DPP

DAILY PRACTICE PROBLEMS

Class : XIIth
Date :

Solutions

Subject : PHYSICS
DPP No. : 10

Topic :- ELECTROSTATIC POTENTIAL AND CAPACITANCE

1 **(b)**

Presence of point charge $(+q)$ induces negative charge on inner surface of hollow conducting sphere and positive charge on outer of sphere. Hence, field lines will be directed radially outward from surface of sphere as shown in(b)

2 **(a)**

KE = PE of two protons

$$= \frac{e^2}{4\pi\varepsilon_0 r} = \frac{9 \times 10^9 \times (1.6 \times 10^{-19})^2}{10^{-10}}$$

$= 23 \times 10^{-19}$ J

$\therefore$ KE of each proton $= \frac{23}{2} \times 10^{-19}$ J

$= 11.5 \times 10^{-19}$ J

3 **(d)**

When two conductors of capacities $C_1$and C_2 and potentials V_1 and V_2 are connected by a conducting wire, charge redistributes in these conductors till potential of both the conductors become equal, known as common potential.

Common potential $=\frac{\text{net charge}}{\text{total capacity}}$

ie $$V = \frac{q_1 + q_2}{C_1 + C_2}$$

or $$V = \frac{C_1V_1 + C_2V_2}{C_1 + C_2}$$

4 **(a)**

The points S and R are inside the uniform electric field, so these will be at equal potential.

5 **(a)**

$\because \quad V = 4x^2$

Hence, $\vec{E} = -\frac{dV}{dr} = -8x\hat{i}$

Hence, value of $\vec{E}$ at (1m, 0, 2m) will be

$\vec{E} = -8 \times 1\hat{i} = -8\hat{i}\ \text{Vm}^{-1}$

6 **(a)**

In free space, the electric field between plates of capacitor.

$$E_0 = \frac{q}{A\varepsilon_0} \qquad \text{...(i)}$$

When plates of capacitor dipped in oil tank then, the electric field between the plates is

$$E_0 = \frac{q}{A\varepsilon} \qquad \text{...(ii)}$$

(when ε is the permittivity of medium)

or $$E = \frac{E_0}{AK\varepsilon_0} \qquad [\because\ \varepsilon = K\varepsilon_0]$$

From Eqs. (i) and (ii),

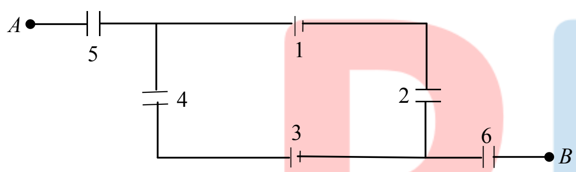
$$E = \frac{E_0}{K}$$

(where K is the dielectric constant)

Hence, the electric field between the plates is increase.

7 **(a)**

In the given circuit capacitor's (1) (2) and (3) are connected in series, hence equivalent capacitance is



$$\frac{1}{C'} = \frac{1}{C} + \frac{1}{C} + \frac{1}{C} = \frac{3}{C}$$

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

This is connected in parallel with (4).

$$\therefore\ C'' = C' + C = \frac{C}{3} + C = \frac{4C}{3}$$

The three capacitor's (5),$\frac{4C}{3}$, (6) are now connected in series.

$\therefore$ Equivalent capacitance is

$$\frac{1}{C'''} = \frac{1}{C} + \frac{3}{4C} + \frac{1}{C}$$

$$\frac{1}{C'''} = \frac{11}{4C}$$

$$\Rightarrow\ C''' = \frac{4C}{11}$$

8 **(b)**

Here, $\vec{E} = 8\hat{i} + 4\hat{j} + 3\hat{k}$

$\vec{S} = 100\hat{k}$

(direction of area is perpendicular to x-y plane)

$\phi = \vec{E}.\vec{s} = (8\hat{i} + 4\hat{j} + 3\hat{k}).100\hat{k}$

$= 300$ unit

9 **(c)**

Potential difference between two equipotential surfaces A and B.

$$V_A - V_B = kq\left(\frac{1}{r_A} - \frac{1}{r_B}\right)$$

$$= kq\left(\frac{r_B - r_A}{r_A r_B}\right)$$

$$= \frac{kqt_1}{r_A r_B}$$

Or

$$t_1 = \frac{(V_A - V_B) r_A r_B}{kq}$$

Or $t_1 \propto r_A r_B$

Similarly, $t_2 \propto r_B r_C$

Since,

$r_A < r_B < r_C$, therefore $r_A r_B < r_B r_C$

$\therefore \quad t_1 < t_2$

10 **(a)**

If a dielectric slab is inserted between the plates of a charged capacitor, the intensity of electric field potential difference of capacitor and the energy stored all reduce to $\frac{1}{K}$ times and capacity of the capacitor increases K times. But the charge on the capacitor remains unchanged.

Here, K is the dielectric constant of dielectric.

11 **(b)**

The effective capacitance of three capacitor connected in parallel=$3C$

When $3C$is connected in series to C

$$C_{\text{resul}} = \frac{3C \times C}{3C + C} = 3.75$$

$$\Rightarrow \qquad C = 5\mu\text{F}$$

12 **(a)**

In series combination, charge is constant.

$$\therefore \qquad V \propto \frac{1}{C}$$

Now, $\quad \frac{V_2}{V_1} = \frac{KC}{C} = \frac{K}{1}$

But $\quad V_1 + V_2 = V$

or $\frac{V_2}{K} + V_2 = V$ or $V_2 = \frac{K}{K+1}V$

13 **(c)**

Stored charge on capacitor becomes zero only when it is discharged through resistance or when two capacitors of equal capacitances are charged and then connected to opposite terminals. Here the capacitances are different.

14 **(a)**

The energy which is stored in the condenser is given by

$E = \frac{1}{2} . \frac{q^2}{C}$ ...(i)

where q is charge and C the capacitance.

Also, $C = \frac{\varepsilon_0 A}{d}$ ...(ii)

From Eqs. (i) and (ii), we get

$E = \frac{1}{2} . \frac{q^2 d}{\varepsilon_0 A} \Rightarrow E \propto d$

When plate separation (d) is increased energy increases.

15 **(a)**

Potential due to charge (q) at point (r) is given by

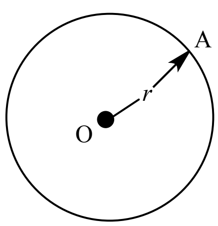
$V = \frac{1}{4\pi e_0} . \frac{q}{r}$

Since, charge Q is rotated in a circle of radius r, hence its potential remains same at all points on the path, hence $\Delta V = 0$.

Also, work done $= q\Delta V$

Where q is charge and $\Delta V = 0$.

$\therefore$ Work done $=0$.



16 **(d)**

In the arrangement shown both plates of capacitors C_3 are joined to point B. Hence, it does not act as a capacitor and is superfluous. Now C_1 and C_2 are in parallel, hence $C_{AB} = C_1 + C_2 = C + C = 2C$

17 **(c)**

At P due to shell, potential

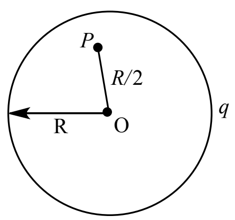
$V_1 = \frac{q}{4\pi\varepsilon_0 R}$

at P due to Q, potential

$V_2 = \frac{Q}{4\pi\varepsilon_0 \frac{R}{2}} = \frac{2Q}{4\pi\varepsilon_0 R}$

∴ Net potential at P

$V = V_1 + V_2 = \frac{q}{4\pi\varepsilon_0 R} + \frac{2Q}{4\pi\varepsilon_0 R}$



18 **(c)**
When a capacitor is charged, work is done by the charging battery. As the capacitor charges, the potential difference across its plates rises. The total amount of work in charging the capacitor is stored up in the capacitor, in the form of electric potential energy between the plates.

19 **(c)**
In a parallel plate capacitor, the capacity of capacitor,

$$C = \frac{k\varepsilon_0 A}{d}$$

∴ $C \propto A$

So, the capacity of capacitor increases if area of the plate is increased.

20 **(d)**
Potential of big drop $V = n^{2/3}V'$

V'= potential of small drop

n=no. of drops=125

V=2.5

∴ $2.5 = (125)^{2/3}\, V'$

2.5=25V' V'=0.1 volt

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