DPP
DAILY PRACTICE PROBLEMS

Class : XIIth | Solutions | Subject : PHYSICS
Date : | | DPP No. :7

Topic :- Electric charges and fields

1 **(b)**

After connecting through a wire $V_A = V_B$

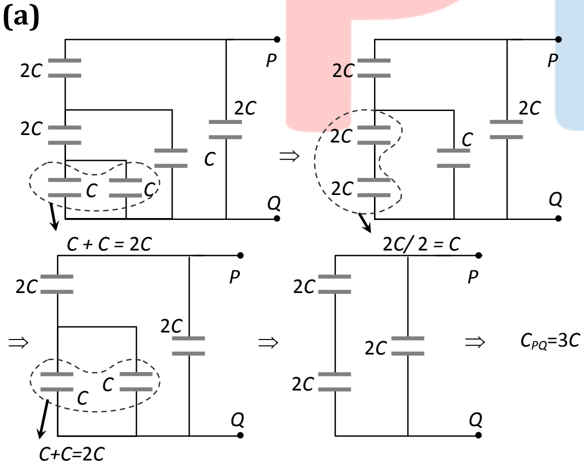
$$\Rightarrow \frac{kQ_A}{r_A} = \frac{kQ_B}{r_B} \Rightarrow \frac{Q_A}{Q_B} = \frac{r_A}{r_B}$$

Ratio of electric field

$$\frac{E_A}{E_B} = \frac{Q_A}{Q_B} \times \left(\frac{r_B}{r_A}\right)^2 \quad \left[\because E = \frac{kQ}{r^2}\right]$$

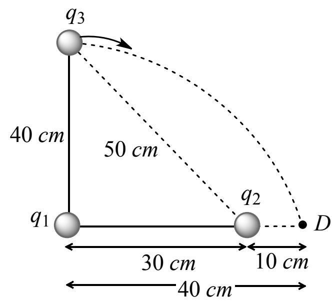
$$\Rightarrow \frac{E_A}{E_B} = \frac{r_A}{r_B} \times \left(\frac{r_B}{r_A}\right)^2 = \frac{r_B}{r_A} = \frac{2}{1}$$

3 **(a)**



4 **(a)**

Change in potential energy $(\Delta U) = U_f - U_i$



$$\Rightarrow \Delta U = \frac{1}{4\pi\varepsilon_0}\left[\left(\frac{q_1q_3}{0.4} + \frac{q_2q_3}{0.1}\right) - \left(\frac{q_1q_3}{0.4} + \frac{q_2q_3}{0.5}\right)\right]$$

$$\Rightarrow \Delta U = \frac{1}{4\pi\varepsilon_0}[8q_2q_3] = \frac{q_3}{4\pi\varepsilon_0}(8q_2)$$

$$\therefore k = 8q_2$$

5 **(a)**

Thin metal plates doesn't affect the capacitance

7 **(d)**

Electric field at the centre of charged circular ring is zero. Hence electric field at O due to the part $ACDB$ is equal in magnitude and opposite in direction that due to the part AKB

8 **(b)**

An electric field is zero non-zero on the axis of hollow current carrying conductor.

So, this statement is correct.

10 **(c)**

Common potential $V = \frac{C_1V_1}{C_1 + C_2} = \frac{10^{-2}}{16 \times 10^{-6}} = 625V$

11 **(b)**

$$C = \frac{\varepsilon_0 A}{x}$$

$$\therefore \frac{dC}{dt} = \varepsilon_0 A \frac{d}{dt}\left(\frac{1}{x}\right) = \frac{-\varepsilon_0 A}{x^2}\left(\frac{dx}{dt}\right) = \frac{-\varepsilon_0 A}{d^2}\left(\frac{dx}{dt}\right)$$

$$\Rightarrow \left|\frac{dC}{dt}\right| = \frac{\varepsilon_0 A}{d^2} v \text{ i.e.} \left|\frac{dC}{dt}\right| \propto \frac{1}{d^2}$$

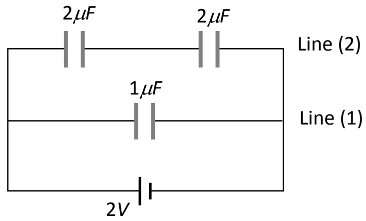
12 **(b)**

$U = \frac{Q^2}{2C}$; in given case C increases so U will decrease

15 **(d)**

Potential difference across both the lines is same i.e. $2V$. Hence charge flowing in line 2

$Q = \left(\frac{2 \times 2}{2 + 2}\right) = 2\mu C$



So charge on each capacitor in line (2) is 2 μC Charge time $1Q = 2 \times 1 = 2\mu C$

16 **(a)**

During the growth of voltage in a $C - R$ circuit the voltage across a capacitor at time t is given by $V = V_0(1 - e^{\frac{t}{CR}})$ for the given circuit as per given conduction at time t

$V = \frac{3}{4}$ th of the voltage applied across $C = \frac{3}{4}V_0$

So, $\frac{3}{4}V_0 = V_0\left(1 - e^{\frac{t}{RC}}\right) \Rightarrow e^{\frac{t}{RC}} = \frac{1}{4} \Rightarrow e^{\frac{t}{RC}} = 2^2$

$\Rightarrow 2RC \ln 2 = 2 \times (2.5 \times 10^6) \times (4 \times 10^{-6}) \times (0.693)$

$= 13.86\ s$

17 **(c)**

Electric lines of force are always normal to metallic body

18 **(c)**

Energy stored in the capacitor $= \frac{1}{2}CV^2 \times 100$

$= \frac{1}{2} \times 10 \times 10^{-6} \times (100 \times 10^3)^2 \times 100 = 5 \times 10^6\ J$

Electric energy costs $= 108\ paise\ per\ kWH = \frac{108\ Paise}{3.6 \times 10^6\ J}$

$\therefore$ Total cost of charging $= \frac{5 \times 10^6 \times 108}{3.6 \times 10^6} = 150\ Paise$

19 **(a)**

In case of spherical metal conductor to charge quickly spreads uniformly over the entire surface because of which charges stay for longer time on the spherical surface. While in case of non-spherical surface, the charge concentration is different at different points due to which the charges do not stay on the surface for longer time

20 **(c)**

$F_1 = \frac{kQ_1Q_2}{d^2}$ and $F_2 = \frac{k\left(\frac{Q_1 - Q_2}{2}\right)^2}{d^2}$

According to question,

$F_1 = F_2$

$Q_1Q_2 = \frac{(Q_1 - Q_2)^2}{4} \Rightarrow 4Q_1Q_2 = Q_1^2 + Q_2^2 - 2Q_1Q_2$

$0 = Q_1^2 + Q_2^2 - 6Q_1Q_2 \Rightarrow \frac{Q_1}{Q_2} = -3 \pm \sqrt{8}$

ANSWER-KEY										
Q.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
A.	**B**	**D**	**A**	**A**	**A**	**C**	**D**	**B**	**A**	**C**
Q.	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
A.	**B**	**B**	**D**	**D**	**D**	**A**	**C**	**C**	**A**	**C**