WEEKLY TEST RANKER'S BATCH TEST - 14 RAJPUR
SOLUTION Date 29-12-2019

[PHYSICS]

1. **(a)** The horizontal components are $(B_H)_1 = B\cos\varphi_1$ and $(B_H)_2 = B\cos\varphi_2$

$$\therefore \frac{(B_H)_1}{(B_H)_2} = \frac{\cos\varphi_1}{\cos\varphi_2} = \frac{\cos 30^o}{\cos 45^o} = \frac{\sqrt{3}}{2}\times\sqrt{2} = \frac{\sqrt{3}}{\sqrt{2}}$$

2. **(d)** From the relation $B_V = I\sin\varphi$

$$I = \frac{V}{\sin\varphi} = \frac{6\times10^{-5}}{\sin 40.6^\circ} = \frac{6\times10^{-5}}{0.65} = 9.2\times10^{-5} \text{ tesla}$$

3. **. (c)**

$$B^2 = B_V^2 + B_H^2 \Rightarrow B_V = \sqrt{B^2 - B_H^2} = \sqrt{(0.5)^2 - (0.3)^2} = 0.4$$

Now $\tan\varphi = \frac{B_V}{B_H} = \frac{0.4}{0.3} = \frac{4}{3} \Rightarrow \varphi = \tan^{-1}\left(\frac{4}{3}\right)$.

4. **(a)**

$$\therefore \tan\delta = \frac{V}{H}$$

$$\tan 45^\circ = \frac{V}{H\cos 30^\circ}$$

(Divide (1) and (2))

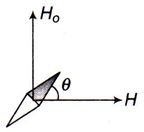
$$\delta = \tan^{-1}\left(\frac{\sqrt{3}}{2}\right)$$

5. **(c)** Here, $\delta = 30^\circ$ and $\underline{H} = 0.5$ oersted.

Now, $B\cos\delta = H$ or $B = \frac{H}{\cos\delta}$, $B = \frac{0.5}{\cos 30^\circ}$

$= \frac{1}{2}\times\frac{2}{\sqrt{3}} = \frac{1}{\sqrt{3}}$ oersted.

6. **(a)** In given case H and H_0 are perpendicular to each other.



From figure $\tan\theta = \frac{H_0}{H}$

$$\Rightarrow \theta = \tan^{-1}\left(\frac{H_0}{H}\right)$$

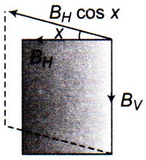
7. **(a)** In first case

$$\tan\theta = \frac{B_V}{B_H} \quad \text{... (i)}$$

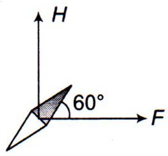
Second case

$$\tan\theta' = \frac{B_V}{B_H \cos x} \quad \text{... (ii)}$$

From equations (i) and (ii), $\frac{\tan\theta'}{\tan\theta} = \frac{1}{\cos x}$



8. **(d)**



From figure at equilibrium

$$\tan 60° = \frac{H}{F}$$

9. **(d)** $T' = \frac{T}{n} \Rightarrow T' = \frac{2}{2} = 1\text{ sec}$

10 **(c)** $T = 2\pi\sqrt{\frac{I}{MB_H}} \Rightarrow T \propto \sqrt{I} \propto \sqrt{w} \Rightarrow T' = \sqrt{2}\,T_0$

11. **(a)** $T' = \frac{T}{n}$

12. **(c)** $\frac{T_A}{T_B} = \sqrt{\frac{(B_H)_B}{(B_H)_A}} \Rightarrow \frac{60/10}{60/20} = \sqrt{\frac{(B_H)_B}{36\times10^{-6}}}$

$\Rightarrow (B_H)_B = 144\times10^{-6}T$

13. **(c)** When magnet of length l is cut into four equal parts. then

$$m' = \frac{m}{2} \text{ and } l' = \frac{l}{2}; \quad \therefore \quad M' = \frac{m}{2}\times\frac{l}{2} = \frac{ml}{4} = \frac{M}{4}$$

New moment of inertia

$$I' = \frac{wl^2}{12} = \frac{\frac{w}{4}.\left(\frac{1}{2}\right)^2}{12} = \frac{1}{16}.\frac{wl^2}{12}$$

Here w is the mass of magnet.

$\therefore \; I' = \frac{1}{16} I$; Time period of each part

$$T' = 2\pi\sqrt{\frac{I'}{M'B_H}}$$

$$= 2\pi\sqrt{\frac{I/16}{(M/4)B_H}} = 2\pi\sqrt{\frac{I}{4MB_H}} = \frac{T}{2}$$

14. **(b)** Given $v_1 = \frac{20}{60} = \frac{1}{3}\sec^{-1}$ and $v_2 = \frac{15}{60} = \frac{1}{4}\sec^{-1}$

Now

$$v = \frac{1}{2\pi}\sqrt{\frac{MB_H}{I}} = \frac{1}{2\pi}\sqrt{\frac{MB\cos\varphi}{I}} \quad (\because \; B_H = B\cos\varphi)$$

$$\therefore \; \frac{v_1}{v_2} = \sqrt{\frac{B_1\cos\varphi_1}{B_2\cos\varphi_2}} \Rightarrow \frac{B_1}{B_2} = \left(\frac{v_1}{v_2}\right)^2\left(\frac{\cos\varphi_2}{\cos\varphi_1}\right)^2$$

$$\Rightarrow \frac{B_1}{B_2} = \left(\frac{1/3}{1/4}\right)^2 \frac{\cos 60°}{\cos 30°} = \frac{16}{9} \times \frac{1/2}{\sqrt{3}/2} = \frac{16}{9\sqrt{3}}.$$

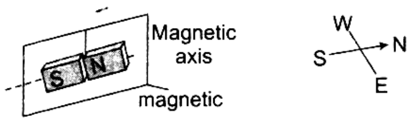
15. **(c)** No. of oscillation per minute $= \frac{1}{2\pi}\sqrt{\frac{MB_H}{I}}$

$\Rightarrow \; n \propto \sqrt{MB_H}$; $M \to 4$ times

$B_H \to 2$ times

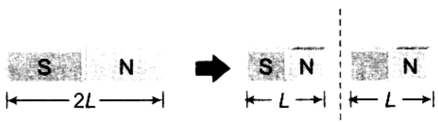
16.

(a)



17.

(c)



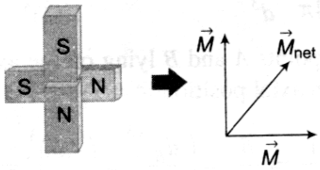
Pole strength of each part = m

Magnetic moment of each part

$$= M' = m'L' = mL = \frac{M}{2}$$

18.

(b)



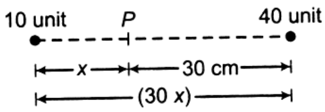
$\Rightarrow M_{net} = \sqrt{M^2 + M^2} = \sqrt{2}M$

19.

(b) Number of lines of force passing through per unit area normally is intensity of magnetic field, hence option (c) is incorrect. The correct option is (b).

20.

(b) Suppose magnetic field is zero at point P. Which lies at a distance x from 10 unit pole. Hence, at P



$$\frac{\mu_0}{4\pi}\cdot\frac{10}{x^2} = \frac{\mu_0}{4\pi}\cdot\frac{40}{(30-x)^2} \Rightarrow x = 10 \text{ cm}$$

So from stronger pole distance is 20 cm.

21

(b) Magnetic intensity on end side on position is twice the broad side on position.

22.

(d) For a magnet $B = \frac{\mu_0}{4\pi}\cdot\frac{2M}{x^3}$ (Nearly)

$$\Rightarrow \frac{B_1}{B_2} = \left(\frac{x_1}{x_2}\right)^3 = \left(\frac{x}{2x}\right)^3 = \frac{1}{8} \text{ (Approx.)}$$

23. **(c)** $B_1 = \frac{2M}{d^3}.B_2 = \frac{M}{d^3}$; $\therefore \frac{B_1}{B_2} = 2:1$

24. **(c)** For null deflection $\frac{M_1}{M_2} = \left(\frac{d_1}{d_2}\right)^3 = \left(\frac{40}{50}\right)^3 = \frac{64}{125}$

25. **(b)** $B_{equatorial} = \frac{\mu_0}{4\pi}\frac{M}{r^3}$

26.

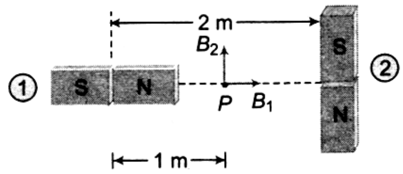
(b) Magnetic moment of circular loop carrying current

$$M = IA = I(\pi R^2) = I\pi\left(\frac{L}{2\pi}\right)^2 = \frac{IL^2}{4\pi} \Rightarrow L = \sqrt{\frac{4\pi M}{I}}$$

27.

(b) With respect to 1st magnet, P lies in end side-on position

$$\therefore\ B_1 = \frac{\mu_0}{4\pi}\left(\frac{2M}{d^3}\right) \text{ (RHS)}$$



With respect to 2nd magnet. P lies in broad side on position.

$$\therefore\ B_2 = \frac{\mu_0}{4\pi}\left(\frac{M}{d^3}\right) \text{ (Upward)}$$

$$B_1 = 10^{-7} \times \frac{2\times 1}{1} = 2\times 10^{-7} T,\ B_2 = \frac{B_1}{2} = 10^{-7} T$$

As B_1 and B_2 are mutually perpendicular, hence the resultant magnetic field

$$B_R = \sqrt{B_1^2 + B_2^2} = \sqrt{(2\times 10^{-7})^2 + (10^{-7})^2}$$

$$= \sqrt{5}\times 10^{-7} T$$

28.

(c) In C.G.S. $B_{axial} = 9 = \frac{2M}{x^3}$ ... (i)

$$B_{equaterial} = \frac{M}{\left(\frac{x}{2}\right)^3} = \frac{8M}{x^3} \quad \text{... (ii)}$$

From equations (i) and (ii) $B_{equaterial} = 36$ Gauss

29.

(a) Torque $\tau = MB_H \sin\theta$

$$= 0.1\times 10^{-3} \times 4\pi \times 10^{-3} \times \sin 30^o = 10^{-7} \times 4\pi \times \frac{1}{2}$$

$$= 2\pi \times 10^{-7} N \times m$$

30.

(a) $W = MB(\cos\theta_1 - \cos\theta_2) = MB(\cos 0° - \cos 60°)$

$$= MB\left(1 - \frac{1}{2}\right) = \frac{MB}{2}$$

and $\tau = MB\sin\theta = MB\sin 60° = MB\frac{\sqrt{3}}{2}$

$$\therefore\ \tau = \left(\frac{MB}{2}\right)\sqrt{3} \Rightarrow \tau = \sqrt{3}\,W$$

31.

(d) $W = MB(\cos\theta_1 - \cos\theta_2)$; $\theta_1 = 0°$ and $\theta_2 = 360°$

$\Rightarrow W = 0$

32.

(b) $W_1 = MB(\cos 0° - \cos 90°) = MB(1-0) = MB$

$W_2 = MB(\cos 0° - \cos 60°) = MB\left(1-\frac{1}{2}\right) = \frac{MB}{2}$

$\therefore W_1 = 2W_2 \Rightarrow n = 2$

33.

(b) $\tau = MB \sin\theta$

$\tau = 200 \times 0.25 \times \sin 30° = 25\ N \times m.$

34.

(b) $\vec{\tau} = \vec{M} \times \vec{B} \Rightarrow \vec{\tau} = 50\hat{i} \times (0.5\hat{i} + 3\hat{j})$

$= 150(\hat{i} \times \hat{j}) = 150\ \hat{k} N \times m.$

35.

(c) $\tau = MB\sin\theta \Rightarrow \tau \propto \sin\theta$

$\Rightarrow \frac{\tau_1}{\tau_2} = \frac{\sin\theta_1}{\sin\theta_2} \Rightarrow \frac{\tau}{\tau/2} = \frac{\sin 90°}{\sin\theta_2}$

$\Rightarrow \sin\theta_2 = \frac{1}{2} \Rightarrow \theta_2 = 30°$

$\Rightarrow$ Angle of rotation $= 90° - 30 = 60°$

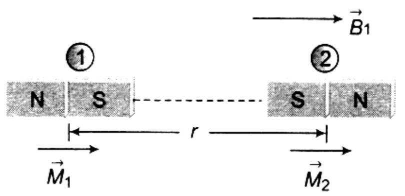
36.

(b) $W = MB(1 - \cos\theta)$; where $\theta = 180°$

$\Rightarrow W = 2MB \Rightarrow W = 2 \times 2 \times 5 \times 10^{-3} = 2 \times 10^{-2} J$

37.

(d)



Both the magnets are placed in the field of one another, hence potential energy of dipole (2) is

$U_2 = -M_2B_1 \cos 0 = -M_2B_1 = M_2 \times \frac{\mu_0}{4\pi}.\frac{2M_1}{r^3}$

By using $F = -\frac{dU}{dr}$, force on magnet (2) is

$F_2 = -\frac{dU_2}{dr} = -\frac{d}{dr}\left(\frac{\mu_0}{4\pi}.\frac{2M_1M_2}{r^3}\right) = -\frac{\mu_0}{4\pi}.6\frac{M_1M_2}{r^4}$

38. (C)
39. (D)
40. (C)

41. **(d)** $B_H = \sqrt{3}\, B_V$, also $\tan\theta = \frac{B_V}{B_H} = \frac{1}{\sqrt{3}} \Rightarrow \theta = 30^\circ$

42.

(c)

$$\tan 30^\circ = \frac{\tan\delta}{\cos\theta} \text{ or } \cos\theta = \frac{\tan\delta}{\tan 30^\circ} = \sqrt{3}\tan\delta$$

Again, $\tan 45^\circ = \frac{\tan\delta}{\sin\theta}$ or $\sin\theta = \tan\delta$

Now, $\sin^2\theta + \cos^2\theta = 1$

$\therefore\ \tan^2\delta + 3\tan^2\delta = 1$

or $\tan^2\delta \frac{1}{4}$ or $\tan\delta = \frac{1}{2}$

or $\frac{1}{\cot\delta} = \frac{1}{2}$ or $\delta = \cot^{-1}(2)$.

43. **(a)** Frequency $\nu \propto \sqrt{B_H}$
44. **(A)**
45. **(A)**

[CHEMISTRY]

46.

Glycol is used as an antifreeze in automobiles.

47.

Four primary alcohols of $C_5H_{11}OH$ are possible. These are:

(i) $CH_3CH_2CH_2CH_2CH_2OH$

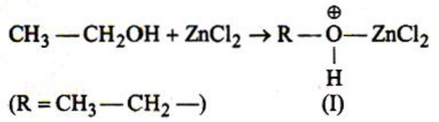
(ii) $CH_3CH_2-CH(CH_3)-CH_2OH$

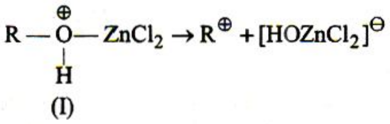
(iii) $CH_3-CH(CH_3)-CH_2CH_2OH$

(iv) $CH_3-C(CH_3)_2-CH_2OH$

48.

$ZnCl_2$ is a lewis acid and interact with alcohol.



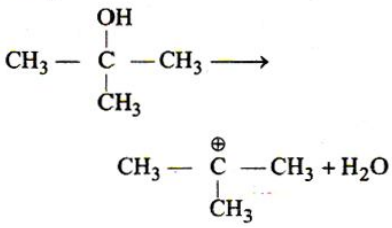


1 mole of carbon = 12gm of carbon
$= 6.023 \times 10^{23}$ C – atoms.

Carbocation is formed as intermediate in the S_N^1 mechanism which these reaction undergoes.

In the absence of $ZnCl_2$ formation of primary carbocation is difficult which is the case with (ii) while (i) undergoes reaction.

(iii) Tertiary carbocation casily formed due to the stability.

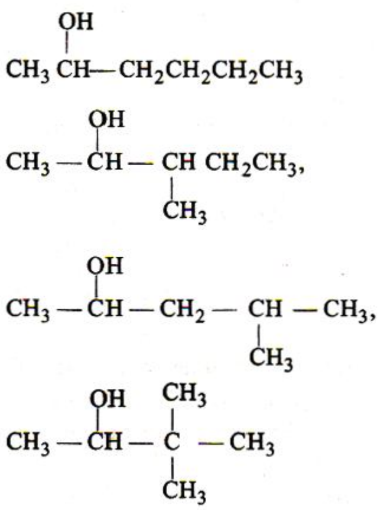


(iv) In the presence of $ZnCl_2$, 2° carbocation is formed from $(CH_3)_2 - \underset{|}{\overset{}{C}}H - OH$

i.e., $CH_3 - \overset{\oplus}{C}H - CH_3$

49.

Compound containing $CH_3CH(OH)$ or CH_3CO–group give positive iodoform test.



50.

$$CH_3-Br \xrightarrow{KCN} \underset{(A)}{CH_3-CN} \xrightarrow{H_3O^+}$$

$$\underset{(B)}{CH_3-COOH} \xrightarrow{LiAlH_4} \underset{\substack{(C)\\ \text{Ethyl alcohol}}}{CH_3-CH_2-OH}$$

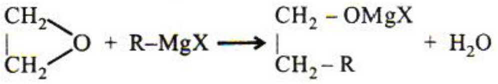
51.

$$CH_3CH_2OH \xrightarrow{PBr_3} CH_3CH_2Br \xrightarrow{alc.KOH} CH_2=CH_2$$

$$CH_2=CH_2 \xrightarrow{H_2SO_4} CH_3-CH_2-HSO_4 \xrightarrow[heat]{H_2O} CH_3CH_2OH$$

52.

Ethylene oxide when treated with Grignard Reagent gives primary alcohol.



$$\longrightarrow R-CH_2-CH_2-OH + Mg(X)(OH)$$

53.

CH_3OH does not have $-CH(OH)CH_3$ group hence it will not form yellow precipitate with an alkaline solution of iodine (haloform reaction).

54.

Primary alcohol on oxidation give aldehyde which on further oxidation give carboxylic acid whereas secondary alcohols give ketone.

$$\underset{\text{n-propyl alcohal}}{CH_3CH_2CH_2OH} \xrightarrow{[O]}$$

$$CH_3CH_2CHO \xrightarrow{[O]} CH_3CH_2COOH$$

$$\underset{\text{isopropyl alcohal}}{(H_3C)_2CH-OH} \xrightarrow{[O]} \underset{\text{Ketone}}{(H_3C)_2C=O}$$

55.

$$C_2H_5OH + 4I_2 + 6NaOH \longrightarrow$$

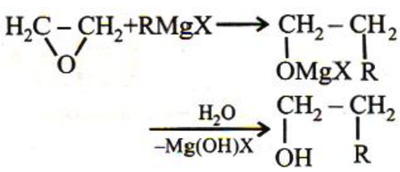
$$\underset{\text{Iodoform}}{CHI_3}\downarrow + HCOONa + 5NaI + 5H_2O$$

56.

$$CH_3-CH=CH_2 \xrightarrow[NaOH/H_2O_2]{B_2H_6} \underset{\text{Propanol}}{CH_3-CH_2-CH_2-OH}$$

57.

We know that



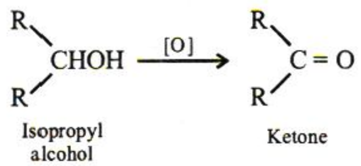
58.

Due to –I-effect of the three C–Cl-bonding between Cl and C-atom of the OH group, $CCl_3CH(OH)_2$ is most stable.

59.

Secondary alcohols on oxidation give ketones.

Note : – Primary alcohols from aldehydes.



60.

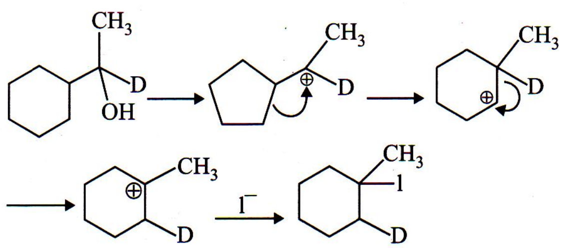
1° Alcohols on catalytic dehydrogenation give aldehydes.

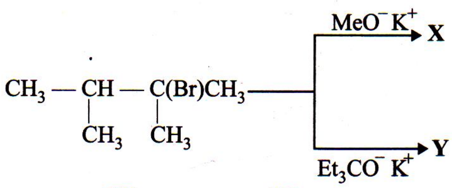
$$\underset{1°\text{ alcohol}}{RCH_2OH} \xrightarrow[300°C]{Cu} \underset{\text{Aldehyde}}{RCHO} + H_2$$

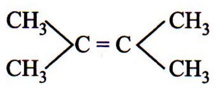
61.

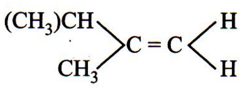
Water gas is mixed with half of its volume of hydrogen. The mixture is compressed to approximately 200 – 300 atmospheres. It is then passed over a catalyst ($ZnO + Cr_2O_3$) at 300°C. Methyl alcohol vapours are formed which are condensed

$$\underset{\text{Compressed gas}}{CO + 2H_2} \xrightarrow[300°C]{ZnO+Cr_2O_3} \underset{\text{Methyl alcohol}}{CH_3OH}$$

62. (a) 

63. (a) 

X =  (Saytzeff)

Y =  (Hoffmann)

64.

$KMnO_4$ (alkaline) and OsO_4 / CH_2Cl_2 are used for hydroxylation of double bond while O_3 /Zn is used for ozonolysis. Therefore, the right option is (c), i.e.,

$$3CH_3CH=CH_2 \xrightarrow{BH_3 \text{ in THF}} (CH_3CH_2CH_2)_3B$$

$$\xrightarrow[NaOH]{3H_2O_2} \underset{\text{1-propanol}}{3CH_3CH_2CH_2OH} + H_3BO_3$$

65.

Lucas reagent is conc. HCl + anhyd. $ZnCl_2$.

66.

Electron withdrawing $-NO_2$ group has very strong –I and –R effects so, compound 3 will be most acidic.

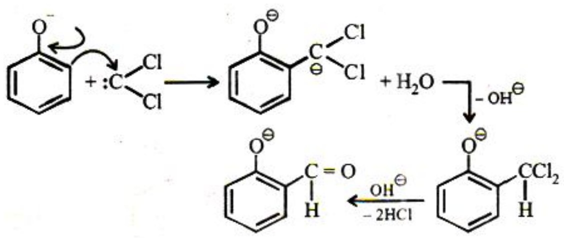
67.

This is an example of Williamson ether synthesis reaction in which sodium alkoxide reacts with alkyl halide and gives ether.

68.

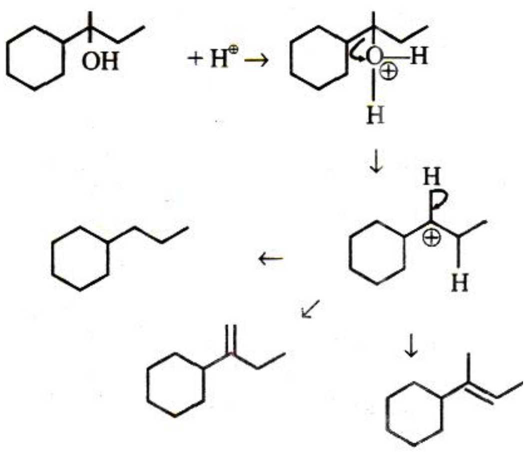
$$CHCl_3 + NaOH \rightleftharpoons :\overset{\ominus}{C}Cl_3 + H_2O$$

$$:\overset{\ominus}{C}Cl_3 \longrightarrow :CCl_2 + Cl^{\ominus}$$

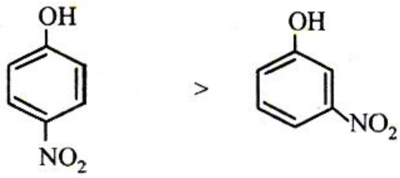


Therefore functional group – CHO is introduced.

69.

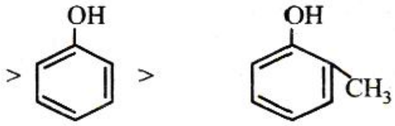


70.



(iv) (iii)

(– I and – M effects, both increase acidity) (only – I effect)



(i) (ii)

(+ I effect of CH_3 group decreases acidity)

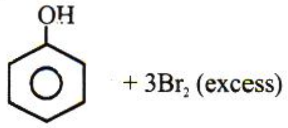
∴ Correct choice : (b)

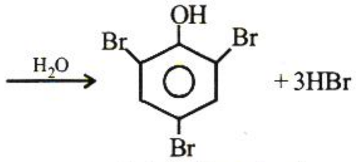
71.

Phenol is most acidic because its conjugate base is stabilised due to resonance, while the rest three compounds are alcohols, hence, their corrosponding conjugate bases do not exhibit resonance

72.

With Br_2 water, phenol gives 2, 4, 6- tribromophenol.



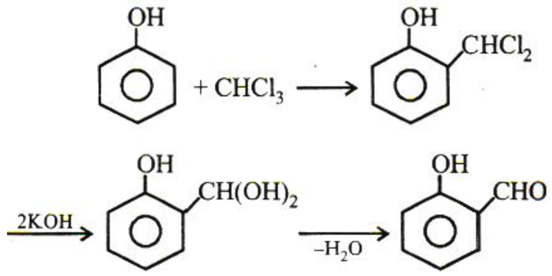


2, 4, 6 Tribromphenol

73.

Due to strong electron-donating effect of the OH group, the electron density in phenol is much higher than that in toluene, benzene and chlorobenzene and hence phenol is readily attacked by the electrophile.

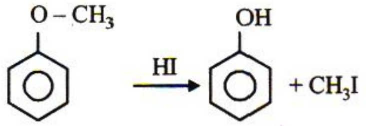
74.



Reimer-Tiemann reaction.

75.

When Ar – O – R ethers are reacted with HI, they are cleaved at weaker O – R bond to give phenol and alkyl iodide.



76. **(d)** As this is alkaline hydrolysis.

77.

Williamson synthesis is one of the best methods for the preparation of symmetrical and unsymmetrical ethers. In this method, an alkyl halide is allowed to react with sodium alkoxide.

78.

$$CH_3-CH_2-CH=CH_2 \xrightarrow[\text{(Peroxide effect)}]{HBr/H_2O_2}$$

$$\underset{(Y)}{CH_3-CH_2-CH_2-\underset{\displaystyle Br}{\underset{|}{CH_2}}}$$

$$\downarrow$$

$$\underset{(Z)}{CH_3-(CH_2)_3-O-CH_2-CH_3}$$

79.

In the cleavage of mixed ethers with two different alkyl groups, the alcohol and alkyl iodide that form depend on the nature of alkyl group. When primary or secondary alkyl groups are present, it is the lower alkyl group that forms alkyl iodide therefore

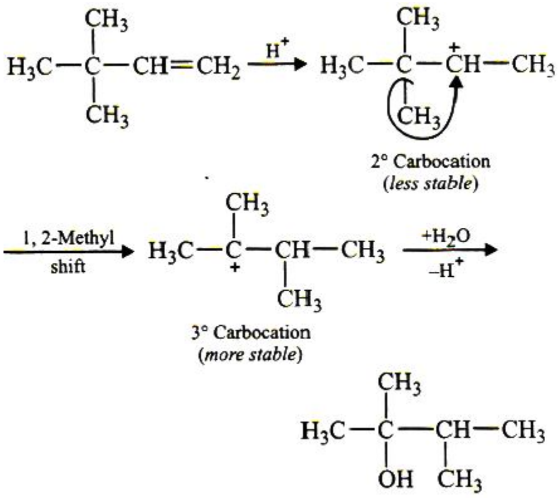
$$CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2-O-CH_2-CH_3+HI\xrightarrow{\Delta}$$

$$CH_3-\overset{\displaystyle CH_3}{\overset{|}{CH}}-CH_2OH+CH_3CH_2I$$

80.

$$C_6H_5ONa + C_2H_5I \xrightarrow{\Delta} \underset{\text{Phenetole}}{C_6H_5OC_2H_5} + NaI$$

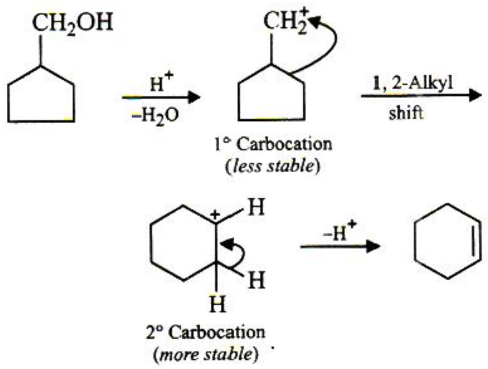
81.



82.

83.

84.



85.

C_2–OH is 3° while C_5–OH is 2°. Since 3° alcohols are weaker acids than 2° alcohols, therefore, 3° alcohols are stronger bases than 2° alcohols, *i.e.*, option (*a*) is correct.

86.

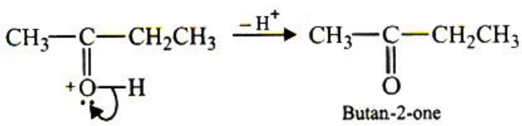
The order of reactivity depends upon the stability of the carbocations formed, *i.e.*, $FCH_2\overset{+}{C}HCH_3$, $FCH_2CH_2\overset{+}{C}HCH_3$, $CH_3\overset{+}{C}HCH_3$ and $Ph\overset{+}{C}H_2$.
Since the relative stabilities of these carbocations follow the order :

$Ph\overset{+}{C}H_2 > CH_3\overset{+}{C}HCH_3 > FCH_2CH_2\overset{+}{C}HCH_3 > FCH_2\overset{+}{C}HCH_3$, therefore, the order of reactivity of the alcohols (I, II, III and IV) follows the sequence : IV > III > II > I.

87.

The order of reactivity depends upon the stability of the carbocations formed, *i.e.*, $FCH_2\overset{+}{C}HCH_3$, $FCH_2CH_2\overset{+}{C}HCH_3$, $CH_3\overset{+}{C}HCH_3$ and $Ph\overset{+}{C}H_2$.
Since the relative stabilities of these carbocations follow the order :

$Ph\overset{+}{C}H_2 > CH_3\overset{+}{C}HCH_3 > FCH_2CH_2\overset{+}{C}HCH_3 > FCH_2\overset{+}{C}HCH_3$, therefore, the order of reactivity of the alcohols (I, II, III and IV) follows the sequence : IV > III > II > I.



Butan-2-one

88.
89.

Due to almost identical sizes of 2*p*-orbitals of C and F, + R-effect and –I-effect of F almost balance each other and hence *p*-fluorophenol is almost as acidic as phenol. However, *p-chlorophenol and p-nitrophenol are more acidic than phenol.* Further, due to stronger –R and –I-effect of NO_2

group, *p*-nitrophenol is a much stronger acid than *p*-chlorophenol in which Cl has only weak + R and –I-effect. Thus, option (*c*) is correct.

90.

3° Alcohols react fastest with Lucas reagent by S_N1 mechanism (*i.e.*, carbocation intermediate) to give turbidity.