DPP

DAILY PRACTICE PROBLEMS

Class : XIIth
Date :

Solutions

Subject : PHYSICS
DPP No. : 8

Topic :- Electric charges and fields

1 **(c)**

The torque on a dipole moment is $\vec{\tau} = \vec{p} \times \vec{E}$. The maximum value is when they are perpendicular to each other so that $pE\sin\theta$ is maximum *i.e.*,$\sin\theta = 1$

$\tau = (3 \times 10^4 NC^{-1})(6 \times 10^{-30} c \times m) = 18 \times 10^{-26} Nm$

2 **(d)**

The electric field is always perpendicular to the surface of a conductor and field lines never cross the conducting surface

3 **(a)**

From $F = \frac{1}{4\pi\varepsilon_0}\frac{q_1q_2}{r^2}$

$$\varepsilon_0 = \frac{1}{4\pi F}\frac{q_1q_2}{r^2} = \frac{[\mathrm{A^2T^2}]}{[\mathrm{MLT^{-2}}][\mathrm{L^2}]}$$

$= [\mathrm{M^{-1}L^{-3}T^4A^2}]$

4 **(c)**

Electric field in vacuum $E_0 = \frac{\sigma}{\varepsilon_0}$

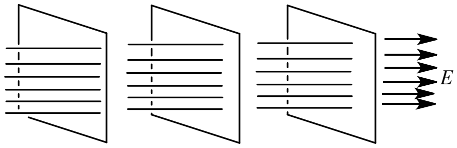
In medium $E = \frac{\sigma}{\varepsilon_0 K}$

If $K > 1$, then $E < E_0$

5 **(b)**

An equipotential surface is a surface with a constant value of potential at all points on the surface. For a uniform electric field, say, along the x-axis, the equipotential

surfaces are planes normal to the x-axis, *i.e.*, planes parallel to the $y - z$ plane. Equipotential surfaces for a dipole and its electric field lines are shown in figure.



As said above that on equipotential surface, potential at all points is constant, this means that on equipotential surface work done in moving a test charge from one point to other point is zero.

6 **(b)**

According to Gauss's applications

7 **(d)**

$\phi_E = \frac{Q_{\text{enclosed}}}{\varepsilon_0}$,$Q_{\text{enclosed}}$ remains unchanged

8 **(c)**

Distance

$$BC = AB\sin 60° = (2R)\frac{\sqrt{3}}{2} = \sqrt{3}R$$

$$\therefore |F_{BC}| = \frac{1}{4\pi\varepsilon_0}\frac{\left(\frac{q}{3}\right)\left(\frac{2q}{3}\right)}{(\sqrt{3}R)^2} = \frac{q^2}{54\pi\varepsilon_0 R^2}$$

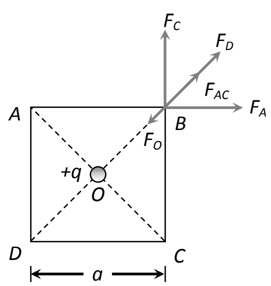
9 **(b)**

If all charges are in equilibrium, system is also in equilibrium.

Charge at centre : charge q is in equilibrium because no net force acting on it corner charge :

If we consider the charge at corner B. This charge will experience following forces

$F_A = k\frac{Q^2}{a^2}$,$F_C = \frac{kQ^2}{a^2}$,$F_D = \frac{kQ^2}{(a\sqrt{2})^2}$ and $F_O = \frac{KQq}{(a\sqrt{2})^2}$



Force at B away from the centre $= F_{AC} + F_D$

$$= \sqrt{F_A^2 + F_B^2} + F_D = \sqrt{2}\frac{kQ^2}{a^2} + \frac{kQ^2}{2a^2} = \frac{kQ^2}{a^2}\left(\sqrt{2} + \frac{1}{2}\right)$$

Force at B towards the centre $= F_O = \frac{2kQq}{a^2}$

For equilibrium of charge at B, $F_{AC} + F_D = F_O$

$$\Rightarrow \frac{kQ^2}{a^2}\left(\sqrt{2} + \frac{1}{2}\right) = \frac{2KQq}{a^2} \Rightarrow q = \frac{Q}{4}(1 + 2\sqrt{2})$$

10 **(b)**

Charge on smaller sphere

$$= \text{Total charge}\left(\frac{r_1}{r_1 + r_2}\right) = 30\left(\frac{5}{5 + 10}\right) = 10\mu C$$

11 **(c)**

$$q_3 = \frac{C_3}{C_2 + C_3}.Q$$

$$q_3 = \frac{3}{3 + 2} \times 80 = \frac{3}{5} \times 80$$

$$= 48\ \mu C$$

12 **(c)**

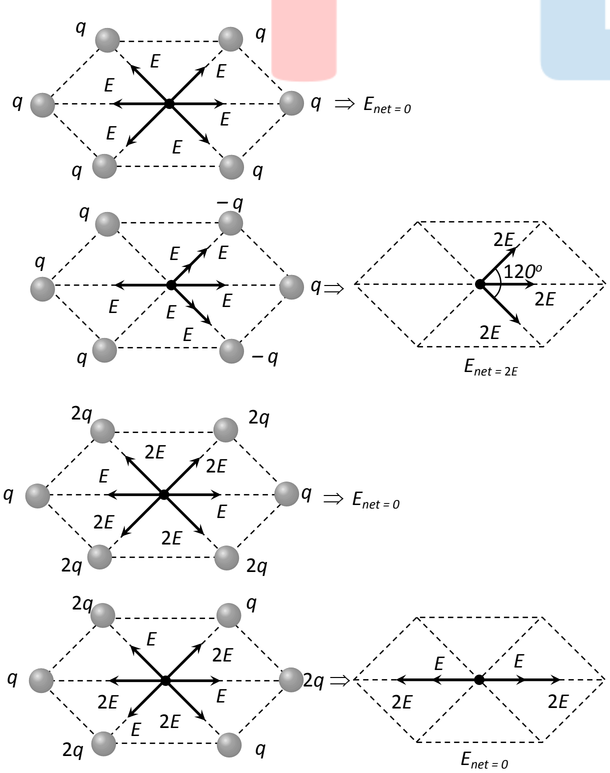
Inside the hollow charged spherical conductor electric field is zero

13 **(d)**

On equatorial line of electric dipole, $\propto \frac{1}{r^3}$.

14 **(b)**

Electric field at a point due to positive charge acts away from the charge and due to negative charge it act's towards the charge



15 **(c)**

For non-conducting sphere $E_{in} = \frac{k.Qr}{R^3} = \frac{\rho r}{3\varepsilon_0}$

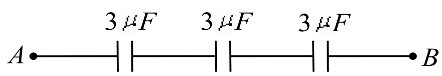
16 **(b)**

Every system tends to decrease its potential energy to attain more stability when we increase charge on soap bubble its radius increases $\left[U \propto \frac{1}{r}\right]$

17 **(a)**

Electric field $E = \frac{1}{4\pi\varepsilon_0} \times \frac{Q}{r^2}$

18 **(a)**



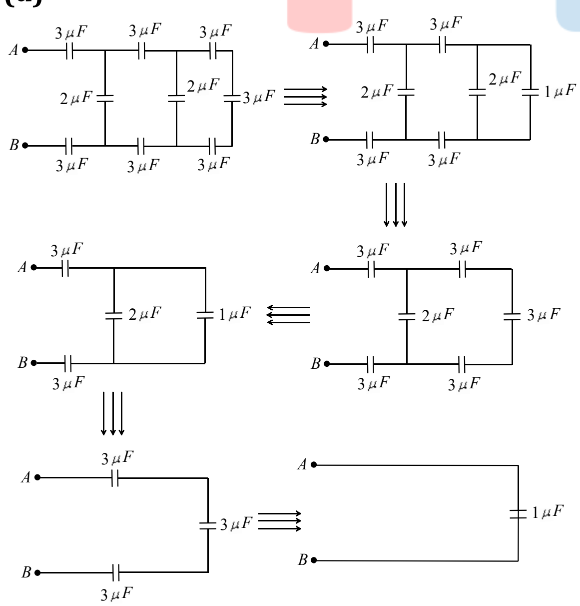
$$\frac{1}{C_{AB}} = \frac{1}{3} + \frac{1}{3} + \frac{1}{3} = 1 \Rightarrow C_{AB} = 1\mu F$$

19 **(a)**

$$C_{AB} = 3 + \frac{3}{3} = 4\mu F\ ,\ C_{AC} = \frac{3}{2} + \frac{3}{2} = 3\mu F$$

$\therefore C_{AB} : C_{AC} = 4 : 3$

20 **(d)**



Starting from the right end of the network, three $3\mu\ F$ capacitors are connected in series. The equivalent capacitance of these three capacitors is

$$\frac{1}{C_S} = \frac{1}{3} + \frac{1}{3} + \frac{1}{3} \Rightarrow C_S = 1\mu\, F$$

C_S and $2\mu F$ are in parallel. The equivalent capacitance of these two capacitors is

$C_P = C_S + 2\mu\, F = 1\, \mu\, F + 2\mu\, F = 3\mu\, F$

Proceeding in this way, finally three $3\mu\, F$ are in series. Therefore, the equivalent capacitance between A and B is

$$\frac{1}{C_{AB}} = \frac{1}{3} + \frac{1}{3} + \frac{1}{3} \Rightarrow C_{AB} = 1\mu\, F$$

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