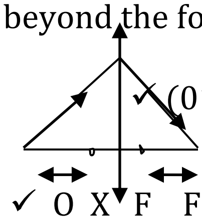
KAMSSA 2022 PHYSICS PAPER 2 MARKING GUIDE

- (a)(i) Focal length is the distance between the principal focus and the optical centre. (01 mark)

  (ii) Focal plane is the vertical plane perpendicular to the axis of the lens and passing through the focal point. (01 mark)

  (b) Suppose an object **O** is placed at a distance **X** in front of principal focus forming an image at distance **Y** beyond the focal point as shown.



✓ (01 mark)

✓ O X F F Y I ✓ (½ mark)

(01 mark)

U = X+F ✓ (½ mark)

V = y+F ✓ (½ mark)

Using; $\frac{1}{F} = \frac{I}{U} + \frac{I}{V}$

$\frac{I}{F} = \frac{I}{X+F} + \frac{I}{Y+F}$ ✓

F² = XY hence; ✓

Newton\`s formular.

(C) Consider the liquid lens combination;

$$\frac{I}{F} = \frac{I}{Fi} + \frac{I}{Fg}$$

$$\frac{I}{hi} = \frac{I}{Fi} + \frac{I}{F} \checkmark \ldots \quad i \qquad (01\ mark)$$

But; $\frac{i}{Fi} = (ni - i)\left(\frac{I}{\gamma I} + \frac{I}{\gamma 2}\right)$

$$\frac{I}{FI} = \left(\frac{4}{3} - I\right)\left(\frac{I}{=\gamma} + \frac{I}{\infty}\right)$$

$$\frac{I}{FI} = \frac{I}{-3\gamma I} \ldots \checkmark \qquad (\tfrac{1}{2}\,mark) \qquad *$$

Putting equation $*$ in (i)

$$\frac{I}{hI} = \frac{I}{-3\gamma I} + \frac{I}{F}$$

$$\gamma I = \frac{hif}{3(hI-f)} \ \ldots\ldots\ (02\ marks)$$

Consider the paraffin lens combination;

$$\frac{I}{h2} = \frac{I}{fP} + \frac{I}{f} \ \ldots\ldots\ldots\ (03\ marks)$$

But; $\frac{I}{fP} = (nP - I)\left(\frac{I}{\gamma I} + \frac{I}{\gamma \sim}\right)$

$$\frac{I}{fP} = (nP - I)\left(\frac{I}{-\gamma I} + \frac{I}{\infty}\right)$$

$$\frac{I}{fI} = \frac{I - nP}{\gamma I} \ \ldots\ldots\ldots\ldots (XX)$$

Putting; (XX) into (3)

$$\frac{I}{h\sim} = \frac{I-nP}{\gamma I} + \frac{I}{f}$$

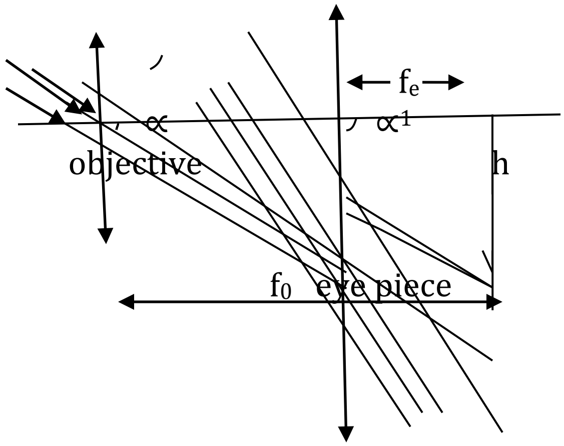
$$nP = I + \left(\frac{h\sim - f}{h\sim f}\right)\left(\frac{hIf}{3(hI-f)}\right)$$

Therefore; $nP = I + \frac{h1(h2-f)}{3h2(h1-f)}$

(d)(i) Visual angle is the angle subtended by the object to an unaided eye.

Magnifying power is the ratio of the angle subtended at the eye by the image when using the instrument to the angle subtended at the un aided eye by the object.

(ii) A Galilean telescope when in normal adjustment forms the final image at infinity.



Angular magnification, $M = \frac{\propto 1}{\propto}$

For small angles in radians, $\propto \frac{1}{\approx} tan \propto \frac{h}{fe}$

$\propto \approx tan \propto = \frac{h}{fo}$

There fore; $M = \frac{\propto 1}{\propto} = \left(\frac{\frac{h}{fe}}{h/_{fo}} \right)$

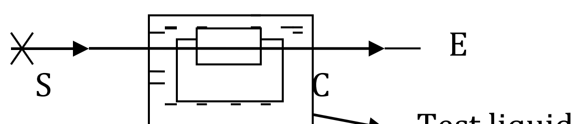
$M = \frac{fo}{fe}$.

(e) Convex mirror reflects the rays from the distant object and brings them into observer`s view. (Focus)

- (a)(i)Monochromatic light is the one which compiles of only one colour.

(ii) Absolute refractive index is the ratio of speed of light in vacuum to speed of light in a given medium.

(b) (i)



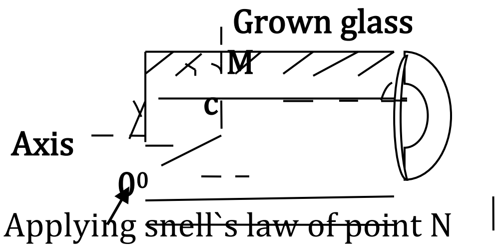
- The liquid whose refractive index is required is placed in a transparent glass vessel having thin plane parallel sides.
- The air cell C is then lowered into the liquid so that it can rotate about a vertical axis.
- A bright source of monochromatic lights is positioned on one side of the vessel so that its rays are incident normally on the sides of the vessel and the air cell; and light from S can be seen directly by the observer E.
- The air cell C is now rotated slowly about a vertical axis until the light is suddenly cut off from E and so no light passes through C.
- The air cell is now rotated in the opposite direction until the light is again suddenly cut off from E.
- The angle∅, between the two positions of **C** for the extinction of the light is determined.
- The refractive index of the liquid is then obtained from $n = \frac{I}{Sin(^0/_2)}$

(ii) . This is because monochromatic light contains only one colour. Otherwise say white light was used, its colour would be brought to different focus which would distract the observer.

C (i) Critical angle is the angle of incidence in a denser medium for which the angle of refraction in a less dense medium is 90^0.

Total internal reflection is the phenomenon which occurs when the angle of incidence in the optically denser medium exceeds the critical angle and all the lights is reflected back into the denser medium.

(ii)



Applying ~~snell`s law of point~~ N

$\cap_3 \sin\theta = \cap_1 \sin\gamma$

But; $\gamma + c = 90^0$

⇨ $\cap \sin\theta = \cap_1 \sin(90^0 - c)$

Therefore; $\cap_3 \mathrm{Sin}\theta = \cap_1 \mathrm{Cos}\, c$

Therefore $\mathrm{Cos}\, c = \frac{\cap 3 \sin\theta}{\cap 1}$

Applying Snell`s law at M

$\cap_1 \sin c = \cap_2 \sin 90^0$

$\Rightarrow \mathrm{Sin}\, c = \frac{\cap 2}{\cap 1}$

Using trigonometry;

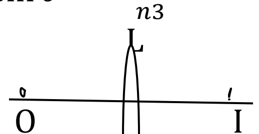
$\mathrm{Sin}^2 c + \mathrm{Cos}^2 c = 1$

$\left(\frac{n2}{n1}\right)^2 + \left(\frac{n3 \sin\theta}{n1}\right)^2 = 1$

$n_2^2 + n_3^2 \mathrm{Sin}^2\theta = n_1^2$

$\sin\theta = \frac{\sqrt{n^2_{1-n_2^2}}}{n3}$

d (i)



Suppose convex lens **L** forms an image of **O**at **I,** if the object **O** was placed at **I,** the lens would form the image at **O** the **I** and **O** are called conjugation points.

(ii)

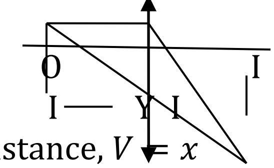


Image distance, $V = x$

Object distance, $u = y - x$

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

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

$\frac{1}{f} = \frac{y}{yx - x^2}$

$yx - x^2 = fy$

$x^2 - yx + fy = 0$

For real image;

$b^2 \geq 4ac$

$y^2 \geq 4fy$

$y^2 - 4fy \geq 0$

$y(y - 4f) \geq 0$

$y > 0$ and $y - 4f > 0$

Therefore; $y = 4f$ is the least distance.

- (a) - Frequency is the number of cycles completed by a wave per second.
  - Amplitude is the maximum displacement of wave particles from the equilibrium position.

(b) Amplitude, A = 3.0m

Wave length, $\lambda = 0.2$m

$v = 15\text{ms}^{-1}$

Period, $T = \frac{\lambda}{v}$

$T = \frac{0.2}{15}$

$T = \frac{1}{75^s}$

$f = 75\text{Hz}$

From general wave equation

$y = Asin(wt - \emptyset)$

$y = Asin\left(2\pi ft - \frac{2\pi x}{\lambda}\right)$

$y = 3.0sin2\pi\left(75t - \frac{x}{0.2}\right)$

$y = 3.0sin\left[(2\pi \times 75)\left(t - \frac{x}{0.2 \times 75}\right)\right]$

$y = 3.0sin2\pi\left(t - \frac{x}{15}\right)m$

(c)(i) $V = \sqrt{\frac{T}{\varkappa}}$

$[V] = LT^{-1}$

$[T] = MLT^{-2}$

$(\varkappa) = ML^{-1}$

$\left[\sqrt{\frac{T}{\varkappa}}\right] = \left(\frac{MLT^{-2}}{ML^{-1}}\right)^{1/2}$

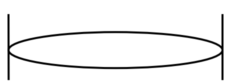
$\left[\sqrt{T/M}\right] = (L^2T^{-2})^{1/2}$

$\left[\sqrt{T/\varkappa}\right] = LT^{-1}$

therefore; $[V] = \left[\sqrt{1/\varkappa}\right]$

since $[R.H.S] = [L.H.S]$the equation is dimensionally consistent.

(ii)



$l = \frac{\lambda}{2}$

$\lambda = 2l$

$V = f\lambda$

$VA = fA(2lA)$

$VA = 2fAlA$

$VB = 2fBlA$

$\frac{VA}{VB} = \frac{fAlA}{fBlB}$

But; $fA = 4fB$

Therefore; $\frac{VA}{VB} = \frac{4lA}{lB}$

$\frac{VA}{VB} = 4\left(\frac{50 \times 10^{-2}}{1.50}\right)$

$$\frac{VA}{VB} = \frac{4}{3}$$

For transverse wave; $V = \sqrt{\frac{T}{\varkappa}}$

$$\frac{\sqrt{T/_{\varkappa A}}}{\sqrt{T/_{\varkappa B}}} = \frac{4}{3}\ since\ Ta = TB = T$$

$$\frac{\varkappa B}{\varkappa A} = (4/_3)^2$$

$$\varkappa B : \varkappa A = 16 : 9$$

(d). Variation of F and T

Diagram

- The length l between the two bridges is kept constant
- A suitable mass, m is attached to the free end of the string on the scale pan
- Pluck the string in the middle and a tuning fork of known frequency f is sounded near it.
- Vary the masses on the pan until a loud sound is heard.
- Record the mass m of the corresponding frequency f in a suitable table including values of f^2.
- Repeat the above procedures using different tuning forks of different frequency.
- A graph of f^2 against mass m is plotted.
- A straight-line graph through the origin is obtained which implies that, $f^2 \propto m$
- Since $T = mg, T \propto m$. Hence it implies that $f^2 \propto T$
- Therefore; $f \propto \sqrt{T}$, thus f increases with increase in tension.

- (a) Optical length is the distance travelled by a wave in an optical system.
  - Interference is the super position of waves from different two coherent sources resulting into alternate regions of maximum and minimum intensity.

(b)(i) Diagram

- Mono chromatic light is made incident almost normally onto the upper glass plate.
- It's partly reflected at X and partly transmitted in the air film and reflected at Y.
- The light reflected at X and Y is coherent; when they overlap above the upper slide, they interfere.
- Where the path difference is an odd multiple of a half the wave length bright fringe is formed and where the path difference is an integral multiple of full wave length a dark fringe is formed.

(ii) Sets of coloured fringes are seen. The central fringe is white with coloured fringes on either side.

C. Diagram

- Suppose waves from A and B superposes to form a bright fringe at P.
- Path difference $BN = BP - AP = a \sin \theta$
- Since $b \gg a, \theta$ is very small

- $\sin\theta \geqslant tan\theta = \frac{yn}{b}$
- From (1)
- $BN = \frac{ayn}{b}$
- For the h^{th} brought fringe at P
- Path difference $BN = n\lambda$
- $\frac{ayn}{b} = n\lambda$
- $yn = \frac{n\lambda b}{a}$ ---------(2)
- for $(n+1)^{th}$ bright fringe;
- $yn + 1 = (n+1)\frac{\lambda b}{9}$ ……… (3)
- Fringe separation, $yn + 1 - yn$

$$Y = \frac{\lambda b}{a}$$

(d)(i) $\lambda = 4.7 \times 10^{-7}m$

$b = 1.4m$

$a = 0.42 \times 10^{-3}m$

From $yn = \frac{n\lambda b}{a}$ for n^{th} bright fringe

$y_5 = \frac{5\lambda b}{a}$ ------------------- (1)

For dark fringes

$yn = \left(n + \frac{1}{2}\right)\lambda\frac{b}{a}$

$y_2 = 2.5\lambda\frac{b}{a}$ ------------------------ (2)

$y_5 - y_2 = (5 - 2.5)\frac{\lambda b}{9}$

$y_5 - y_2 = 2.5\frac{\lambda b}{9}$

$= \frac{2.5 \times 4.7 \times 10^{-7} \times 1.4}{0.42 \times 10^{-3}}$

$y_5 - y_2 = 3.92mm$

(ii) The separation between the fringes will decrease; hence they will be too close to each other.

- (a)(i) Angle of clip is the angle between the earth`s resultant magnetic flux density and the horizontal.

(ii) Magnetic meridian is the vertical plane through the magnetic North and South Pole of earth`s magnet.

(iii) Angle of declination is the angle between geographic and magnetic meridian.

(b) diagram

Wings cut the vertical component. So B_v, will affect the plane

$B_v = B\sin 30^0$

$B_v = 0.48x10^{-2}x \sin 30^0$

$B_v = 0.24x10^{-2}T$

(c) (i) diagram
(ii) diagram

(d) Diagram

- From Fleming's left hand rule
- Force on WX = BINbsinθ (upwards)
- Force on $zy =$ BINbsinθ (down wards)
- Force on WZ = BINl (in wards)
- Force on XY = BINL (outwards)
- Force on WX and ZY cancel since they are equal and opposite
- Forces on XY and WZ constitute a couple of moment;
  T = Force X perpendicular distance
  T = (BINl)(bcosθ)
  T = BI(lxb)Ncosθ
  T = BIANcosθ

(e) Diagram

- Consider a single straight wire carrying a current at right angles to a uniform magnetic field.
- Current in the wire produces a magnetic field around the wire. The external magnetic field interacts with the field due to the current. The resultant magnetic field is stronger below the wire than above. The force due to resultant magnetic field acts on the wire.

(f) A rocket interacts with the horizontal component of earth`s field.

Diagram

But $B_H = \beta \cos d$, d is angle of dip
Then, force, F = $BIl \cos d$

$$F = 84 \times 10^{-3} \times 2 \times 5 \times \cos 60$$
$$F = 0.42\text{N}$$

6. (a) Magnetic flux is the product of magnitude of magnetic flux density and area of projection normal to the magnetic field lines.
   - Magnetic flux density is the force acting perpendicularly on a conductor of length 1M carrying a current of 1A in the direction normal to the field.

(b) (i) $F = BIl$

But; $I = \frac{V}{R}$

$$F = \frac{\beta VL}{R}$$
$$F = \frac{0.5 \times 2.5 \times 30 \times 10^{-2}}{0.75}$$
$$F = 0.50N$$

(ii) $E = BIV$

$$V = \frac{E}{Bl}$$
$$V = \frac{2.5}{0.5 \times 30 \times 10^{-2}}$$

$$V = 16.67ms^{-1}$$

Maximum speed attained = $16.67ms^{-1}$

(c)(i) diagram
(current down in a vertical plane)
X is the neutral point and is the point where the resultant magnetic field is zero.
(ii) diagram
At X

$B_1 = B_2$

$\frac{\varkappa 0 I1}{2\pi y} = \frac{\varkappa 0 I2}{2\pi(10-y)}$

$\frac{16}{y} = \frac{20}{10-y}$

$4(10 - y) = 5y$
$40 - 4y = 5y$
$40 = 9y$
Therefore; $y = 4.44cm.$
Neutral point is 4.441m from wire carrying 16.0A

(d) Absolute determination of resistance
Diagram
The circuit is connected as above. The metal disc of known radius γ is placed at the centre of the solenoid carrying current with the plane of the disc perpendicular to the magnetic field.

The disc is rotated using a driving shaft. The speed of rotation of the disc is adjusted until the galvanometer shows no deflection. The number of revolutions for a given interval of time is counted and frequency (f) determined.

The resistance is calculated from $R = \varkappa 0 n\pi r^2 f$ where n is the number of turns per meter of solenoid.

7. (a)(i) Peak value is the maximum value of alternating current.

(ii) diagram
A sinusoidal voltage $V = V0\sin(wt)\ where\ w = 2\pi f$
Charge across plates, Q = CV

$$Q = CV_0 \sin wt$$

From definition, current $I = \frac{dq}{dt}$

$$I = \frac{d}{dt}(cvo\ sinwl)$$

$$I = CV_0 w\cos wt$$

$$I = CV0wSin(wt + \frac{\pi}{2})$$

$$I = Io\sin\left(2\pi ft + \frac{\pi}{2}\right)$$

Where, $I_o = 2\pi fcVo$

(iii). Diagram

(b)(i) The polarity of ac changes as the frequency of the ac mains supply, thus there is continuous charging and discharging of the capasitor hence ac continous flows. Whereas when a capacitor is connected to a DC source, the capacitor charges and when it is fully charged, the drifting of electrons eventually stops and current will be out off.

(ii) 7 b(ii)

Ac can be stepped up or down to any required value

a.c can transmitted for a long distance with minimum energy losses

7c diagram

The current to be measured is fed into the meter through rectifier diode which conducts current in only one direction .As direct current of varying magnitude flows through the meter ,the average current (I rms)

7d (ii

Vo =480w and R= 40$\boldsymbol{\Omega}$

Vo = $\boldsymbol{I}$oR

480 =40$\boldsymbol{I}$o

$\therefore \boldsymbol{Io} = \mathbf{12}\boldsymbol{A}$

NO 8

Ohm's law states that the current passing through a metallic conductor is directly propotional to the pd across its ends provide temperature and other physical conditions are constant

b)

diagram

The connection is as shown above

The length Xof the bare wire is noted

Close the switch K and then read and record the Ammeter and Voltmeter readings $\boldsymbol{I}$ and V respectively the resistance of the length,Xof the wire is obtained as R $= \frac{V}{I}$

The above procedures are repeated for different length, X of the wire

Results are tabulated as;

X(cm)	$\boldsymbol{I}$(A)	V(V)	R($\boldsymbol{\Omega}$)
–	–	–	–

A graph of R against X IS plotted

A straight line graph through the origin is obtaine hence R $\propto x$

8c

case $\boldsymbol{I}$ when the cell is connected

emf, E $= KL_1$ .... (i)

When resistor is connect;

IR $=KL_2$ ....(ii)

Equation (i)÷ (ii)

$$\frac{E}{IR} = \frac{L_1}{L_2}$$

But E = $\boldsymbol{I}$ (R+r)

$$\therefore \frac{I(R+r)}{IR} = \frac{L_1}{L_2}$$

$$\frac{R+r}{R} = \frac{L_1}{L_2}$$

$$\frac{15+r}{15} = \frac{84.8}{75.0}$$

∴ r = 1.96**Ω**

8 d (i) diagram

$$\text{Current}, \boldsymbol{I} = \frac{E}{E+r}$$

$$\boldsymbol{I} = \frac{18.0}{8+3}$$

$$\boldsymbol{I} = {}^{18}/_{11}\,A$$

Power generated P = E

$$P = 18.0 \text{ X } \frac{18}{11}$$

$$P = 29.45\text{W}$$

8d (II)

$$\text{Efficiency \%} = \frac{power\ output}{power\ input} X\ 100\%$$

$$= \frac{1^2 R}{El} \text{ X100\%}$$

$$= \frac{({}^{18}/_{11})^2 X\ 8}{29.45} \text{ X 100\%}$$

$$= 72.7\%$$

8 (e) Variation of efficiency and power with load 100%

Diagram

8(f) When current passes through the wire , the electrons are acceleted and they collide with neighbours and atoms , As aresult they lose some of their kinetic energy which is dispated as heat energy in the wire

NO 9 (a)

Electric potential is the work done in moving a positive charge of one coloumb from infinity to a point in the field against electic field

9 (b) diagram

Force on I C CHARGE , F $=\frac{Q}{4\pi\varepsilon_0 X^2}$

Work done to move the charge through DX against the field is dw = -F dx

The total work done in moving a+IC charge from infinity to a point a distance r from Q

$$W = \int_{X=\varphi}^{X=r} -F\,dx$$

$$W = \int_{\varphi}^{r} -\frac{Q}{4\pi\varepsilon_0 X^2}\,dx$$

$$W = \frac{-Q}{4\pi\varepsilon_0}\left[\frac{-1}{X}\right]_{\varphi}^{r}$$

$$W = \frac{Q}{4\pi\varepsilon_0}\left(\frac{1}{r}\frac{-1}{\varphi}\right)$$

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

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

9 (c)

Electric field E $=\frac{KQ}{r^2}$

$$\vec{E}\text{ AP} = \frac{9.0X10^9 X\ 0.10\mu C}{(5X10^{-2})^2}$$

$$\vec{E}\text{ AP} = 360{,}000NC^{-1}$$

$$\vec{E}\text{BP} = 180{,}000N0^{-1}$$

DIAGRAM

$\cos\propto\ = \frac{4}{5}$ and $\sin X = \frac{3}{5}$

$$\vec{E} \quad \begin{pmatrix} EAP\cos\propto - EBP\cos\propto \\ EAP\sin\propto + EBP\sin\propto \end{pmatrix}$$

$$= \begin{pmatrix} 360{,}000X\frac{4}{5} - 180{,}000X\frac{4}{5} \\ 360{,}000X\frac{3}{5} + 180{,}000X\frac{3}{5} \end{pmatrix}$$

$$\vec{E} \quad \begin{pmatrix} 144{,}000 \\ 324{,}000 \end{pmatrix} N0^{-1}$$

$$|\vec{E}| = \sqrt{144{,}000^2 + 324{,}000^2}$$

$$|\vec{E}| = 3.55X10^5 NC^{-1}$$

Direction $= \tan^{-1}\begin{pmatrix} 324{,}000 \\ 144{,}000 \end{pmatrix}$

$= 66°$ above the horizontal

9 (d) DIAGRAM

X - is the neutral point

9(e) DIAGRAM

When a negatively charged cloud passes over a lightening conductor,it induces positive charge on the spikes of the conductor which results into high electrifield intensity

The high electric field intensity on the spikes ionizes the air molucules around it .charges similar to those of spikes (positive) are repelled to the cloud while negative charges are attracted to the spikes and discharged

This way charge from the cloud is safely conducted to the ground

NO 10 (a) DIAGRAM

10 b(I) diagram

- Plate Y is earthed while x is connected to cap of the gold leaf electroscope
- Plate x is charged and divergence of the leaf is noted
- Plate Y is then discharged upwards relative to x and the divergence of the leaf of the electroscope is seen to increase .The pd between the plates has thus increase .Since $C=\frac{Q}{V}$, capacitance has decreasedwith decrease in area and $C \propto A$
- Plate Y is now restored to its initial position. Plate Yis now moved close to x and the divergence of the leaf of electroscope is seen to decrease. The pd betweenthe plates has decreased since $C = \frac{Q}{V}$, capacitance has increased with decrease in plate separation and $C \propto \frac{1}{d}$
- Plates are now restored, an insulator is inserted between the plates .Divergence of the leaf decreases ,since $C = \frac{Q}{V}$ capacitance has increased and $C \propto \varepsilon$

  10b (ii)

  Plate area A $= 10cm \times 15cm$

  $= 150cm^2$

  Capacitance , $= \frac{\varepsilon_0 A}{d}$

  $C = \frac{8.85X10^{-12}X150X10^{-4}}{5X10^{-3}}$

  $C = 2.655X10^{-11}F$

10 (C)

CHARGE $Q = CV$

$69X10^{-10}$ 50C

$\therefore$ $C = 1.38X10$ F

$Also$ $C = 4\pi\varepsilon r$

$1.38X10^{-11} = 4\pi X10.7X10^{-2}\varepsilon$

$\therefore$ $\varepsilon = 1.026X10^{-22}Fm^{-1}$

10 d(i) DAIGRAM

$V = V_1 + V_2$

$Q/_C = Q/_{C_1} + Q/_{C_2}$ (Q is the same in series)

$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2}$

$\therefore$ $C = \frac{C_1C_2}{C_1C_2}$

10 d(ii)

Charge in $20\mu\Omega$ **before connection**

Q = CV

Q $=20\mu$C X40.0V

Q =0.0008C

After connection

DIAGRAM

$C = 20\mu F + 60\mu F$

$C = 80\mu F$

$Pdv = \frac{Q}{C}$

$V = \frac{0.0008C}{80\mu F}$

$V = 10V$

END

END