V = -E \Delta x$$

$$\Leftrightarrow E = -\frac{\Delta V}{\Delta x}$$

$$\Leftrightarrow E = -\frac{dv}{dx}$$

$$\text{or } E = -\frac{v}{x}$$



$$V_{AB} = V - (V + \Delta V) \\ = -\Delta V$$

$$\text{Workdone} = E \times x$$

$$d \quad (ii)$$

$$W = F_e \quad \text{X}$$

$$F_e = V_d = 1800 \quad \text{X}$$

$$= \frac{12 \times 10^{-3}}{1800} \quad \text{X}$$

$$= 150000 \text{ N}$$

$$Mg = F_e \quad \text{X} \quad \text{when held still} \quad \text{X}$$

$$q = \frac{4.8 \times 10^{-15} \times 9.8 \times 12 \times 10^{-3}}{1800} \quad \text{X} \quad W = F_e \quad \text{X}$$

$$= 314 \times 10^{-19} \text{ C} \quad \text{X}$$

$$\text{but } W = mg \quad \text{X} \quad F_e = qE = \frac{qV}{d} \quad \text{X}$$

$$\therefore \frac{qV}{d} = mg \quad \text{X}$$

$$\Rightarrow q = \frac{mgd}{V} \quad \text{X}$$

$$= \frac{4.8 \times 10^{-15} \times 9.81 \times 12 \times 10^{-3}}{1800} = 3.14 \times 10^{-19}$$



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Subject: Physics

Paper code: PS10/2

Level: PLE UCE UACE

Year: 2023

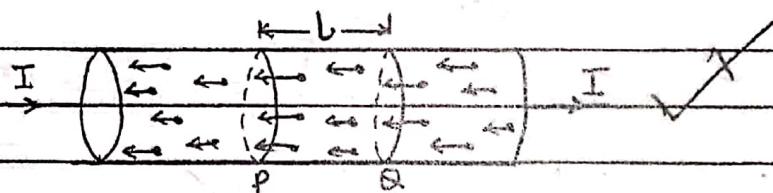
29

Q10 a) E.m.f of a cell is the p.d between the terminals of a cell in an open circuit ✓
or It is the ratio of power generated to the current it delivers.

(01)

or The workdone to convey 1C of charge round in a complete circuit in which a cell is connected.

b



Volume of the section PQ of the Conductor = lA
Total no of charge carriers in the section = nLA
Total charge in the section = $enLA$ ✓

Suppose in 1 second all charge in section

PQ is swept through section Q, then ✓
charge swept per second is $neLA$ ✓

(04)

But charge flow per second is Current I , ✓
and distance covered per second is Velocity V , ✓

$$\therefore I = neVA$$

But distance moved per second is Velocity, ✓

$$\therefore V = \frac{I}{neA}$$

where V is the drift Velocity.

DR

- Volume of Conductor = $\pi l A$, where l - length of conductor
- Total no. of charge carriers in conductor = $n \times l A t$
- Total charge, $Q = n e A t$
- Suppose all charge flows out of conductor in time t
- The charge flowing per second,

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DRAFT $I = \frac{Q}{t} = \frac{n e A t}{t} = n e A$ $V = \frac{l}{t}$ $\Rightarrow V = I / n e A$ Paper code: PS1012

Subject: PHYSICS Year: 2023
 Level: PLE UCE UACE (30)

C - when o.m.f of the driver cell is less than the test p.d. In this case, the test p.d drives current through the slide wire for all points (04)

- when the cells are not connected in opposition to each other. In this case, the test cell only supports the driver cell

$$d \quad I_d (R_g + r \times 32.0) = 1.018$$

$$V(Q+KL) = 1.018 \quad r = \frac{4}{100}$$

$$I \cdot 40 + I \cdot \frac{4 \cdot 32}{100} = 1.018 \quad I_d \times r \times 68.5 = E_x$$

$$I = 0.02466 A$$

$$I_d (40 + 4 \times 32.0) = 1.018 \quad (i)$$

$$E_x = KL \quad 100$$

$$= \frac{4 \times 0.02466 \times 68.5}{100} T_d \times \frac{4}{100} \times 68.5 = E_x \quad (ii)$$

$$= 0.06757 V$$

$$(ii) \text{ gives } \frac{0.04 \times 68.5}{40 + 0.04 \times 32.0} = \frac{E_x}{1.018}$$

$$E_x = \frac{0.04 \times 68.5 \times 1.018}{40 + 0.04 \times 32.0}$$

$$= 0.06757 V$$

(06)



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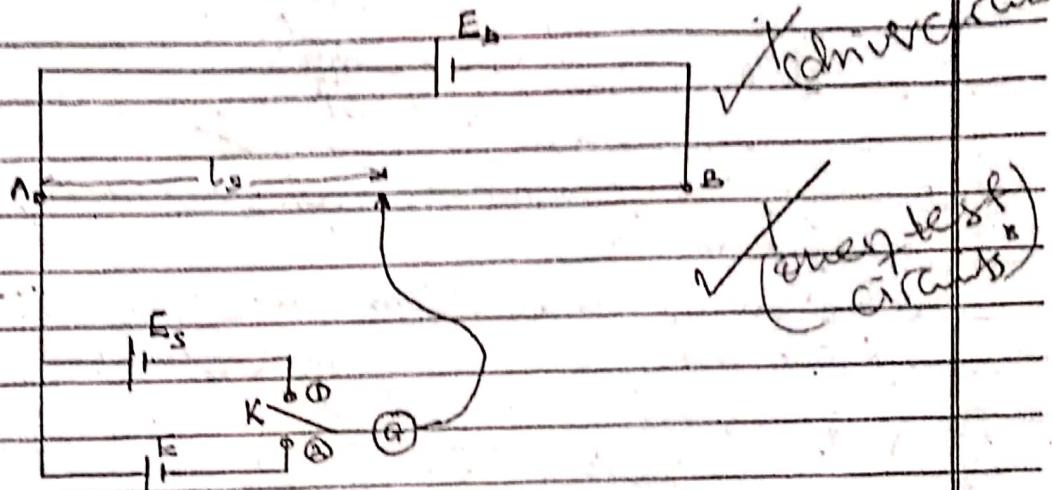
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Level: PLE UCE UACE

(31)

Year:

10e



The circuit is set up as above. where AB is a uniform wire, E_s and E are emfs of standard and test cells respectively. Switch K is connected to position ① ✓ and the jockey tapped at different points along the uniform wire until where the galvanometer G shows no deflection. The balance length l_s is measured and recorded. K is now connected to position ② and the balance position located ✓. The balance length l_t is measured and recorded.

Em.f E is then calculated from

$$E = \frac{E_s \cdot l}{l_s}$$

3(b) • Determining plasma temp

- spectral photograph from gas molecules known to be close to plasma (sun) is taken and one of them is identified.
- The width ($\lambda_2 - \lambda_1$) of the spectral line is measured.
- spectral photograph of light emitted by the element in laboratory is taken and its position (wavelength) λ is noted.
- speed of gas molecules, $v = \frac{\lambda_2 - \lambda_1}{\Delta t} / c$
- Temperature of plasma, $T = \frac{mv^2}{2} = \frac{m(\lambda_2 - \lambda_1)^2}{3R}$
where M is molar mass of He gas

- wavelength shift;

$$= \lambda' - \lambda$$

- speed of star,

$$v = \frac{|\lambda' - \lambda|}{c} c$$

where c is speed of light in air

determining whether the star moving away or towards earth

- spectral photograph of light from star is taken.
- for a given element present in star, the spectrum is compared with that taken from laboratory (λ')
- If there is red shift, the star is moving away.
- If there is blue shift, the star is approaching.

• Determining speed of star

- spectral photograph of light from star is taken.
- for a given element present in star,
- The wavelength λ' (position) is noted.
- For same element, the wavelength λ (position) on laboratory spectrum is noted.

Right to use script to generate grids
 - I am a student
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OCTOBER - NOVEMBER, 2022
 - I do not know how to spell some words
 Candidate's Name Some words Scan point Bwanki
 Random No.
 Signature Error of Commission better than error of Commisioner
 Subject Paper code / Personal Number 0752138777
 - RPPP rule, stick to best reward
 Do not write in this margin
 UC
 Page 7 of 8

Optical path difference - integral multiple of λ (bright)
 Optical path difference - " " " " (bright)
 Geometrical path difference - " " " " λ (dark)
 $2b = (2n-1) \frac{\lambda}{2}$ - bright or $2t = (n-\frac{1}{2}) \lambda$
 $2t = n\lambda$ - dark

- intersection of rays on screen.
 - m is magnitude but when used in fringes sign convention.

- optical flatness / smoothness - produces regular pattern
 - fringe spacing is same.

- general equal freq, f_V

For light - see

Intensity

- constant phase relation (source creates wave from same source)

- Virtual sources give virtual E.

(i) - Brightness goes off the bulb

- Since $I \propto \sin^2 \theta$ in front of aperture, I decreases.

or increase in aperture $\propto Q$, hence I increases.

(ii) Brightness of bulb reduces since $I \propto f$, current reduces it

