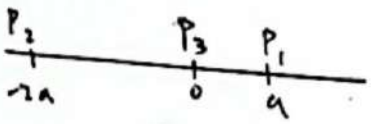
1.



$$k\frac{q_1 q_3}{a^2} = k\frac{q_2 q_3}{(-2a)^2}$$

$$\frac{q_1}{a^2} = \frac{q_2}{4a^2}$$

$$q_2 = 4q_1 \#$$

B

2.

initial

$$k\frac{Q_0 Q_0}{D^2} = F$$

C touched A

charge of A $= \frac{1}{2}Q_0$

charge of C $= \frac{1}{2}Q_0$

C touched B

charge of C $= (\frac{1}{2}Q_0 + Q_0)\cdot\frac{1}{2} = \frac{3}{4}Q_0$

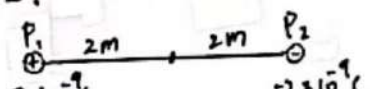
charge of B $= (\frac{1}{2}Q_0 + Q_0)\cdot\frac{1}{2} = \frac{3}{4}Q_0$

F between A and B

$$= k\frac{\frac{1}{2}Q_0 \cdot \frac{3}{4}Q_0}{D^2} = \frac{3}{8}F \#$$

C

3.



electric field by P_1 ⊕

$$\frac{8.988\times10^9 \cdot 8\times10^{-9}}{2^2} = 17.976$$

electric field by P_2 ⊖

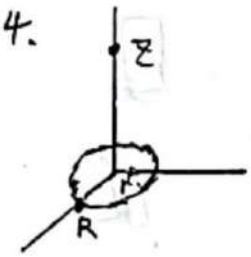
$$\frac{8.988\times10^9 \cdot 1.2\times10^{-9}}{2^2} = -4.494$$

total electric field

$17.976 + 4.494 \doteq 22.5$ #

E

4.



$$E = \int dE$$

$$= \frac{1}{4\pi\varepsilon_0}\int_0^R \frac{2\pi r z\sigma}{(r^2+z^2)^{3/2}}\,dr$$

$$= \frac{\sigma z}{2\varepsilon_0}\int_0^R \frac{r}{(r^2+z^2)^{3/2}}\,dr$$

$$= \frac{\sigma z}{2\varepsilon_0}\left[\frac{-1}{(r^2+z^2)^{\frac{1}{2}}}\Big|_0^R\right]$$

$$= \frac{\sigma z}{2\varepsilon_0}\left[\frac{-1}{(R^2+z^2)^{\frac{1}{2}}} + \frac{1}{z}\right]$$

$$= \frac{\sigma}{2\varepsilon_0}\left(1 - \frac{z}{\sqrt{R^2+z^2}}\right)$$

$\sigma = 2.5\times10^{-6}$

$R = 0.075$

$z = 0.15$

$\varepsilon_0 = 8.854\times10^{-12}$

$\therefore E \doteq 1.5\times10^4$

5.

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

$$\phi_{base} + \phi_{surface} = \frac{Q_{total}}{\varepsilon_0}$$

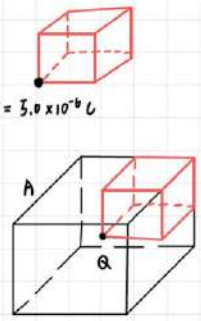
$$\phi_{base} + 9.8\times10^4 = \frac{6.6\times10^{-7}}{8.854\times10^{-12}}$$

$$\phi_{base} \doteq -9.8\times10^4 + 7.45\times10^4$$

$$\doteq -2.3\times10^4$$ #

C

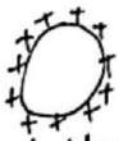
6.



$$\Phi_E = \frac{1}{8}\oint_A \vec{E}\cdot d\vec{A} = \frac{1}{8}\frac{Q}{\varepsilon_0} = \frac{1}{8}\frac{5\times10^{-6}}{\varepsilon_0} \doteq 70588 - (B)$$

7.

Solid charged "conducting" sphere



inside sphere

$\because q_{in} = 0$

$\therefore$ flux $= 0$

$\Rightarrow \vec{E} = 0$

outside sphere

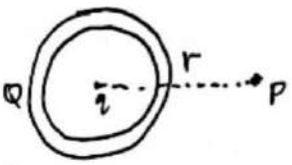
$$E = \frac{kQ}{r^2} \propto r^2$$

$\Rightarrow$

#

E

8.



$$E_{total} = E_q + E_Q$$

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

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

D