St. Mary's Convent School Gulaothi, U.P. (2026 – 27)

Set - B

MCQ PAPER

Class 12

Physics

T.sign______

Time: 45 min.

Max Marks:20

NAME:- Write name in capital letter	A	N	O	K	H	I												

ROLL NO:-	2				

General instructions

1.All question are compulsory.

2.Write neately and clearly in given space.

3.Do not cut or fill the circle given on upper and bottom of paper.

4.Write the answer of each question in the space provided

Write the option in capital letters only)

Section A : Write down the correct option for the given questions.

ANS 1: (b) 0.5/0.5

ANS 2: (a) 0.0/0.5

ANS 3: (d) 0.0/0.5

ANS 4: (a) 0.5/0.5

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Section B Very Short Answer (2 × 1 = 2 marks)

ANS 5:

1.0 ✓

Coloumb's law states that the force on an electric charge is directly proportional to the product of charges & inversely proportional to the square of distance between them.

$$F \propto \frac{q_1 q_2}{r^2}$$

$$\boxed{F = K\frac{q_1 q_2}{r^2}}$$ (where K is constant) $(K = 9 \times 10^9)$

ANS 6:

0.5

Omits 'per unit charge' and infinity origin; formula incorrect (V=W/q).

Electric potential at a point is defined as the work done in bringing a test positive charge from a point to another point in the electric field.

$$\boxed{V = \frac{W}{q}}$$

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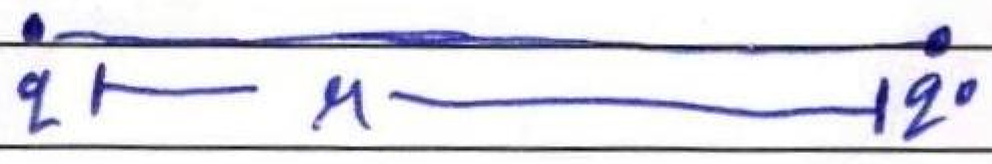
ANS 7:



$$F = \frac{Kqq_0}{r^2}$$

$$E = \frac{F}{q_0}$$

$$E = \frac{\frac{Kq\cancel{q_0}}{r^2}}{\cancel{q_0}}$$

$$\boxed{E = \frac{Kq}{r^2}}$$

Marks	2.0
Teacher's feedback	Correct derivation from Coulomb's law; final expression for the magnitude is right. For completeness, you could include the direction with the radial unit vector r-hat.

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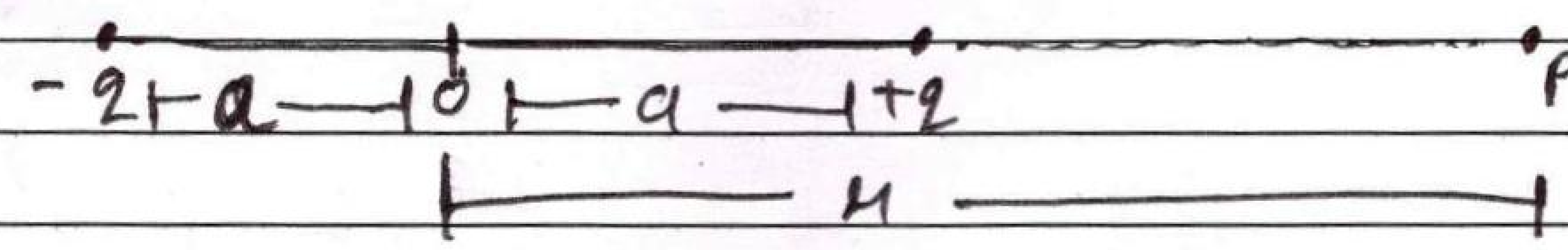
ANS 8:

~~At axial~~



Electric field due to charge -q $(E_\ominus) = \frac{Kq}{(r+a)^2}$

Electric field due to charge +q $(E_\oplus) = \frac{Kq}{(r-a)^2}$

$$E_\oplus - E_\ominus = \frac{Kq}{(r-a)^2} - \frac{Kq}{(r+a)^2}$$

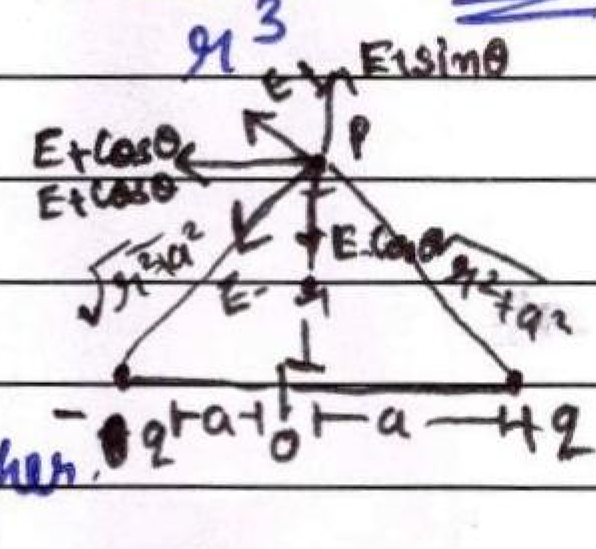
$$= Kq\left(\frac{\cancel{r^2}+\cancel{a^2}+2ar - \cancel{r^2}-\cancel{a^2}+2ar}{[(r-a)(r+a)]^2}\right)$$

$$= \frac{Kq \times 4ar}{(r^2-a^2)^2} \qquad (a <<< r) \qquad (2aq = P)$$

$$= \frac{2KPr}{r^4} = \frac{2KP}{r^3} \text{ Ans}$$

At equator -

$E_\oplus \sin\theta$ & $E_\ominus \sin\theta$ ~~becom~~ gets cancelled out by eachother.



$$E_\oplus \cos\theta + E_\ominus \cos\theta = 2E\cos\theta = \frac{2Kq}{a^2+r^2} \times \frac{r}{\sqrt{r^2+a^2}}$$

$$= \frac{2Kqr}{(r^2+a^2)^{3/2}} = \frac{KP}{r^3} \text{ Ans}$$

Marks	2.0
Teacher's feedback	Correct: you identified the dipole moment p = 2aq. For completeness, state that p is a vector directed from –q to +q. Extra field derivations were unnecessary but not incorrect.

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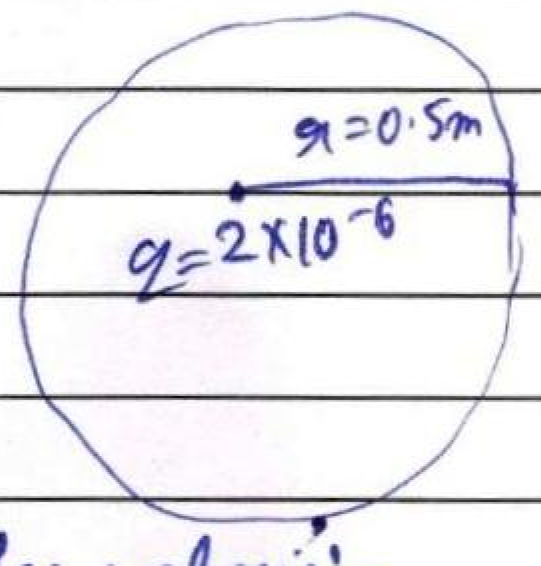
ANS 9:

$Q = 2\times10^{-6}C$

$r = 0.5m$

$\phi_E = ??$



Electric flux through the sphere:-

$\phi_E = \oint E \cdot dA$

$\phi_E = EA$ (After Integration)

$EA = \frac{q}{\epsilon_0}$

$E = \frac{q}{A\epsilon_0}$

$\phi_E = \frac{9\times10^9 \times 2\times10^{-6}}{(0.5)^2} \times \frac{22}{7} \times (0.5)^2$

$\phi_E = 18\times3.14\times10^2$

$= 18\times314$

$= 5652$ Ans

$\begin{array}{r} 314 \\ \times 18 \\ \hline 2512 \\ 314 \\ \hline 5652 \end{array}$

Marks	1.0
Teacher's feedback	Correctly used Gauss's law (Φ = q/ε0). Flux is independent of radius. Numerical evaluation is incorrect; Φ = 2×10^-6 / 8.854×10^-12 ≈ 2.26×10^5 N·m^2/C. Avoid arbitrary factors like 18×3.14×10^2.

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ANS 10:

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

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

$dw = Vd\cancel{Q}q$

$dw = \frac{Q}{C} dq$

$\int dw = \frac{1}{C} \int Q\, dq$

$\cancel{\int dw}\ W = \frac{1}{C} \times \frac{Q^2}{2}$

$U = \frac{Q^2}{2C}$ Ans

$U = \frac{1}{2} \times \frac{Q^2}{C} \times \frac{C}{C}$

$U = \cancel{Q}\ \frac{1}{2} V^2 C$ As

Marks	2.0
Teacher's feedback	Correct derivation from dW = V dq and integration; final expressions U = Q^2/(2C) and U = 1/2 C V^2 are correct. Minor omission: specify integration limits 0 to Q.

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ANS 11:

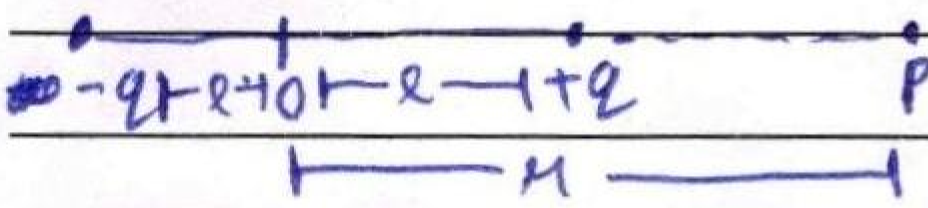
In the dielectric medium, the capacitance decreases because the value of constant will decrease.
~~and the distance~~

0.0 von 2.0

Marks	0.0
Teacher's feedback	A dielectric increases capacitance (C = Kε0A/d with K>1). Polarization reduces the field and potential, so for the same charge C increases. Your answer incorrectly states both capacitance and dielectric constant decrease.

Page total:

ANS 12:



Electric potential at $-q$
$= \frac{Kq}{(r+l)}$

Electric potential at $+q$
$= \frac{Kq}{(r-l)}$

Potential at a point due to dipole
$= \cancel{\frac{Kq}{(r+l)^2}} \frac{Kq}{(r-l)} - \frac{Kq}{(r+l)}$

$= Kq\left(\frac{1}{(r-l)} - \frac{1}{(r+l)}\right)$

$= \cancel{Kq\left(\frac{r^2+l^2+2rl - r^2-l^2+2rl}{(r^2-l^2)^2}\right)}$

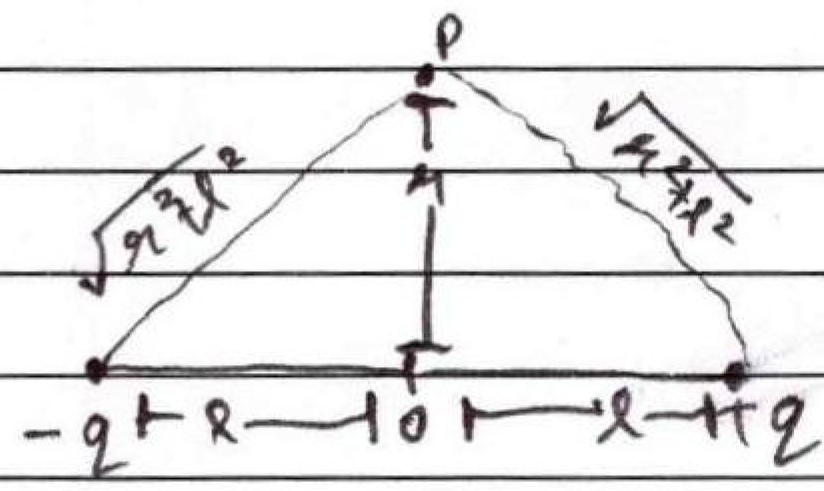
$= \cancel{Kq\left(\frac{4rl}{(r^2-l^2)^2}\right)}$

$= \cancel{\frac{2KPr}{(r^2-l^2)^2}}$ $(2lq=P)$ $(l \lll r)$

$= \cancel{\frac{2KPr}{r^4} = \frac{2KP}{r^3}}$

$= Kq\left(\frac{\cancel{r}+l - \cancel{r}+l}{r^2-l^2}\right)$ $(l \lll r)$ $(2ql=P)$

$= \frac{KP}{r^2}$ Ans



Electric potential at $(-q)$
$= -\frac{Kq}{\sqrt{r^2+l^2}}$

Electric potential at $(+q)$
$= +\frac{Kq}{\sqrt{r^2+l^2}}$

Potential at equator due to dipole $= \frac{Kq}{\sqrt{r^2+l^2}} - \frac{Kq}{\sqrt{r^2+l^2}}$

$= 0$ Ans

Marks	2.0
Teacher's feedback	Correct axial derivation and p definition; equatorial potential noted. However, you didn't give the general result V = K(p cosθ)/r^2 or clearly define geometry/angles, and you mixed variables (r vs x). State far-field (x □ a) explicitly.

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ANS 13:

$C = 8\,pF \cancel{= 8\times10}$

$8p = \frac{\varepsilon_0 K A}{D}$

Now,

$C' = \frac{K}{\cancel{8}3} \times \frac{\varepsilon_0 A \times 2}{D D}$

$C' = \frac{K \varepsilon^{\circ} A}{3 D}$

$C' = \frac{C}{3}$

$C' = \frac{8}{3} p$ Ans

Marks	0.0
Teacher's feedback	Capacitance scales as k/d. Halving the plate separation doubles C; inserting dielectric k=6 multiplies by 6. Net factor = 12, so C' = 96 pF. Using 3d and C/3 is incorrect; distance should be d/2.

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11.5/20.0

Usha Rani 04:59, 18.08.202