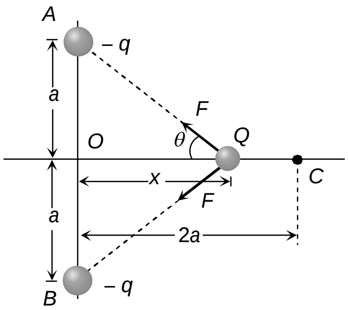
**PRACTICE TEST OYJ B PHYSICS ELECTROSATICS 23 DEC 2019**

**1.** (d) By symmetry of problem the components of force on $Q$ due to charges at $A$ and $B$ along y-axis will cancel each other while along $x$-axis will add up and will be along $CO$. Under the action of this force charge $Q$ will move towards $O$. If at any time charge $Q$ is at a distance $x$ from $O$. Net force on charge $Q$




$$F_{net} \Rightarrow 2F\cos\theta = 2\frac{1}{4\pi\varepsilon_0}\frac{-qQ}{(a^2+x^2)}\times\frac{x}{(a^2+x^2)^{1/2}}$$

*i.e.*, $F_{net} = -\frac{1}{4\pi\varepsilon_0}\cdot\frac{2qQx}{\left(a^2+x^2\right)^{3/2}}$

As the restoring force $F_{net}$ is not linear, motion will be oscillatory (with amplitude $2a$) but not simple harmonic.

**2.** (c) Charge will move along the circular line of force because $x^2+y^2=1$ is the equation of circle in $xy$-plane.

**3.** (a) Because of the presence of positive test charge $q_0$ in front of positively charged ball, charge on the ball will be redistributed, less charge on the front half surface and more charge on the back half surface. As a result of this net force $F$ between ball and point charge will decrease *i.e.* actual electric field will be greater than $F/q_0$.

**4.** (c) Electric field at a distance $R$ is only due to sphere because electric field due to shell inside it is always zero.

Hence electric field $= \frac{1}{4\pi\varepsilon_0}\cdot\frac{3Q}{R^2}$

**5.** (d) $q_1+q_2=Q$ and $\frac{q_1}{4\pi r^2}=\frac{q_2}{4\pi R^2}$ (given)

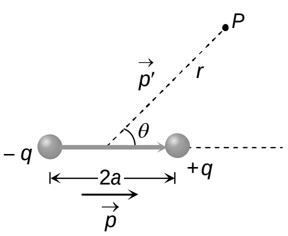
$q_1=\frac{Qr^2}{R^2+r^2}$ and $q_2=\frac{QR^2}{R^2+r^2}$

Potential at common centre

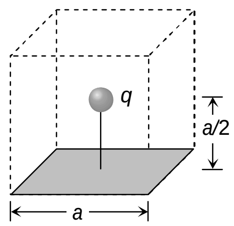
$$\frac{1}{4\pi\varepsilon_0}\left[\frac{Qr^2}{(R^2+r^2)r}+\frac{QR^2}{(R^2+r^2)R}\right]=\frac{Q(R+r)}{4\pi\varepsilon_0(R^2+r^2)}$$

**6.** (a) For the given situation, diagram can be drawn as follows

As shown in figure component of dipole moment along the line $OP$ will be $p'=p\cos\theta$. Hence electric potential at point $P$ will be $V=\frac{1}{4\pi\varepsilon_0}\cdot\frac{p\cos\theta}{r^2}$

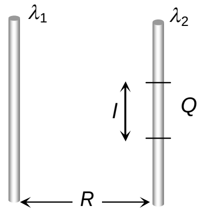



**7.** (d) An imaginary cube can be made by considering charge $q$ at the centre and given square is one of it's face.



So flux from given square (*i.e.* one face) $\phi = \dfrac{q}{6\varepsilon_0}$

**8.** (b) Force on $l$ length of the wire 2 is

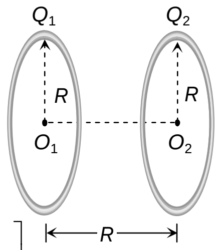



$F_2 = QE_1 = (\lambda_2 l)\dfrac{2k\lambda_1}{R}$

$\Rightarrow \dfrac{F_2}{l} = \dfrac{2k\lambda_1\lambda_2}{R}$

Also $\dfrac{F_1}{l} = \dfrac{F_2}{l} = \dfrac{F}{l} = \dfrac{2k\lambda_1\lambda_2}{R}$

**9.** (b) $W = q(V_{O_2} - V_{O_1})$




where $V_{O_1} = \dfrac{Q_1}{4\pi\varepsilon_0 R} + \dfrac{Q_2}{4\pi\varepsilon_0 R\sqrt{2}}$

and $V_{O_2} = \dfrac{Q_2}{4\pi\varepsilon_0 R} + \dfrac{Q_1}{4\pi\varepsilon_0 R\sqrt{2}}$

$\Rightarrow V_{O_2} - V_{O_1} = \dfrac{(Q_2 - Q_1)}{4\pi\varepsilon_0 R}\left[1 - \dfrac{1}{\sqrt{2}}\right]$

So, $W = \dfrac{q.(Q_2 - Q_1)}{4\pi\varepsilon_0 R}\dfrac{(\sqrt{2}-1)}{\sqrt{2}}$

**10.** (c, d) Under electrostatic condition, all points lying on the conductor are in same potential. Therefore, potential at $A$ = potential at $B$.

From Gauss's theorem, total flux through the surface of the cavity will be $q/\varepsilon_0$.

Note : ❑ Instead of an elliptical cavity, if it would had been a spherical cavity then options (a) and (b) were also correct.

**11.** (d) $V = \dfrac{q}{4\pi\varepsilon_0 x_0}\left[1 + \dfrac{1}{3} + \dfrac{1}{5} + ...\right] - \dfrac{q}{4\pi\varepsilon_0 x_0}\left[\dfrac{1}{2} + \dfrac{1}{4} + \dfrac{1}{6} + ...\right]$

$= \dfrac{q}{4\pi\varepsilon_0 x_0}\left[1 - \dfrac{1}{2} + \dfrac{1}{3} - \dfrac{1}{4} + ....\right] = \dfrac{q}{4\pi\varepsilon_0 x_0}\log_e 2$

**12.** (a, c) Here $E = \dfrac{1}{4\pi\varepsilon_0}.\dfrac{Qz_0}{(R^2 + z_0^2)^{3/2}}$

where $Q$ is the charge on ring and $z_0$ is the distance of the point from origin.

Then $F = qE = \dfrac{-Qqz_0}{4\pi\varepsilon_0(R^2 + z_0^2)^{3/2}}$

When charge $-q$ crosses origin, force is again towards centre *i.e.*, motion is periodic.
Now if $z_0 << R$

$\therefore\ F = -\dfrac{1}{4\pi\varepsilon_0}.\dfrac{Qqz_0}{R^2} \Rightarrow F \propto -z_0$ *i.e.*, motion is S.H.M.

**13.** (a, c)For non-conducting solid sphere $E_{in} \propto r$

and $E_{out} \propto \dfrac{1}{r^2}$

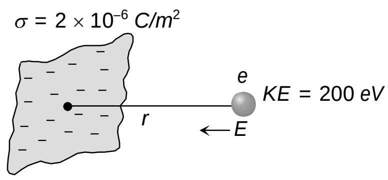
*i.e.* for $r < R$; $E$ increases as $r$ increases

and for $R < r < \infty$; $E$ decreases as $r$ increases

**14.** (a) $\int_{-\infty}^{0} -\vec{E}\cdot\vec{dl}$ = potential at centre of non-conducting ring

$= \dfrac{1}{4\pi\varepsilon_0} \times \dfrac{q}{r} = \dfrac{9\times10^9 \times 1.11\times10^{-10}}{0.5} = 2\,volt$

**15.** (a) Let an electron is projected towards the plate from the $r$ distance as shown in fig.



It will not strike the plate if and only if $KE \le e(E \cdot r)$ (where $E$ = Electric field due to charge plate $= \frac{\sigma}{2\varepsilon_0}$)

$\Rightarrow r \ge \frac{KE}{eE}$. Hence minimum value of $r$ is given by

$$r = \frac{KE}{eE} = \frac{200\,eV}{e \times \frac{\sigma}{2\varepsilon_0}} = \frac{400 \times 8.86 \times 10^{-12}}{2 \times 10^{-6}} = 1.77mm$$

**16.** (b) $Q = ne$ ; where $n$ = number of moles $\times\ 6.02 \times 10^{23} \times 10$

$$\Rightarrow Q = \frac{500}{18} \times 6.02 \times 10^{23} \times 10 \times 1.6 \times 10^{-19} = 2.67 \times 10^{7}\,C$$

**17.** (d) $E_x = -\frac{dV}{dx} = -(6 - 8y^2)$, $E_y = -\frac{dV}{dy} = -(-16xy - 8 + 6z)$

$$E_z = -\frac{dV}{dz} = -(6y - 8z)$$

At origin $x = y = z = 0$ so, $E_x = -6, E_y = 8$ and $E_z = 0$

$$\Rightarrow E = \sqrt{E_x^2 + E_y^2} = 10\ N/C.$$

Hence force $F = QE = 2 \times 10 = 20N$

**18.** (b) Flux linked with the given sphere $\phi = \frac{Q}{\varepsilon_o}$;

where $Q$ = Charge enclosed by the sphere.

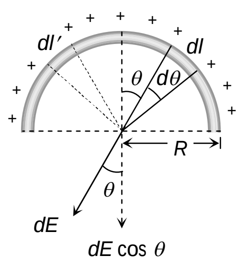
Hence $Q = \phi\varepsilon_o = (EA)\varepsilon_o$

$\Rightarrow Q = 4\pi(\gamma_o)^2 \times A\gamma_o\varepsilon_o = 4\pi\varepsilon_o A\gamma_o^3$.

**19.** (a) From figure $dl = R\,d\theta$;

Charge on $dl = \lambda R\,d\theta$ $\quad \left\{\lambda = \frac{q}{\pi R}\right\}$

Electric field at centre due to $dl$ is $dE = k.\frac{\lambda R d\theta}{R^2}$.




We need to consider only the component $dE\cos\theta$, as the component $dE\ \sin\theta$ will cancel out because of the field at $C$ due to the symmetrical element $dl'$.

Total field at centre $= 2\int_0^{\pi/2} dE\cos\theta$

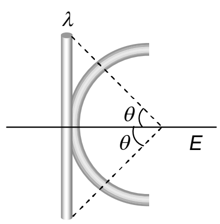
$$= \frac{2k\lambda}{R}\int_0^{\pi/2}\cos\theta\,d\theta = \frac{2k\lambda}{R} = \frac{q}{2\pi^2\varepsilon_0 R^2}$$

**Alternate method** : As we know that electric field due to a finite length charged wire on it's perpendicular bisector is given by $E = \frac{2k\lambda}{R}\sin\theta$.

If it is bent in the form of a semicircle then $\theta = 90°$

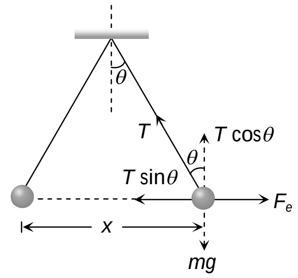
$$\Rightarrow E = \frac{2k\lambda}{R}$$

$$= 2 \times \frac{1}{4\pi\varepsilon_0}\left(\frac{q/\pi R}{R}\right)$$



$$= \frac{q}{2\pi^2\varepsilon_0 R^2}$$

**20.** (a)




In equilibrium $F_e = T\sin\theta$ ....... (i)

$mg = T\cos\theta$ ....... (ii)

$$\tan\theta = \frac{F_e}{mg} = \frac{q^2}{4\pi\varepsilon_o x^2 \times mg} \text{ also } \tan\theta \approx \sin\theta = \frac{x/2}{L}$$

Hence $\dfrac{x}{2L} = \dfrac{q^2}{4\pi\varepsilon_o x^2 \times mg}$

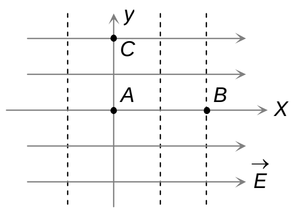
$$\Rightarrow x^3 = \frac{2q^2 L}{4\pi\varepsilon_o mg} \Rightarrow x = \left(\frac{q^2 L}{2\pi\varepsilon_o mg}\right)^{1/3}$$

**21.** (d) Outside the charged sphere, (for equal distances from centre) if electric fields at two points are same then both points must be equipotential points.

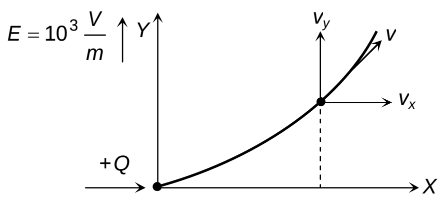
**22.** (c) Option (a) shows lines of force starting from one positive charge and terminating at another. Option (b) has one line of force making closed loop. Option (d) shows all lines making closed loops. All these are not correct. Only option (c) is correct.

**23.** (b) Potential decreases in the direction of electric field. Dotted lines are equipotential lines

$\therefore\ V_A = V_C$ and $V_A > V_B$




**24.** (c) Body moves along the parabolic path.



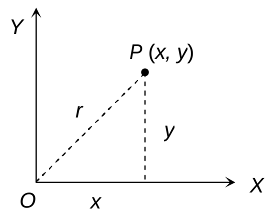

For vertical motion : By using $v = u + at$

$$\Rightarrow v_y = 0 + \frac{QE}{m}.t = \frac{10^{-6}\times 10^3}{10^{-3}}\times 10 = 10\,m/\text{sec}$$

For horizontal motion – It's horizontal velocity remains the same *i.e.* after 10 *sec*, horizontal velocity of body $v_x$ = 10 *m/sec*.

Velocity after 10 *sec* $v = \sqrt{v_x^2 + v_y^2} = 10\sqrt{2}\,m/sec$

**25.** (b) $E_x = -\dfrac{dV}{dx} = -ky$ ; $E_y = -\dfrac{dV}{dy} = -kx$

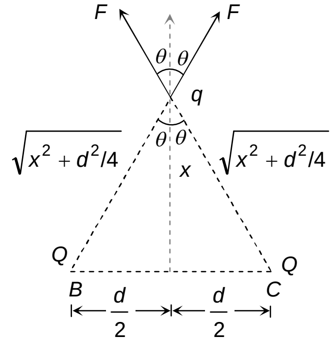


$\Rightarrow E = \sqrt{E_x^2 + E_y^2} = k\sqrt{x^2 + y^2} = kr \Rightarrow E \propto r$

**26.** (c) Suppose third charge is similar to $Q$ and it is $q$

So net force on it

$F_{net} = 2F\cos\theta$




Where $F = \dfrac{1}{4\pi\varepsilon_0}\cdot\dfrac{Qq}{\left(x^2 + \dfrac{d^2}{4}\right)}$ and $\cos\theta = \dfrac{x}{\sqrt{x^2 + \dfrac{d^2}{4}}}$

$\therefore F_{net} = 2 \times \dfrac{1}{4\pi\varepsilon_0}\cdot\dfrac{Qq}{\left(x^2 + \dfrac{d^2}{4}\right)} \times \dfrac{x}{\left(x^2 + \dfrac{d^2}{4}\right)^{1/2}}$

$= \dfrac{2Qqx}{4\pi\varepsilon_0\left(x^2 + \dfrac{d^2}{4}\right)^{3/2}}$

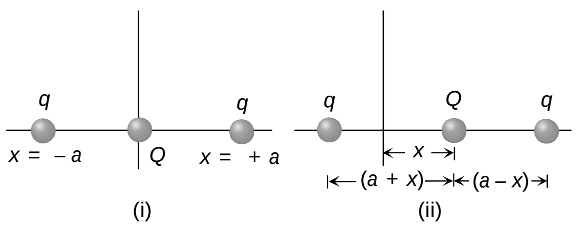
For $F_{net}$ to be maximum $\dfrac{dF_{net}}{dx} = 0$

*i.e.* $\dfrac{d}{dx}\left[\dfrac{2Qqx}{4\pi\varepsilon_0\left(x^2 + \dfrac{d^2}{4}\right)^{3/2}}\right] = 0$

or $\left[\left(x^2 + \dfrac{d^2}{4}\right)^{-3/2} - 3x^2\left(x^2 + \dfrac{d^2}{4}\right)^{-5/2}\right] = 0$

*i.e.* $x = \pm\dfrac{d}{2\sqrt{2}}$

**27.** (b) Initially according to figure (i) potential energy of $Q$ is $U_i = \dfrac{2kqQ}{a}$ ......(i)




(i) (ii)

According to figure (ii) when charge $Q$ is displaced by small distance $x$ then it's potential energy now

$U_f = kqQ\left[\dfrac{1}{(a+x)} + \dfrac{1}{(a-x)}\right] = \dfrac{2kqQa}{(a^2 - x^2)}$ .......(ii)

Hence change in potential energy

$$\Delta U = U_f - U_i = 2kqQ\left[\frac{a}{a^2 - x^2} - \frac{1}{a}\right] = \frac{2kqQx^2}{(a^2 - x^2)}$$

Since $x << a$ so $\Delta U = \frac{2kqQx^2}{a^2} \Rightarrow \Delta U \propto x^2$

**28.** (a) Suppose distance of closest approach is $r$, and according to energy conservation applied for elementary charge.

Energy at the time of projection = Energy at the distance of closest approach

$$\Rightarrow \frac{1}{2}mv^2 = \frac{1}{4\pi\varepsilon_0} \cdot \frac{(Ze).e}{r} \Rightarrow r = \frac{Ze^2}{2\pi\varepsilon_0 mv^2}$$

**29.** (a) When dipole is given a small angular displacement $\theta$ about it's equilibrium position, the restoring torque will be

$\tau = -pE\sin\theta = -pE\theta$ (as $\sin\theta = \theta$)

or $I\frac{d^2\theta}{dt^2} = -pE\theta$ (as $\tau = I\alpha = I\frac{d^2\theta}{dt^2}$)

or $\frac{d^2\theta}{dt^2} = -\omega^2\theta$ with $\omega^2 = \frac{pE}{I} \Rightarrow \omega = \sqrt{\frac{pE}{I}}$

**30.** (c) Electric field is perpendicular to the equipotential surface and is zero every where inside the metal.

**31.** (c) $$E = \frac{1}{4\pi\varepsilon_0}\cdot\left[\frac{5\times10^{-9}}{(1\times10^{-2})^2} - \frac{5\times10^{-9}}{(2\times10^{-2})^2} + \frac{5\times10^{-9}}{(4\times10^{-2})^2} - \frac{(5\times10^{-9})}{(8\times10^{-2})^2} + .....\right]$$

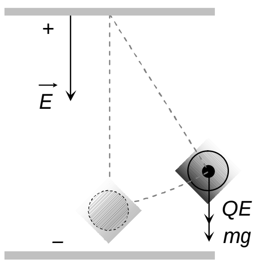
$$\Rightarrow E = \frac{9\times10^9\times5\times10^{-9}}{10^{-4}}\left[1 - \frac{1}{(2)^2} + \frac{1}{(4)^2} - \frac{1}{(8)^2} + ...\right]$$

$$\Rightarrow E = 45\times10^4\left[1 + \frac{1}{(4)^2} + \frac{1}{(16)^2} + ...\right] - 45\times10^4\left[\frac{1}{(2)^2} + \frac{1}{(8)^2} + \frac{1}{(32)^2} + ...\right]$$

$$\Rightarrow E = 45\times10^4\left[\frac{1}{1-\frac{1}{16}}\right] - \frac{45\times10^4}{(2)^2}\left[1 + \frac{1}{4^2} + \frac{1}{(16)^2} + ..\right]$$

$E = 48\times10^4 - 12\times10^4 = 36\times10^4\ N/C$

**32.** (c)

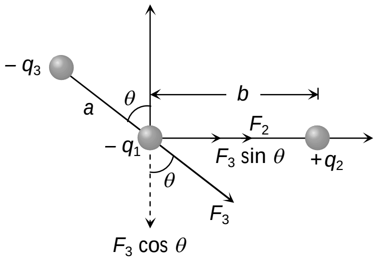



Net downward force $mg' = mg + QE$

$\Rightarrow$ Effect acceleration $g' = \left(g + \frac{QE}{m}\right)$

Hence time period $T = 2\pi\sqrt{\frac{l}{g'}} = 2\pi\sqrt{\frac{l}{\left(g + \frac{QE}{m}\right)}}$

**33.** (c)



$F_2$ = Force applied by $q_2$ on $-q_1$

$F_3$ = Force applied by $(-q_3)$ on $-q_1$

$x$-component of Net force on $-q_1$ is

$F_x = F_2 + F_3 \sin\theta \quad = k\dfrac{q_1q_2}{b^2} + k.\dfrac{q_1q_3}{a^2}\sin\theta$

$\Rightarrow F_x = k\left[\dfrac{q_1q_2}{b^2} + \dfrac{q_1q_3}{a^2}\sin\theta\right]$

$\Rightarrow F_x = k\cdot q_1\left[\dfrac{q_2}{b^2} + \dfrac{q_3}{a^2}\sin\theta\right] \Rightarrow F_x \propto \left(\dfrac{q_2}{b^2} + \dfrac{q_3}{a^2}\sin\theta\right)$

**34.** (a) In case of a charged conducting sphere

$V_{\text{inside}} = V_{\text{centre}} = V_{\text{surface}} = \dfrac{1}{4\pi\varepsilon_o}.\dfrac{q}{R}$, $V_{\text{outside}} = \dfrac{1}{4\pi\varepsilon_0}.\dfrac{q}{r}$

If $a$ and $b$ are the radii of sphere and spherical shell respectively, then potential at their surface will be

$V_{\text{sphere}} = \dfrac{1}{4\pi\varepsilon_0}.\dfrac{Q}{a}$ and $V_{\text{shell}} = \dfrac{1}{4\pi\varepsilon_0}.\dfrac{Q}{b}$

$\therefore V = V_{\text{sphere}} - V_{\text{shell}} = \dfrac{1}{4\pi\varepsilon_0}.\left[\dfrac{Q}{a} - \dfrac{Q}{b}\right]$

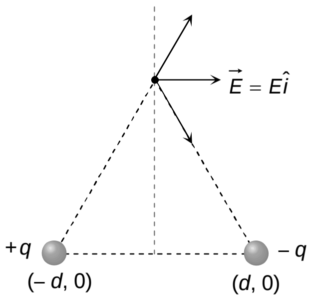
Now when the shell is given charge (–3$Q$), then the potential will be

$V'_{\text{sphere}} = \dfrac{1}{4\pi\varepsilon_0}\left[\dfrac{Q}{a} + \dfrac{(-3Q)}{b}\right]$, $V'_{\text{shell}} = \dfrac{1}{4\pi\varepsilon_0}\left[\dfrac{Q}{b} + \dfrac{(-3Q)}{b}\right]$

$\therefore V'_{\text{sphere}} - V'_{\text{shell}} = \dfrac{1}{4\pi\varepsilon_0}\left[\dfrac{Q}{a} - \dfrac{Q}{b}\right] = V$

**35.** (a) From figure, it is clear that $\vec{E}$ at all points on the $y$-axis is along $\hat{i}$. Here $\vec{E}$ of all points on $x$-axis cannot have the same direction.

Here electric potential at origin is zero so no work is done in bringing a test charge from infinity to origin.




Here dipole moment is in – $x$ direction (– $q$ to + $q$).

Hence only option (a) is correct.

**36.** (a) By the concept of electrical image, it is considered that an equal but opposite charge present on the other side of the plate at equal distance. Hence force

$F = \dfrac{40 \times 40}{4^2} = 100\,dynes$

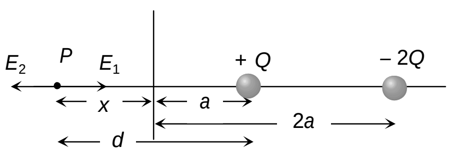
**37.** (d) Energy $= \dfrac{1}{2}\varepsilon_0 E^2 \times (A \times d) = \dfrac{1}{2}\varepsilon_0\left(\dfrac{V^2}{d^2}\right)Ad$

$= \dfrac{1}{2} \times \dfrac{8.85 \times 10^{-12} \times (10^5)^2 \times 25 \times 10^6}{0.75 \times 10^3} = 1475J$

**38.** (b) Suppose electric field is zero at a point $P$ lies at a distance $d$ from the charge + $Q$.

At $P$ $\quad \dfrac{kQ}{d^2} = \dfrac{k(2Q)}{(a+d)^2}$

$\Rightarrow \dfrac{1}{d^2} = \dfrac{2}{(a+d)^2} \Rightarrow d = \dfrac{a}{(\sqrt{2}-1)}$



Since $d > a$ *i.e.* point $P$ must lies on negative $x$-axis as shown at a distance $x$ from origin hence $x = d - a$ $= \frac{a}{(\sqrt{2}-1)} - a = \sqrt{2}\,a$. Actually $P$ lies on negative $x$-axis so $x = -\sqrt{2}\,a$

**39.** (d) If the charges are arranged according to the option (d), the electric fields due to $P$ and $S$ and due to $Q$ and $T$ add to zero, while due to $U$ and $R$ will be added up.

**40.** (d) Charge $q$ will momentarily come to rest at a distance $r$ from charge $Q$ when all it's kinetic energy converted to potential energy *i.e.* $\frac{1}{2}mv^2 = \frac{1}{4\pi\varepsilon_0}.\frac{qQ}{r}$

Therefore the distance of closest approach is given by

$$r = \frac{qQ}{4\pi\varepsilon_0}.\frac{2}{mv^2} \Rightarrow r \propto \frac{1}{v^2}$$

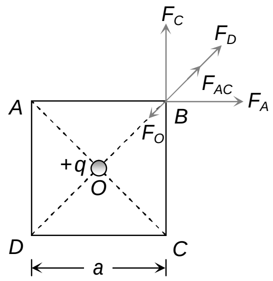
Hence if $v$ is doubled, $r$ becomes one fourth.

**41.** (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

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




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

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

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

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

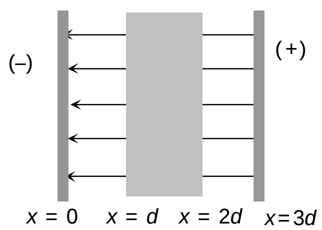
$$\Rightarrow \frac{KQ^2}{a^2}\left(\sqrt{2} + \frac{1}{2}\right) = \frac{2KQq}{a^2} \Rightarrow q = \frac{Q}{4}\left(1 + 2\sqrt{2}\right)$$

**42.** (c) Capacitance will increase but not 5 times (because dielectric is not filled completely). Hence new capacitance may be 200 $\mu\mu F$.

**43.** (b, c) Even after introduction of dielectric slab, direction of electric field will be perpendicular to the plates and directed from positive plate to negative plate.

Further, magnitude of electric field in air $= \frac{\sigma}{\varepsilon_0}$

Magnitude of electric field in dielectric $= \frac{\sigma}{K\varepsilon_0}$




Similarly electric lines always flows from higher to lower potential, therefore, electric potential increases continuously as we move from $x = 0$ to $x = 3d$.

**44.** (d) If length of the foil is $l$ then $C = \dfrac{k\varepsilon_0(l \times b)}{d}$

$\Rightarrow 2 \times 10^{-6} = \dfrac{2.5 \times 8.85 \times 10^{-12}(l \times 400 \times 10^{-3})}{0.15 \times 10^{-3}}$

$\Rightarrow l = 33.9\ m$

**45.** (a, b) By using

$V = V_0 e^{-t/CR} \Rightarrow 40 = 50\, e^{-1/CR} \Rightarrow e^{-1/CR} = 4/5$

Potential difference after 2 *sec*

$V' = V_0 e^{-2/CR} = 50(e^{-1/CR})^2 = 50\left(\dfrac{4}{5}\right)^2 = 32\, V$

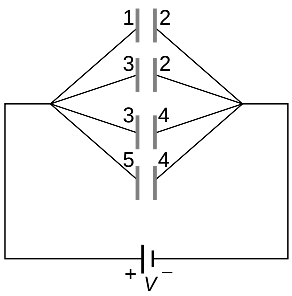
Fraction of energy after 1 *sec*

$= \dfrac{\frac{1}{2}C(V_f)^2}{\frac{1}{2}C(V_i)^2} = \left(\dfrac{40}{50}\right)^2 = \dfrac{16}{25}$

**46.** (a) $U = \dfrac{1}{2}CV^2 = \dfrac{1}{2}\left(\dfrac{\varepsilon_0 A}{x}\right)V^2$

$\therefore \dfrac{dU}{dt} = \dfrac{1}{2}\varepsilon_0 AV^2\left(-\dfrac{1}{x^2}\dfrac{dx}{dt}\right) \Rightarrow \dfrac{dU}{dt} \propto x^{-2}$

**47.** (c) The given circuit can be redrawn as follows. All capacitors are identical and each having capacitance $C = \dfrac{\varepsilon_0 A}{d}$



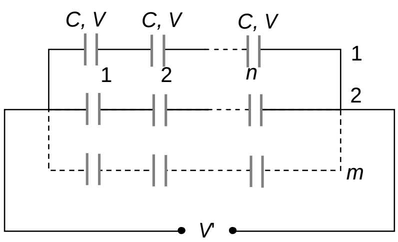

|Charge on each capacitor| = |Charge on each plate|

$= \dfrac{\varepsilon_0 A}{d}V$

Plate 1 is connected with positive terminal of battery so charge on it will be $+\dfrac{\varepsilon_0 A}{d}.V$

Plate 4 comes twice and it is connected with negative terminal of battery, so charge on plate 4 will be $-\dfrac{2\varepsilon_0 A}{d}V$

**48.** (b) Suppose $C = 8\ \mu F$, $C' = 16\mu F$
and $V = 250\ V$, $V' = 1000V$




Suppose $m$ rows of given capacitors are connected in parallel and each row contains $n$ capacitors then potential difference across each capacitor $V = \dfrac{V'}{n}$ and equivalent capacitance of network $C' = \dfrac{mC}{n}$ on putting the values we get $n = 4$ and $m = 8$

$\therefore$ Total capacitors $= n \times m = 4 \times 8 = 32$

**Short Trick :** For such type of problems number of capacitors = $\frac{C'}{C} \times \left(\frac{V'}{V}\right)^2 = \frac{16}{8}\left(\frac{1000}{250}\right)^2 = 32$

**49.** (b) This combination forms a G.P. $S = 1 + \frac{1}{2} + \frac{1}{4} + \frac{1}{8}......$

Sum of infinite G.P. $S = \frac{a}{1-r}$

Here $a$ = first term = 1 and $r$ = common ratio $= \frac{1}{2}$

$\Rightarrow S = \frac{1}{1-\frac{1}{2}} = 2 \Rightarrow C_{eq} = 2\mu F$

**50.** (a) $q_1 = 2CV, \; q_2 = CV$

Now condenser of capacity $C$ is filled with dielectric $K$, therefore $C_2 = KC$

As charge is conserved

$\therefore \; q_1 + q_2 = (C_2^{'} + 2C)V' \; \Rightarrow V' = \frac{3CV}{(K+2)C} = \frac{3V}{K+2}$