

WEEKLY TEST MEDICAL PLUS - 01,02 B, 01 R
SOLUTION Date 22 -12-2019

[PHYSICS]

1. (c) A movable charge produces electric field and magnetic field both.

2. (d) Since charge flows from high potential to lower potential.

If positive charge is given, then $V_1 < V_2$ as $r_1 > r_2$

So positive charge flows from $Q \rightarrow P$

If negative charge is given, then $V_1 > V_2$

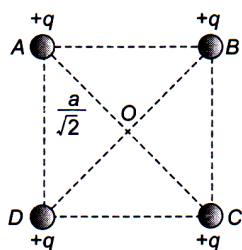
So negative charge flows from $P \rightarrow Q$.

Since it is not given that whether the charge given is positive or negative, hence the information is incomplete.

3. (d) $V = n^{2/3} v \Rightarrow V = (125)^{2/3} \times 50 = 1250 \text{ V}$

4. (b) Potential at the centre O , $V = 4 \times \frac{1}{4\pi\epsilon_0} \cdot \frac{Q}{a/\sqrt{2}}$

where $Q = \frac{10}{3} \times 10^{-9} \text{ C}$ and $a = 8 \text{ cm} = 8 \times 10^{-2} \text{ m}$



$$\text{So } V = 5 \times 9 \times 10^9 \times \frac{\frac{10}{3} \times 10^{-9}}{\frac{8 \times 10^{-2}}{\sqrt{2}}} = 1500\sqrt{2} \text{ volt}$$

5. (a) $V = 9 \times 10^9 \cdot \frac{p}{r^2}$

$$= 9 \times 10^9 \times \frac{(1.6 \times 10^{-19}) \times 1.28 \times 10^{-10}}{(12 \times 10^{-10})^2} = 0.13 \text{ V}$$

6. (a) $F = QE = \frac{QV}{d} \Rightarrow 5000 = \frac{5 \times V}{10^{-2}} \Rightarrow V = 10 \text{ volt}$

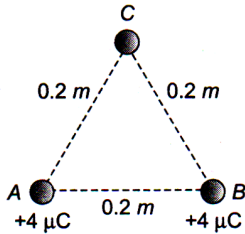
7. (b) Potential inside the sphere will be same as that on its surface i.e., $V = V_{\text{surface}} = \frac{q}{10} \text{ stat volt}$
 $V_{\text{out}} = \frac{q}{15} \text{ stat volt}$

$$\therefore \frac{V_{\text{out}}}{V} = \frac{2}{3} \Rightarrow V_{\text{out}} = \frac{2}{3} V$$

8. (b) Spheres have same potential

i.e., $k \frac{Q_1}{R_1} = k \frac{Q_2}{R_2} \Rightarrow \frac{Q_1}{Q_2} = \frac{R_1}{R_2}$

9. (c) Potential at C = $\left(9 \times 10^9 \times \frac{4 \times 10^{-6}}{0.2}\right) \times 2 = 36 \times 10^4 \text{ V}$



10. (b) By using

$$V = 9 \times 10^9 \times \frac{Q}{r} = 9 \times 10^9 \times \frac{100 \times 10^{-6}}{9} = 10^5 \text{ V}$$

11. (d) If charge acquired by the smaller sphere is Q then its potential $120 = \frac{kQ}{2}$... (i)

Also potential of the outer sphere

$$V = \frac{kQ}{6} \quad \dots \text{(ii)}$$

From equations (i) and (ii) $V = 40 \text{ volt}$

12. (b) Given electric potential of spheres are same i.e., $V_A = V_B$

$$\Rightarrow \frac{1}{4\pi\epsilon_0} \cdot \frac{Q_1}{a} = \frac{1}{4\pi\epsilon_0} \cdot \frac{Q_2}{b} \Rightarrow \frac{Q_1}{Q_2} = \frac{a}{b} \quad \dots \text{(i)}$$

as surface charge density $\sigma = \frac{Q}{4\pi r^2}$

$$\Rightarrow \frac{\sigma_1}{\sigma_2} = \frac{Q_1}{Q_2} \times \frac{b^2}{a^2} = \frac{a}{b} \times \frac{b^2}{a^2} = \frac{b}{a}$$

13. (a) Potential at any point inside the charged spherical conductor equals to the potential at the surface of the conductor i.e., Q/R .

14. (b) Net electrostatic energy $U = \frac{kQq}{a} + \frac{kq^2}{a} + \frac{kQq}{a\sqrt{2}} = 0$
 $\Rightarrow \frac{kq}{a} \left(Q + q + \frac{Q}{\sqrt{2}} \right) = 0 \Rightarrow Q = -\frac{2q}{2 + \sqrt{2}}$

15. (c) The dotted lines may be surface boundary of a conductor. Electric lines of force do not enter a conductor. Potential of a conductor is constant but not necessarily zero.

16. (c) $ABCDE$ is an equipotential surface, on equipotential surface no work is done in shifting a charge from one place to another.

17. (b) In charging of capacitor half of the supplied energy is stored in the capacitor.

18. (a) High K means good insulating property and high x means able to withstand electric field gradient to a higher value.

19. (a) Potential difference across the condenser

$$V = V_1 + V_2 = E_1 t_1 + E_2 t_2 = \frac{\sigma}{K_1 \epsilon_0} t_1 + \frac{\sigma}{K_2 \epsilon_0} t_2$$

$$\Rightarrow V = \frac{\sigma}{\epsilon_0} \left(\frac{t_1}{K_1} + \frac{t_2}{K_2} \right) = \frac{Q}{A \epsilon_0} \left(\frac{t_1}{K_1} + \frac{t_2}{K_2} \right)$$

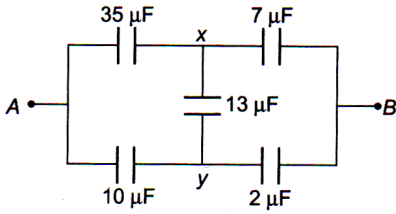
20. (a) In parallel combination $V_1 = V_2$

$$\text{or } \frac{q_1}{C_1} = \frac{q_2}{C_2} \Rightarrow \frac{q_1}{q_2} = \frac{C_1}{C_2}$$

21. $C_R = C_1 + C_2 = \frac{k_1 \epsilon_0 A_1}{d} + \frac{k_2 \epsilon_0 A_2}{d}$

$$= \frac{2 \times \epsilon_0 \frac{A}{2}}{d} + \frac{4 \times \epsilon_0 \frac{A}{2}}{d} = 2 \times \frac{10}{2} + 4 \times \frac{10}{2} = 30 \mu\text{F}$$

22. (b) Circuit can be redrawn as



Now, $V_x = V_y$

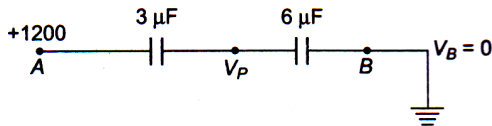
Hence $\frac{35 \mu\text{F}}{10 \mu\text{F}} = \frac{7 \mu\text{F}}{2 \mu\text{F}}$

$$C_{eq} = \left(\frac{7 \times 35}{7 + 35} \right) + \left(\frac{10 \times 2}{10 + 2} \right) = \frac{35}{6} + \frac{10}{6} = \frac{45}{6}$$

$$C_{eq} = \frac{15}{2}$$

23. (d) In series combination, charge is same on each capacitor.

24. (c) Given circuit can be reduced as follows



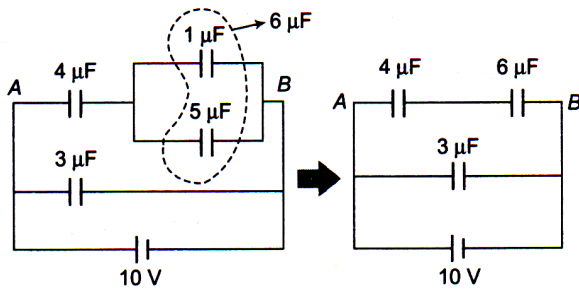
In series combination charge on each capacitor remain same. So using $Q = CV$

$$\Rightarrow C_1 V_1 = C_2 V_2 \Rightarrow 3(1200 - V_p) = 6(V_p - V_B)$$

$$\Rightarrow 1200 - V_p = 2V_p \quad (\because V_B = 0)$$

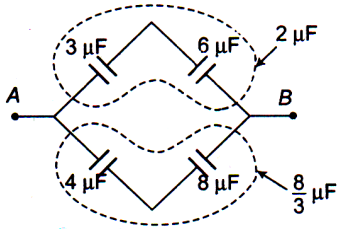
$$\Rightarrow 3V_p = 1200 \Rightarrow V_p = 400 \text{ volt}$$

25. (b) Equivalent capacity between A and B = $\frac{6 \times 4}{10} = 2.4 \mu\text{F}$



Hence charge across $4 \mu\text{F}$ (Since in series combination charge remains constant) or $6 \mu\text{F} = 2.4 \times 10 = 24 \mu\text{C}$.

26. (d) Given circuit is balanced Wheatstone bridge. So capacitor of $2 \mu\text{F}$ can be dropped from the circuit



$$\Rightarrow C_{AB} = 2 + \frac{8}{3} = \frac{14}{3} \mu\text{F}$$

27. (d) The capacitance across A and B

$$= \frac{C_1}{2} + C_1 + C_1 = \frac{5}{2} C_1$$

$$\text{As } Q = CV,$$

$$1.5 \mu\text{C} = \frac{5}{2} C_1 \times 6$$

$$\Rightarrow C_1 = \frac{1.5}{15} \times 10^{-6} = 0.1 \times 10^{-6} \text{ F} = 0.1 \mu\text{F}$$

28. (c) $V' = \frac{V}{8} \Rightarrow \frac{V}{K} = \frac{V}{8} \Rightarrow K = 8$

29. (b) $C' = n^{1/3} C = (64)^{1/3} C = 4C$

30. (c) Volume of 8 small drops = Volume of big drop

$$8 \times \frac{4}{3} \pi r^3 = \frac{4}{3} \pi R^3 \Rightarrow R = 2r$$

As capacity is r , hence capacity becomes 2 times.

31. (a) $U = \frac{1}{2} CV^2 = \frac{1}{2} \times 50 \times 10^{-6} \times (10)^2 = 2.5 \times 10^{-3} \text{ J}$

32. (a) $V_{\text{avg}} = \frac{x_f - x_i}{t_f - t_i}$

$$= \frac{(1 \times 5^2 + 1) - (1 \times 3^2 + 1)}{5 - 3} = \frac{16}{2} = 8 \text{ ms}^{-1}$$

33. (b) Let the initial velocity of ball be u .

Time of rise $t_1 = \frac{u}{g+a}$ and height reached

$$h = \frac{u^2}{2(g+a)}$$

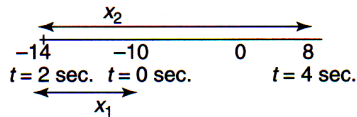
Time of fall t_2 is given by

$$\frac{1}{2}(g-a)t_2^2 = \frac{u^2}{2(g+a)}$$

$$\Rightarrow t_2 = \frac{u}{\sqrt{(g+a)(g-a)}} = \frac{u}{(g+a)} \sqrt{\frac{g+a}{g-a}}$$

$$\therefore t_2 > t_1 \text{ because } \frac{1}{g+a} < \frac{1}{g-a}$$

34. (a)



$$x = t^3 - 3t^2 - 10$$

$$v = \frac{dx}{dt} = 3t^2 - 6t$$

Now, $v = 0$ gives

$$t = 0 \quad \text{and} \quad t = 2 \text{ sec.}$$

Velocity will become zero at $t = 2$ sec., so particle will change direction after $t = 2$ sec.

At $t = 0$

$$x_{(0 \text{ sec})} = -10$$

At $t = 2$ sec.

$$x_{(2 \text{ sec})} = 2^3 - 3(2)^2 - 10 = 8 - 12 - 10 = -14$$

At $t = 4$ sec.

$$\begin{aligned} x_{(4 \text{ sec})} &= 4^3 - 3(4)^2 - 10 \\ &= 64 - 48 - 10 = 6 \end{aligned}$$

Distance travelled = $x_1 + x_2$

$$= |-14 - (-10)| + |6 - (-14)| = 4 + 20 = 24$$

Distance Travelled = 24 units.

35. (b) Between time interval 20 sec to 40 sec, there is non-zero acceleration and retardation.

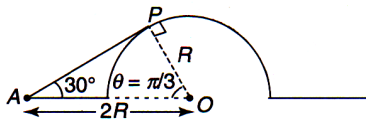
Hence, distance travelled during this interval

= Area between time interval 20 sec to 40 sec

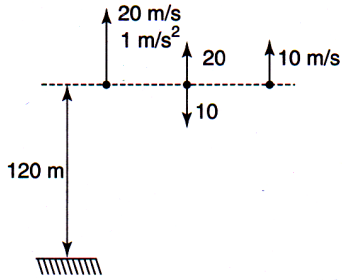
$$= \frac{1}{2} \times 20 \times 3 + 20 \times 1 = 30 + 20 = 50 \text{ m.}$$

36. (c) The required condition is achieved when the particle is at P such that AP is tangent to semicircle.

Hence required time = $\frac{R + \frac{R\pi}{3}}{v} = 1 \text{ sec.}$



37. (a)

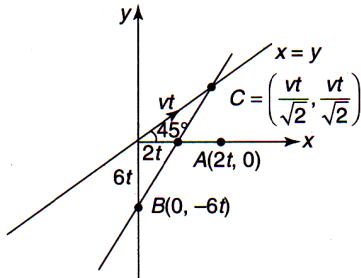


$$-120 = 10t \frac{1}{2} \times 10 \times t^2$$

$$t^2 - 2t - 24 = 0$$

$$t = 6 \text{ sec}$$

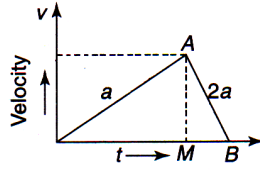
38. (b) Slope AB = slope AC



$$\frac{2t - 0}{0 + 6t} = \frac{2t - \frac{vt}{\sqrt{2}}}{0 - \frac{vt}{\sqrt{2}}}$$

Solve to get $v = 3\sqrt{2} \text{ m/s}$

39. (b) Let OAB be the velocity-time graph of the lift. The ordinate at A (i.e., AM) represents maximum velocity.



Total distance travelled

$$= \text{area of the } \triangle OAB = \frac{1}{2} \times OB \times AM$$

$$AM = v, OM = t_1, t_1 + t_2 = OB = t, MB = t_2$$

$$\therefore \triangle OAB = \frac{1}{2} \times tv = h$$

$$\text{or } vt = 2h \quad \dots(i)$$

$$\text{Now } \frac{v}{t_1} = a \text{ or } t_1 = \frac{v}{a} \quad \dots(ii)$$

$$\text{and } \frac{v}{t_2} = 2a \text{ or } t_2 = \frac{v}{2a} \quad \dots(iii)$$

40. (d) Distance travelled from time ' $t-1$ ' sec to ' t ' sec is

$$S = u + \frac{a}{2} (2t-1) \quad \dots(i)$$

$$\text{from given condition } S = t \quad \dots(ii)$$

$$\text{from (i) and (ii), } t = u + \frac{a}{2} (2t-1)$$

$$\Rightarrow u = \frac{a}{2} + t(1-a).$$

Since u and a are arbitrary constants, and they must be constant for every time.

So, coefficient of t must be equal to zero.

$$\Rightarrow 1-a=0 \Rightarrow a=1 \text{ for } a=1, u = \frac{1}{2} \text{ unit}$$

$$\text{Initial speed} = \frac{1}{2} \text{ unit}$$

41. (c) For first part,

$u = 0, t = T$ and acceleration = a

$$\therefore v = 0 + aT = aT \text{ and } S_1 = 0 + \frac{1}{2}aT^2 = \frac{1}{2}aT^2$$

For second part,

$u = aT$, retardation = a_1 , $v = 0$ and time taken = T_1 (let)

$$\therefore 0 = u - a_1T_1 \Rightarrow aT = a_1T_1$$

$$\text{and from } v^2 = u^2 - 2a_1S_2 \Rightarrow S_2 = \frac{u^2}{2a_1} = \frac{1}{2} \frac{a^2T^2}{a_1}$$

$$S_2 = \frac{1}{2}aT \times T_1 \quad \left(\text{As } a_1 = \frac{aT}{T_1} \right)$$

$$\therefore v_{\text{av}} = \frac{S_1 + S_2}{T + T_1} = \frac{\frac{1}{2}aT^2 + \frac{1}{2}aT \times T_1}{T + T_1}$$

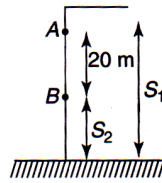
$$= \frac{\frac{1}{2}aT(T + T_1)}{T + T_1} = \frac{1}{2}aT$$

42. (a) Velocity of 1st stone when passing at A

$$V^2 = 0 + 2 \cdot 10 \cdot 5 \Rightarrow V = 10 \text{ m/s}$$

And $S_1 - S_2 = 20 \text{ m}$.

$$\Rightarrow \left(10 \cdot t + \frac{1}{2}10 \cdot t^2 \right) - \left(\frac{1}{2} \cdot 10 \cdot t^2 \right) = 20$$



$$\text{At } t = 2 \text{ s, } S_2 = \frac{1}{2}gt^2 = \frac{1}{2} \times 10 \times 2^2 = 20 \text{ m}$$

Hence height of the tower,

$$H = S_1 + S_2 = 25 + 20 = 45 \text{ m.}$$

43. (c) $v_0 \rightarrow$ maximum speed

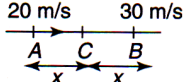
$$s = \frac{v_0 + 0}{2}t_1 \Rightarrow t_1 = \frac{2s}{v_0}$$

$$t_2 = \frac{3s}{v_0}$$

$$5s = \frac{v_0 + 0}{2}t_3 \Rightarrow t_3 = \frac{10s}{v_0}$$

$$v_{\text{av}} = \frac{s + 3s + 5s}{t_1 + t_2 + t_3}$$

$$v_{\text{av}} = \frac{9s}{\frac{2s}{v_0} + \frac{3s}{v_0} + \frac{10s}{v_0}} \Rightarrow \frac{v_{\text{av}}}{v_0} = \frac{3}{5}$$

$$44. (c) a = \frac{V_B^2 - V_A^2}{2 \times 2x} = \frac{900 - 400}{4x} = \frac{125}{x}$$


$$\therefore V_C = \sqrt{V_B^2 + 2ax}$$

$$= \sqrt{400 + 2 \times \frac{125}{x} \times x} = \sqrt{650} = 25.5 \text{ m/s.}$$

$$45. (b) v^2 = 180 - 16x$$

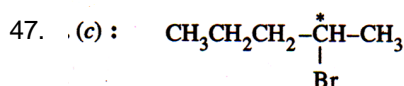
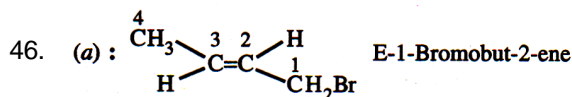
Taking $\frac{d}{dx}$ of both sides

$$\frac{d}{dx}(v^2) = \frac{d}{dx}(180 - 16x) \Rightarrow 2v = \frac{dv}{dx} = -16$$

$$\text{or } a = \frac{v dv}{dx} = -8 \text{ m/s}^2$$

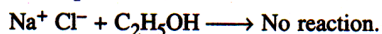
Hence acceleration is -8 m/s^2 .

[CHEMISTRY]



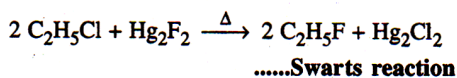
2-Bromopentane (2° , optically active)

48. (c) : Cl^- ion being a weak nucleophile cannot displace OH^- ion which is a stronger nucleophile.

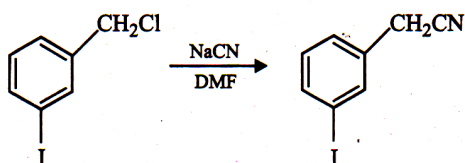


49. (d) ; ZnCl_2 being a Lewis acid coordinates with the O atom of $\text{C}_2\text{H}_5\text{OH}$.

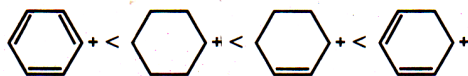
50. (c) : Fluoroethane is prepared by halogen exchange method



51. (d) : Alkyl halides are more reactive than aryl halides, therefore, only the halogen in the side chain is displaced.



52. (b) : The reactivity depends upon the stability of the carbocations which the alkyl chlorides give on ionization. Now stability of the carbocations increases in the order:

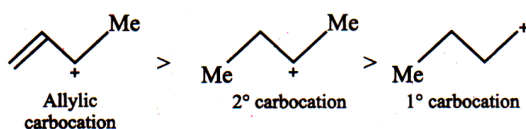


Therefore, the reactivity of their corresponding alkyl chlorides follows the same order, *i.e.*, IV < I < II < III.

53. (a) : Diazonium salts react with CuBr/HBr (Sandmeyer reaction) to form bromobenzene.
54. (d) : Boiling points increase as the number of carbon atoms in the alkyl halide increases. Therefore, the boiling points of II, III and IV with four carbon atoms is higher than that of I with three carbon atoms. Further, the boiling points decrease with the number of branches. Thus,

the boiling points of the four alkyl halides increase in the order: I < IV < III < II.

55. (c) : The reactivity in S_N1 reactions depends upon the stability of the intermediate carbocations. Since the stability of the carbocations derived from (A), (B) and (C) follows the order:



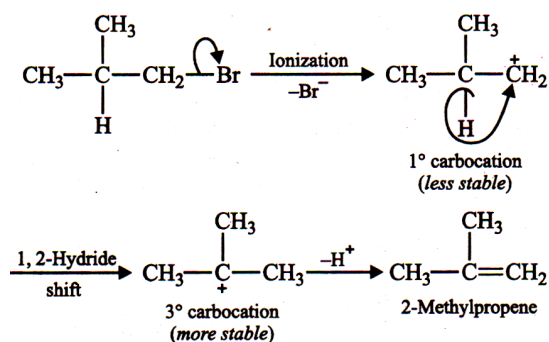
therefore, S_N1 reactivity of these three bromides follows the order: B > C > A, *i.e.*, option (c) is correct.

56. (b) : Stronger the acid, weaker is its conjugate base and hence higher is its leaving group ability.

Now basicity increases in the order: $CF_3-SO_3^-$ < $C_6H_5SO_3^-$ < CH_3COO^- < $C_6H_5O^-$ and hence

its leaving group ability decreases in the reverse order, *i.e.*, $CF_3-SO_3^-$ (I), $C_6H_5SO_3^-$ (II) > CH_3COO^- (IV) > $C_6H_5O^-$ (III), *i.e.*, option (b) is correct.

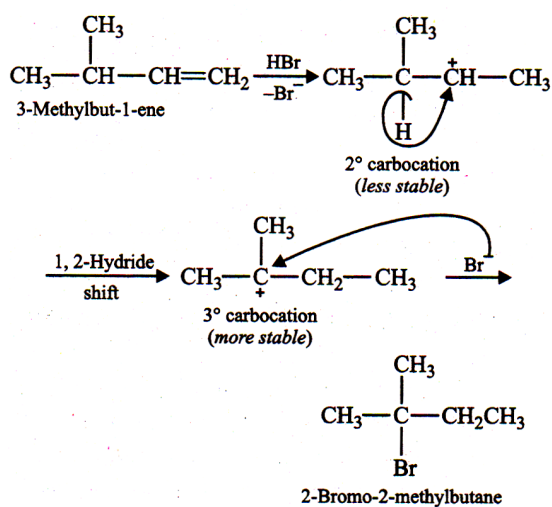
57. (d) : Due to the presence of $-ve$ charge on the oxygen atom, CH_3O^- , HO^- and CH_3CCO^- ions are more nucleophilic than H_2O . Further, due to $+I$ -effect of the CH_3 group, CH_3O^- is more nucleophilic than OH^- . Further, since in CH_3COO^- , $-ve$ charge on oxygen is stabilized by resonance, therefore, its nucleophilicity is lower than those of CH_3O^- and HO^- . Thus, the overall nucleophilicity of all the species decreases in the order: $CH_3O^- > HO^- > CH_3COO^- > H_2O$, i.e., option (d) is correct.
58. (a) : The leaving group ability decreases as the basicity of the nucleophile increases. Since the basicity increases in the order: $Br^- < Cl^- < CH_3COO^- < HO^- < H^-$, therefore, their leaving group ability decreases in the reverse order, i.e., $Br^- > Cl^- > CH_3COO^- > HO^- > H^-$. Thus, option (a) is correct.
59. (c) : Although the given alkyl halide is 1° , yet the carbocation which it generates on ionization, rearranges to form a more stable 3° carbocation which in presence of a strong base (CH_3O^-) prefers to undergo elimination rather than substitution to afford 2-methylpropene



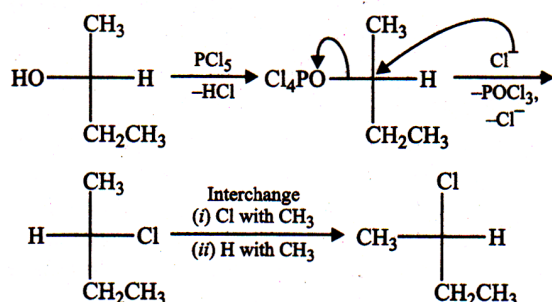
60. (a) : As the steric hindrance increases at the α -carbon atom holding the halogen, the reactivity towards S_N2 mechanism decreases, i.e., $I > III > II > IV$.
61. (a) : Chlorobenzene (*least-reactive*), vinyl chloride (*more reactive*), chloroethane (*most reactive*).
62. (c) : Electron-withdrawing groups increase and electron-donating groups decrease the reactivity towards nucleophilic substitution. Further, more the number of electron-withdrawing groups, higher is the reactivity. Thus, option (c), i.e., $iv > iii > ii < i$ is correct.

63. (a) : Electron-withdrawing groups (i.e., NO_2 , CO_2R , etc.) increase the reactivity of aryl halides towards nucleophilic substitution reactions by stabilizing the intermediate carbanion.
64. (c) : Cl is *o*, *p*-directing, therefore, a mixture of *o*- and *p*-chloroacetophenone is obtained.
65. (d) : Being strained cyclopropane ring readily opens up to form only *n*-propyl bromide. In contrast, reaction (a) gives a mixture of *n*-propyl and isopropyl bromides, reaction (b) gives isopropyl bromide while reaction (c) does not occur at all.

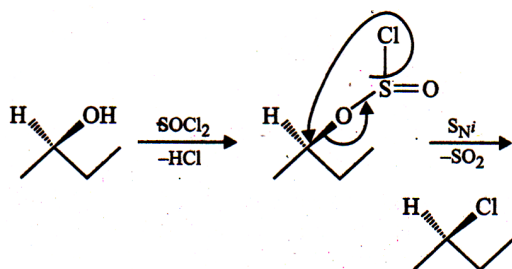
66. (d)



67. (a) : PCl_5 reacts by $\text{S}_{\text{N}}2$ mechanism and hence inversion of configuration occurs.



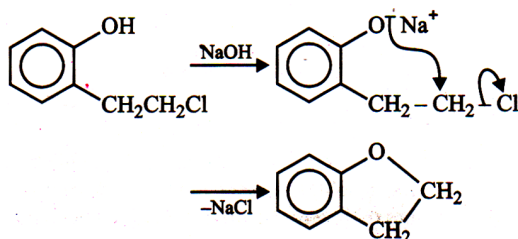
68. (d) : Reaction occurs by $\text{S}_{\text{N}}\text{i}$ mechanism with retention of configuration



69. (b) : The dipole moment of CH_3Cl , CH_3Br and CH_3I decreases as the electronegativity of the halogen decreases. However, due to much smaller size of F as compared to that of Cl, dipole moment (product of charge and distance) of CH_3F is lower than that of CH_3Cl . Thus, option (b) is correct.

70. (b) : Due to symmetry, the molecules of *p*-dichlorobenzene fit closely in the lattice. As a result intermolecular forces are the strongest in *p*-dichlorobenzene and hence it has the highest *m.p.* and lowest solubility.

71. (c) :



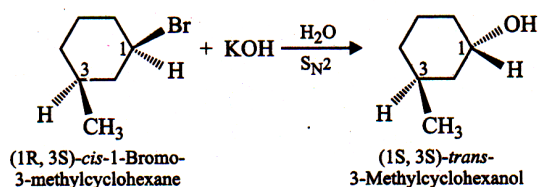
72. (d) : As the size of the alkyl group increases, the $\text{S}_{\text{N}}2$ reactivity decreases. Further, C-Cl bond is stronger and more difficult to cleave than C-Br bond. Thus, option (d) is correct.

73. (b) : 1° Alkyl halides, *i.e.*, CH_3Br .

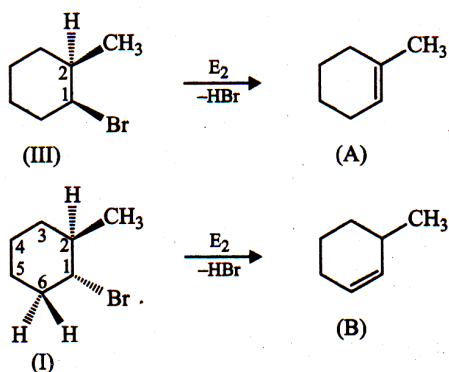
74. (d) : $\text{S}_{\text{N}}2$ reactions occur with inversion of configuration. Therefore an optically active reactant gives an optically active product whose sign of rotation cannot be predicted, *i.e.*, option (d) is correct.

75. (c) : With strong bases like $\text{CH}_3\text{CH}_2\text{O}^-$, *tert*-butyl bromide undergoes elimination to form $(\text{CH}_3)_2\text{C} = \text{CH}_2$ but with weak nucleophiles such as $\text{CH}_3\text{CH}_2\text{OH}$ substitution occurs to afford *tert*-butyl ethyl ether, $(\text{CH}_3)_3\text{C}-\text{O}-\text{CH}_2\text{CH}_3$.

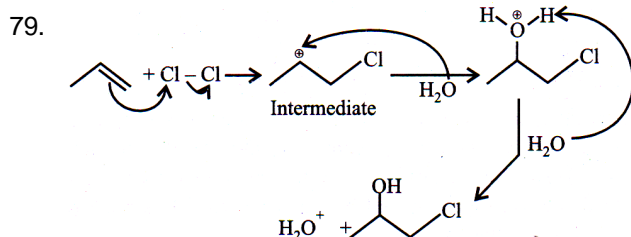
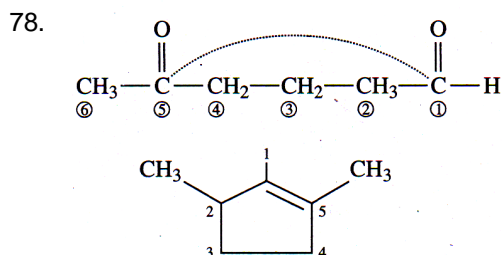
76. (d) : In $\text{S}_{\text{N}}2$ reactions, inversion of configuration occurs.



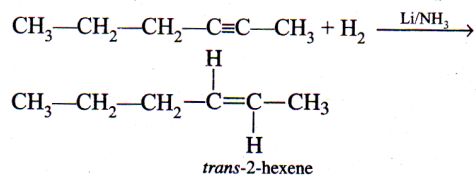
77. (b) : In E_2 reactions, *trans*-elimination occurs. Since in compound (III), there is a *trans*-H-atom on C_2 carbon carrying the CH_3 group, therefore elimination occurs readily to give stable alkene (A).



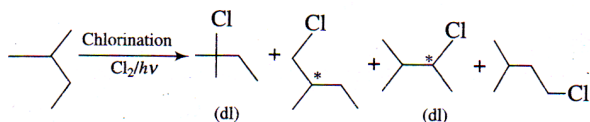
In compound (I), *trans*-H is not available on C_2 but there is a *trans*-H available on C_6 , therefore, elimination occurs on the other side to give less stable alkene (B). Compound (II), however, does not have a *trans*-H on either side (i.e., C_2 or C_6), therefore, E_2 reaction does not occur. Thus, option (b) is correct.



80. 2-hexyne gives *trans*-2-hexene on treatment Li/NH_3

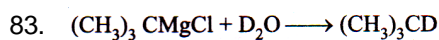


81. On chlorination of 2-methyl butane



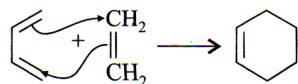
Four chiral compounds are formed.

82.



84.

85. It is Diels-Alder reaction,



86. Least substituted alkene is most reactive for H_2 . *Trans* is more symmetrical than *cis* and so *cis* is more reactive.

87.

