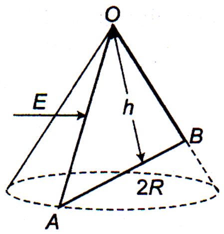
WEEKLY TEST MEDICAL PLUS - 01 TEST - 26 R & B SOLUTION Date 01 -12-2019

[PHYSICS]

1. **(b)** Plane normal to electric field is a triangle with base length $2R$ and height h.



Area of triangle $A = \frac{1}{2} \times 2Rh = Rh$

Electric flux entering the cone $= EA = ERh$

2. **(b)** Charge on glass rod is positive, so charge on gold leaves will also be positive. Due to X-rays, more electrons from leaves will be emitted, so leaves becomes more positive and diverge further.

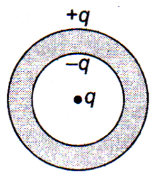
3. **(d)** Negative charge means excess of electron which increases the mass of sphere B.

4. **(b)** When charged metallic ball touches the bottom of can, all of its charge goes to the outer surface of the can. (Net charge on a conductor lies only on its surface).

   When ball is withdrawn from the can, it is uncharged. When ball is placed on the disc of electroscope. Final charge on the leaves is reduced so leaves electroscope converges.

5. **(a)** The object should be positively charged. Being positively charged, it repels positive charge from top plate towards leaves causing to separate more.

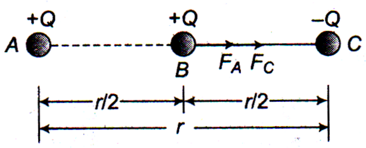
6. **(b)** Let the charge on the ball at centre is q, then $-q$ charge will be induced on the inner surface and $+q$ on the outer surface. field at any point outside the sphere due to inner charges q and $-q$ will jointly be zero.



Outer charge q will produce the electric field at outside points as it would be produced by a charge at the centre. Hence presence of sphere does not affect the electric field outside the sphere.

7. **(d)** Note that there is no field inside the metallic shell.

8. **(c)** Initially, force between A and C $F = k\frac{Q^2}{r^2}$



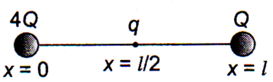
When a similar sphere B having charge $+Q$ is kept at the mid point of line joining A and C, then

Net force on B is $F_{net} = F_A + F_C = k\frac{Q^2}{(r/2)^2} + \frac{kQ^2}{(r/2)^2}$.

$= 8\frac{kQ^2}{r^2} = 8F.$

(Direction is shown in figure)

9. **(d)** The total force on Q

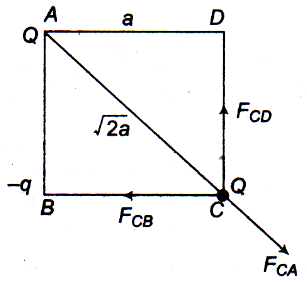


$$\frac{Qq}{4\pi\varepsilon_0\left(\frac{l}{2}\right)^2} + \frac{4Q^2}{4\pi\varepsilon_0 l^2} = 0$$

$$\frac{Qq}{4\pi\varepsilon_0\left(\frac{l}{4}\right)^2} = -\frac{4Q^2}{4\pi\varepsilon_0 l^2} \Rightarrow q = -Q.$$

10. **(a)** In the following figure since $|\vec{F_A}| = |\vec{F_B}| = |\vec{F_C}|$ and they are equally inclined with each other, so their resultant will be zero.

11. **(a)** Different forces on C are shown in figure, a is the side of square.



$$F_{CA} = \frac{1}{4\pi\varepsilon_0} \cdot \frac{Q^2}{2a^2} \text{ along AC}$$

If the resultant force on C is to be zero, the forces on C due to D and B must be along CD and CB respectively. Thus, q must be negative.

Resultant force, F_{CB} and F_{CD} in the direction of CA is given by

$$\frac{1}{4\pi\varepsilon_0} \cdot \frac{Qq}{a^2} \cdot \frac{1}{\sqrt{2}} + \frac{1}{4\pi\varepsilon_0} \cdot \frac{Qq}{a^2} \cdot \frac{1}{\sqrt{2}} = \sqrt{2} \cdot \frac{1}{4\pi\varepsilon_0} \cdot \frac{Qq}{a^2}$$

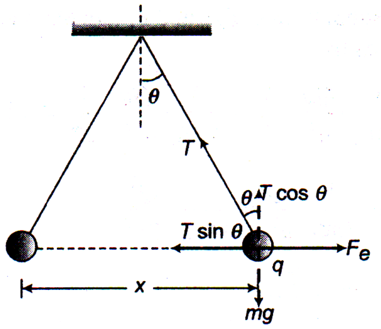
$$\sqrt{2} \cdot \frac{1}{4\pi\varepsilon_0} \frac{qQ}{a^2} = \frac{1}{4\pi\varepsilon_0} \cdot \frac{Q^2}{2a^2}$$

$$|Q| = 2\sqrt{2}\,|q|$$

As q is negative, $Q = -2\sqrt{2}\,q$

12. **(a)** The negative charge oscillates, the resultant force acts as a restoring force and proportional to displacement. When it reaches the plane xy, the resultant force is zero and the mass moves down due to inertia. Thus oscillation is set.

13. (a)



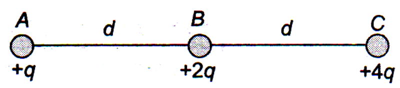
In equilibrium $F_e = T\sin\theta$ ... (i)

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

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

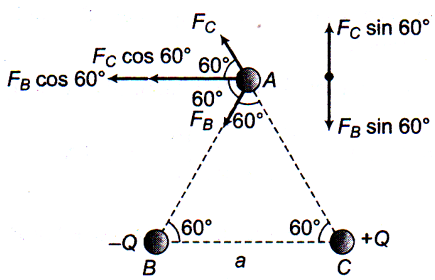
$$\text{Hence } \frac{x}{2L} = \frac{q^2}{4\pi\varepsilon_o x^2 \times mg}$$

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



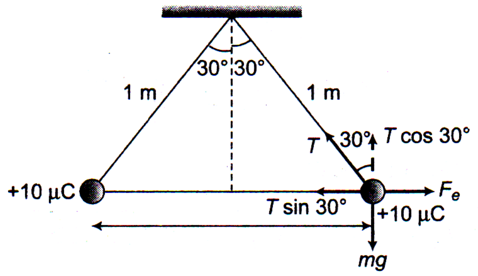
14. (c) We put a unit positive charge at O. Resultant force due to the charge placed at A and C is zero and resultant force due to B and D is towards D along the diagonal BD

15. (c) $|\vec{F_B}| = |\vec{F_C}| = k.\frac{Q^2}{a^2}$



Hence force experienced by the charge at A in the direction normal to BC is zero.

16. **(b)** In the following figure, in equilibrium $F_e = T\sin 30°$, $r = 1$ m



$$\Rightarrow 9\times10^9 . \frac{Q^2}{r^2} = T\times\frac{1}{2}$$

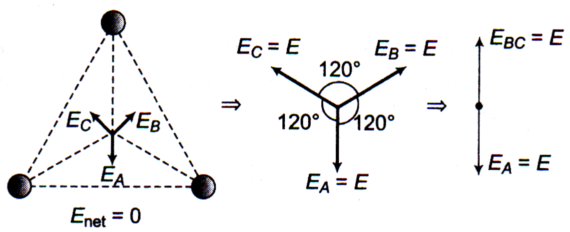
$$\Rightarrow 9\times10^9 . \frac{(10\times10^{-6})^2}{1^2} = T\times\frac{1}{2} \Rightarrow T = 1.8\text{ N}$$

17. **(c)** Flux going in pyramid $= \dfrac{Q}{8\varepsilon_0}$

Which is divided equally among all 4 faces.

$\therefore$ Flux through one face $= \dfrac{Q}{8\varepsilon_0}$

18. **(c)**



19. **(c)** $E_1 = \dfrac{\eta q}{4\pi\varepsilon_0 a^2}$, $E_2 = \dfrac{\eta q}{4\pi\varepsilon_0 a^2}$ Therefore $E = \vec{E}_1 + \vec{E}_2$

$$= \sqrt{E_1^2 + E_2^2 + 2E_1E_2\cos 60°} = \frac{\sqrt{3}\eta q}{4\pi\varepsilon_0 a^2}.$$

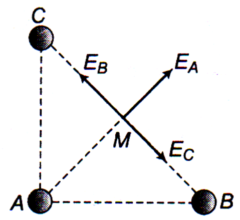
Since $\eta^{-1} < \sqrt{3}, 1 < \sqrt{3}\eta, \sqrt{3}\eta > 1.$

$$\Rightarrow \frac{\sqrt{3}\eta q}{4\pi\varepsilon_0 a^2} > \frac{q}{4\pi\varepsilon_0 a^2} \Rightarrow E_3 > E_0 \left(E_0 = \frac{q}{4\pi\varepsilon_0 a^2} \right).$$

20. **(b)** E_A = Electric field at M due to charge placed at A

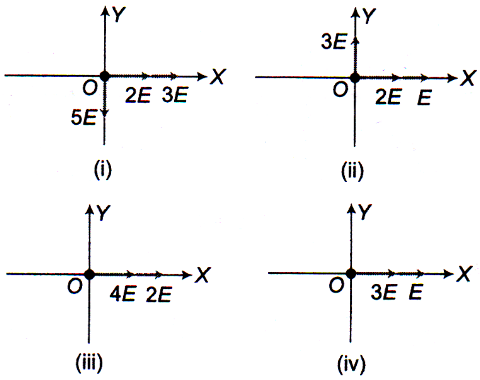
E_B = Electric field at M due to charge placed at B

E_C = Electric field at M due to charge placed at C



As seen from figure $|\vec{E_B}| = |\vec{E_C}|$, so net electric field at M, $E_{net} = E_A$; in the direction of vector 2.

21. **(c)** If electric field due to charge $|q|$ at origin is E then electric field due to charges $|2q|$, $|3q|$, $|4q|$ and $|5q|$ are respectively $2E$, $3E$, $4E$ and $5E$



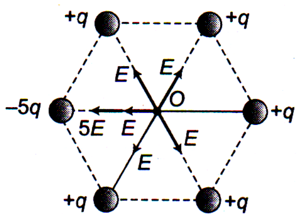
$$E_{(i)} = \sqrt{(5E)^2 + (5E)^2} = 5\sqrt{2}E,$$

$$E_{(ii)} = \sqrt{(3E)^2 + (3E)^2} = 3\sqrt{2}E,$$

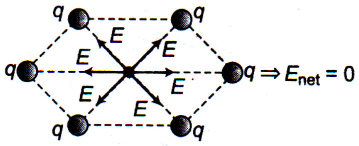
$E_{(iii)} = 4E + 2E = 6E$ and $E_{(iv)} = 3E + E = 4E$

$\Rightarrow E_{(i)} > E_{(iii)} > E_{(ii)} > E_{(iv)}$

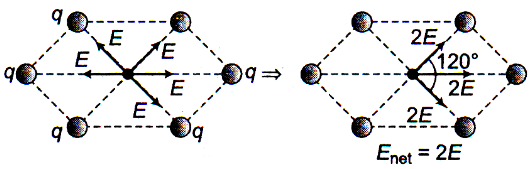
22. **(d)** To obtained net field $6E$ at centre O, the charge to be placed at remaining sixth corner is $-5q$. (see following figure)



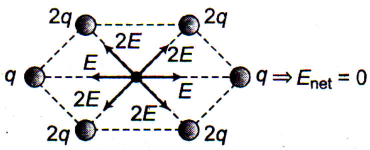
23. **(b)** Electric field at a point due to positive charge acts away from the charge and due to negative charge it act's towards the charge.



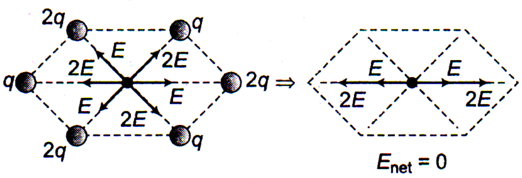
Case(1)



Case(2)

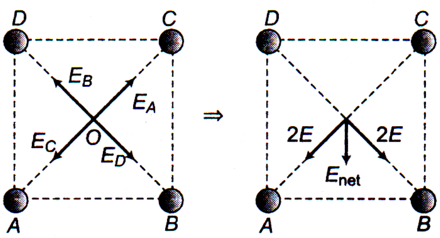


Case(3)



Case(4)

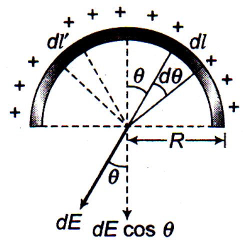
24. **(b)**



$E_A = E, E_B = 2E, E_C = 3E, E_D = 4E$

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

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



26. **(b)** The cork floats motionless if the weight of the cork is equal to electrostatic force due to uniformly charged plane of earth's surface

$$mg = F_e = QE$$

Since earth is considered as a conductor

$$E = \frac{\sigma}{2\varepsilon_0}$$

$$mg = \frac{\sigma}{2\varepsilon_0}Q$$

$$\sigma = \frac{2\varepsilon_0 mg}{Q} = \frac{2\times 8.85\times 10^{-12}\times 10^{-3}\times 9.8}{1\times 10^{-8}}$$

$$= 17.3\times 10^{-8}\ \text{C/m}^2$$

27. **(d)** Electric field at a point on z-axis distant r from origin is

$$E = \frac{1}{4\pi\varepsilon_0}\left(\frac{Qr}{(r^2+R^2)^{3/2}} - \frac{\sqrt{8}\,Qr}{(r^2+4R^2)^{3/2}}\right) = 0$$

Solving we get $r = \sqrt{2}\,R$

28. **(c)** $E = \dfrac{1}{4\pi\varepsilon_0}\cdot\dfrac{ne}{r^2} \Rightarrow n = \dfrac{Er^2}{e}.4\pi\varepsilon_0$

$$\Rightarrow n = \frac{0.036\times 0.1\times 0.1}{9\times 10^9\times 1.6\times 10^{-19}} = \frac{360}{144}\times 10^5$$

$$= 2.5\times 10^5\ \text{N/C.}$$

29. **(a)** Since the lines of forces are terminating on the charges both have to be negative.

30. **(b)** Total enclosed charge $q = 100\,Q$ coulomb

$$\phi_E = \frac{q}{\varepsilon_0} = \frac{100Q}{\varepsilon_0}$$

31. **(c)** In the given figure, the electric lines of force emanate from A and C. Therefore, charges A and C must be positive.

32. **(a)** The field lines of a single positive charge are radially outward.

33. **(d)** Based on theory

34. **(a)** Based on theory

35. **(d)** From the Gauss' law $\phi = \frac{q_{\text{enclosed}}}{\varepsilon_0}$ in which q_{enclosed} is the net charge inside an imaginary closed surface (a Gaussian surface) flux does not depend on the radius of imaginary enclosed surface.

36. **(c)** q is $+ve$ because lines of force emerge from it and $|Q| < |q|$ because more lines emerge from q and less lines terminate at Q.

37. **(a)** In non-uniform electric field. Intensity is more, where the lines are more dense.

38. **(d)** The electric field is always perpendicular to the surface of a conductor. On the surface of a metallic solid sphere, the electrical field is oriented normally (i.e., directed towards the centre of the sphere).

39. **(c)** At A and C, electric lines are equally spaced and dense that's why $E_A = E_C > E_B$

40. **(d)** Charge responsible for producing flux in the shell = $q/3$. In this case, angle formed by the shell at centre of ring $\frac{q}{3\varepsilon_0}$

So, charge to contribute flux in the shell

$$= \frac{2\pi}{3} \frac{q}{2\pi} = \frac{q}{3}$$

41. **(a)** When the point is situated at a point on diameter away from the centre of hemisphere charged uniformly

42. **(c)** No field inside the hollow conducting sphere.

43. **(a)** Since $qE = mg$ or $E = \frac{mg}{q} = \frac{1.7 \times 10^{-27} \times 9.8}{1.6 \times 10^{-19}}$

$= 10.0 \times 10^{-8} = 1 \times 10^{-7}$ V/m

44. . **(a)** Electric field inside a conductor is zero.

45. **(c)** The time required to fall through distance d is

$$d = \frac{1}{2}\left(\frac{qE}{m}\right)t^2 \text{ or } t = \sqrt{\frac{2dm}{qE}}$$

Since $t^2 \propto m$, a proton takes more time.

[CHEMISTRY]

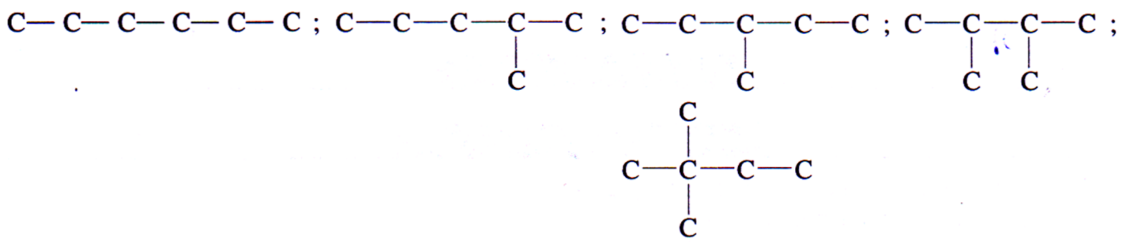
46. The structure of given compounds are

2-Butene	$CH_3—CH=CH—CH_3$	2-Butanol	$CH_3CH_2CH(OH)CH_3$
2-Butyne	$CH_3—C≡C—CH_3$	Butanal	$CH_3CH_2CH_2CHO$

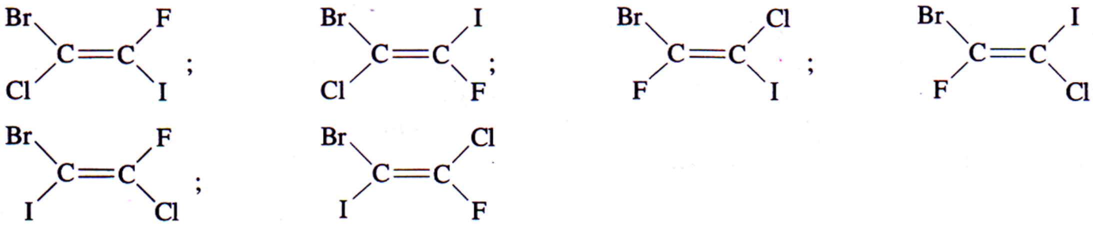
Only 2-Butene shows *cis-trans* isomerism.

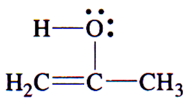
47. Different formulae implies different molar masses.

48. The skeletons of carbon in C_6H_{14} are as follows



49. The six compounds will be



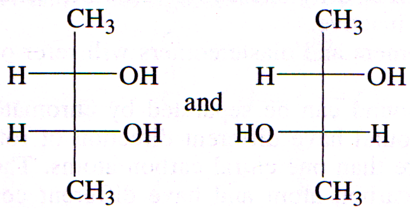
50. The enolic form of acetone is  . It contains 9 sigma bonds, 1 pi bond and two lone pairs of electron on oxygen.

51. Isomers which can be interconverted through rotation around a single bond are known as conformers.

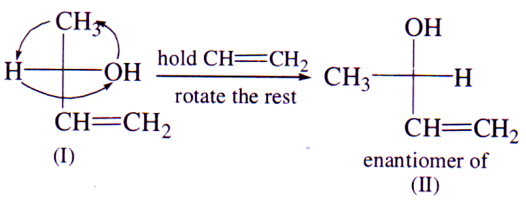
52 Only one optically active compound $H_3CCH(Br)CHBr_2$ is possible.

53. The compounds I and II are enantiomers. Rotation of compound II by 180° produces mirror image of compound I.

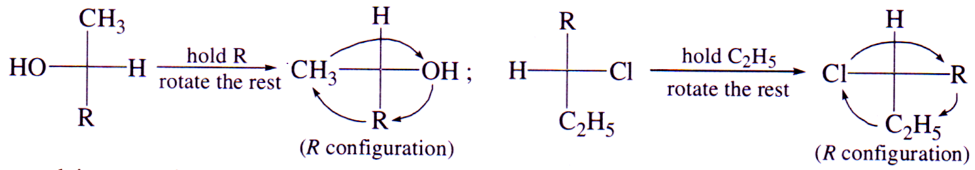
54. For the compound $CH_3CH(OH)CH(OH)CH_3$, two optically active seteroisomers are possible.



55. The structures (I) and (II) represent enantiomers.



56. We have



The compound is named as $(2R_1 3R)$-3-chloro-2-pentanol.

57. The number of stereoisomers will be 16 ($= 2^4$).

58. The two enantiomers differ in their optical activities.