WEEKLY TEST MEDICAL PLUS - 03 TEST - 24 RAJPUR
SOLUTION Date 19-01-2020

[PHYSICS]

1. If there is increases in length, then

$$R \propto l^2$$

$$\frac{R'}{R} = \left(\frac{l'}{l}\right) = \left(\frac{1.1l}{l}\right)^2 = 1.21$$

$\therefore$ $R' = 1.21\,R$

$= 1.21 \times 10 = 12.1\Omega$

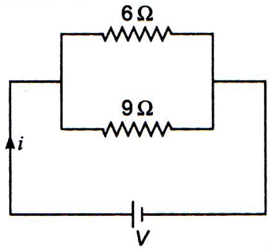
2. $i = \frac{ne}{t}$

$\therefore$ $n = \frac{it}{e} = \frac{0.2 \times 30}{1.6 \times 10^{-19}} = 3.75 \times 10^{19}$

3. R = Slope of V - I graph (V on y-axis and I on x-axis) and R increases with increase in temperature.

4. D
5. D

6. Given circuit is balanced Wheatstone bridge and no current flows through 4 Ω resistance connected across diagonal. Now circuit reduces to



So, equivalent resistance of circuit

$$R_{eq} = \frac{18}{5}\,\Omega$$

$\therefore$Current, $i = \frac{V}{R} = \frac{V}{18/5} = \frac{5V}{18}$ A

7. Power $P = \frac{V^2}{R}$

$\therefore$ $P \propto \frac{1}{R}$

So, $\frac{P_1}{P_2} = \frac{R_2}{R_1}$

8. Power $P = \frac{V^2}{R}$

$\therefore \quad P \propto \frac{1}{R}$

Also, Resistance of wire $\propto \frac{1}{(\text{radius of filament})^2}$

$\therefore P \propto (\text{radius of filament})^2$

So, 100 W bulb has thicker filament.

9. When bulbs are in series

$$P = \frac{V^2}{3R} \qquad \ldots\text{(i)}$$

When bulbs are connected in parallel

$$P' = \frac{V^2}{(R/3)} = \frac{3V^2}{R}$$

$$= 3 \times 3P \qquad \text{[From Eq. (i)]}$$

$$= 9\,P$$

10. $\frac{R_{40}}{R_{100}} = \frac{100}{40} = \frac{5}{2}$

In series, $V_{40} = (440)\left(\frac{5}{7}\right) = 314.3\text{ V}$

and $V_{100} = (440)\left(\frac{2}{7}\right) = 125.7\text{ V}$

Therefore, 40 W bulb will fuse.

11. B

12. Potential difference across 100Ω resistance should be 5V as voltmeter and 100 Ω resistance are in parallel. It means equivalent resistance of voltmeter and 100 Ω should be 50 Ω.
So, resistance of voltmeter must be 100 Ω.

13. Resistance in parallel with voltmeter is zero.

14. In potentiometer, the ratio of emf's is equal to ratio of no deflection lengths.

$$\frac{E_1}{E_2} = \frac{l_1}{l_2} = \frac{2}{3}$$

15. The galvanometer shows no current it means this is a balanced Wheatstone bridge, So,

$$\frac{R}{80} = \frac{AC}{BC} = \frac{20}{80}$$

$$\therefore \qquad R = 20\Omega$$

16.

$$r = R_1\left(\frac{E}{V_1} - 1\right) \qquad \ldots\text{(i)}$$

$$r = R_2\left(\frac{E}{V_2} - 1\right) \qquad \ldots\text{(ii)}$$

Solving we get, $r = 10\ \Omega$

17. Total resistance of given circuit

$$= \frac{80}{1+1} + 20 = 40 + 20 = 60\,\Omega$$

$\therefore$Main current, $i = \frac{2}{60} = \frac{1}{30}$ A

Now, in parallel, there are two resistance of 80 Ω each. (one of voltmeter and other 80 Ω resistance) So, current is equally distributed in 80 Ω resistance and voltmeter, So, $\frac{1}{60}$ A.

Current flows through each.

∴ Potential difference across 80 Ω resistance

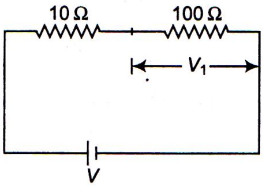
$$= \frac{1}{60} \times 80 = 1.33 \text{ V}$$

18.

$$r = \left(\frac{l_1 - l_2}{l_2}\right) \times R$$

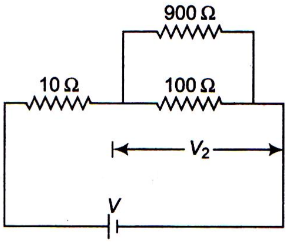
$$\therefore \quad r = \left(\frac{55 + 50}{50}\right) \times 10 = 1\Omega$$

19.



Before connecting the voltmeter let the potential difference across 100 Ω is V_1

$$\therefore \quad V_1 = \left(\frac{100}{100 + 10}\right) \times V = \frac{10}{11} V$$



After connecting the voltmeter across 100 Ω.

Equivalent resistance

$$\frac{100 \times 900}{100 + 900} = 90\,\Omega$$

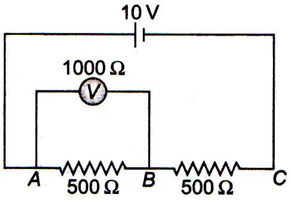
Let this time potential difference is V_2 .

$$\therefore \quad V_2 = \left(\frac{90}{90 + 10}\right) \text{V} = \frac{9}{10} \text{V}$$

$$\text{Magnitude of \% error} = \frac{\frac{10}{11}\text{V} - \frac{9}{10}\text{V}}{\frac{10}{11}\text{V}} \times 100$$

$$= 1.0$$

20.



Equivalent resistance of circuit

$$R_{eq} = 500 + \frac{1000}{3} = \frac{2500}{3}$$

$\therefore$ Current drawn from the cell

$$i = \frac{10}{2500/3} = \frac{3}{250}\ \text{A}$$

$$\text{Reading of voltmeter} = \frac{3}{250} \times \frac{1000}{3}$$

$$= 4\ \text{V}$$

21. $$100 = (10 \times 10^{-3})\,(25 + R)$$

$\therefore$ $$R = 9975\,\Omega$$

22. D

23. When some resistance is connected in parallel, the effective resistance get decreased.

24. A

25. C

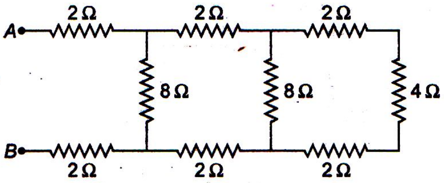
26. If voltmeter is ideal, then R should be $\frac{1.6}{0.4} = 4\,\Omega$. If it is non-ideal R should be greater than 4Ω.

27. D

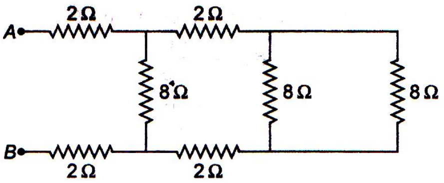
28. B

29. $E = iR_{AC} = \left(\frac{2}{10 + 40}\right)(4) = 0.16\ \text{V}$

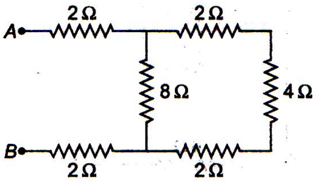
30.



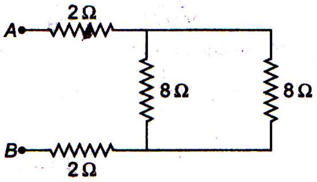
Step (1)



Step (2)



Step (3)



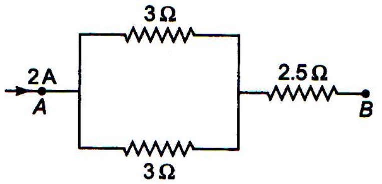
Step (4)

Now, equivalent resistance between A and B is

$$R_{eq} = 2 + 4 + 2$$

$$= 8\ \Omega$$

31. Circuit can be reduced to



Step (1)

Step (2)

∴ Equivalent resistance between A and B

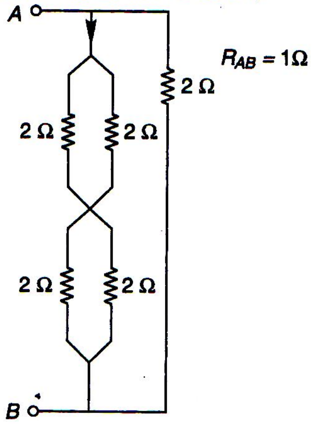
$$R_{eq} = 1.5 + 2.5 = 4\ \Omega$$

Potential difference between A and B

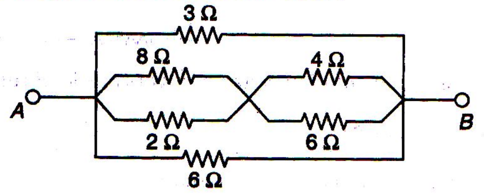
$$V_A - V_B = iR = 2 \times 4.0 = 8 \text{ volt}$$

32. A

33. The simple circuit is as shown below,

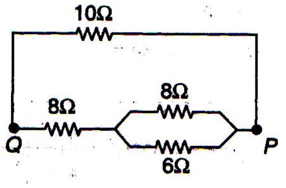


34. The simple circuit is as shown below,



35. The given circuit consists of a balanced Wheatstone bridge.

36. The simple circuit is as shown below.



37. Although current is denoted by arrow but it is a scalar quantity, and power is also scalar quantity, while current density (J) is a vector quantity.

38. Resistance $R = \rho \cdot \frac{l}{A}$

For same meterial and same length

$$\frac{R_2}{R_1} = \frac{A_1}{A_2} = \frac{3}{1}$$

$\therefore$ $R_2 = 3R_1$

Resistance of thick wire, $R_1 = 10\Omega$ (given)

$\therefore$ Resistance of thin wire.

$$R_2 = 3 \times 10 = 30\ \Omega$$

Total resistance of series combination $= 10 + 30 = 40\ \Omega$

39.

$$H = i^2 Rt$$

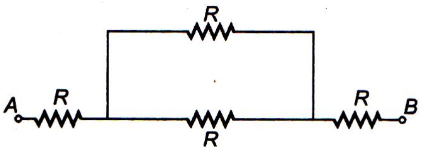
$$\therefore \quad R = \frac{H}{i^2 t} = \frac{[\mathrm{ML^2T^{-2}}]}{[\mathrm{A^2T}]}$$

$$= [\mathrm{ML^2T^{-3}A^{-2}}]$$

40. Rest all three are units of energy.

41. $q = \int_0^5 i\,dt = \int_0^5 (1.2t + 3)\,dt = 30\,\mathrm{C}$

42. Topmost and bottommost figures are short circuited. Simple circuit is shown below.



43.

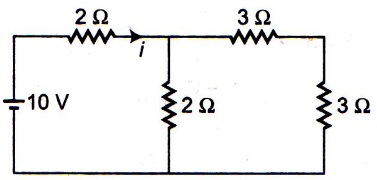
$$\frac{V_{AB}}{V_{BC}} = \frac{R_{AB}}{R_{BC}}$$

$$\therefore \quad \frac{(200/3)}{(100/3)} = \frac{50\ \mathrm{k\Omega}}{R_{BC}}$$

$$\therefore \quad R_{BC} = 25\ \mathrm{k\Omega}$$

44.

$$R_{\text{net}} = 2 + \frac{6 \times 2}{6+2} = \frac{7}{2}\ \Omega$$



$$\therefore \quad i = \frac{10}{(7/2)} = \frac{20}{7}\ \mathrm{A}$$

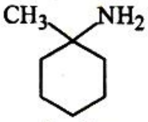
$$i_{3\,\Omega} = \left(\frac{2}{2+6}\right) i$$

$$= \frac{1}{4} \cdot i = \frac{5}{7}\ \mathrm{A}$$

45 Balanced Wheatstone bridge.

$$V_{2\Omega} = 0$$

[CHEMISTRY]

46. 
1° amine

$(C_2H_5)_3N$ — 3° amine

$(CH_3)_3C—NH_2$ — 1° amine

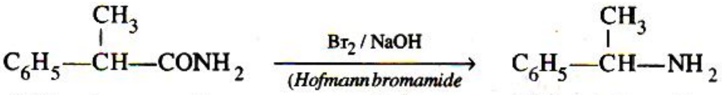
$C_6H_5—\overset{CH_3}{\overset{|}{N}}H$ — 2° amine

Thus, option (*b*) is correct.

47. $\overset{3}{C}H_2=\overset{2}{C}H\overset{1}{C}H_2NHCH_3$ N-Methylprop-2-en-1 amine

48. Due to delocalisation of a lone pair of electrons present on the N-atom into the benzene ring, $C_6H_5NH_2$ is the weakest base.

49. $R—NH_2 + RCHO \xrightarrow[\text{amination}]{\text{Reductive}} [R—N = CHR] \xrightarrow{H_2/Pt} \underset{2^\circ\text{ Amine}}{R—NH—CH_2R}$

50. 

$$C_6H_5—\overset{CH_3}{\overset{|}{C}}H—CONH_2 \xrightarrow[\textit{(Hofmann bromamide reaction)}]{Br_2/NaOH} C_6H_5—\overset{CH_3}{\overset{|}{C}}H—NH_2$$

2-Phenylpropanamide 1-Phenylethanamine

51.

52. Electron-donating groups (*i.e.*, CH_3) increase while electron-withdrawing groups (*i.e.*, NO_2) decrease the basicity of amines. Thus, option (*d*) is correct.

53. Amines (*a*, *b*) have a stronger tendency to accept a proton and hence are stronger Bronsted bases than phenol (*c*) and alcohol (*d*). Since phenol is more acidic than alcohol, therefore, phenol (*c*) has the least tendency to accept a proton and hence it is the weakest Bronsted base.

54.

55. Aniline is a weaker base than NH_3 due to delocalization of lone of pair electrons of the N atom over the benzene ring. Pyrrole (*c*) is not at all basic because the lone pair of electrons on the N-atom is donated towards aromatic sextet formation. Therefore, pyrrolidine (*d*) has a strong tendency to accept a proton and is hence it is the strongest Bronsted base.

56. NH_3 is more basic than H_2O, therefore, NH_2^- is a stronger base than OH^-. Thus, the decreasing order of basic strength is option (*a*), *i.e.*, $NH_2^- > OH^- > NH_3 > H_2O$.

57. The amine which is most basic is most reactive, *i.e.*, $(CH_3)_2NH$.

58. 1° and 2° Amines due to intermolecular H-bonding have higher boiling points (and hence less volatile than 3° amines and hydrocarbons of comparable molecular mass. Further, due to polar C–N bonds, 3° amines are more polar than hydrocarbons which are almost non-polar. Therefore, due to weak dipole-dipole interactions, 3° amines have higher boiling point (*i.e.*, less volatile) than hydrocarbons. In other words, $CH_3CH_2CH_3$ has the least *b.p.* and hence is most volatile.

59. Only treatment of amide with Br_2 is aqueous solution of NaOH will give an amine with lesser number of carbon atoms than in the reactant while

$$RCONH_2 \xrightarrow{Br_2/NaOH} RNH_2$$

all the remaining reactions give an amine with the same number of carbon atoms as in the reactant.

60. Nitrobenzene on reduction with $LiAlH_4$ gives azobenzene

$$2\ C_6H_5NO_2 \xrightarrow{LiAlH_4} C_6H_5N = NC_6H_5$$

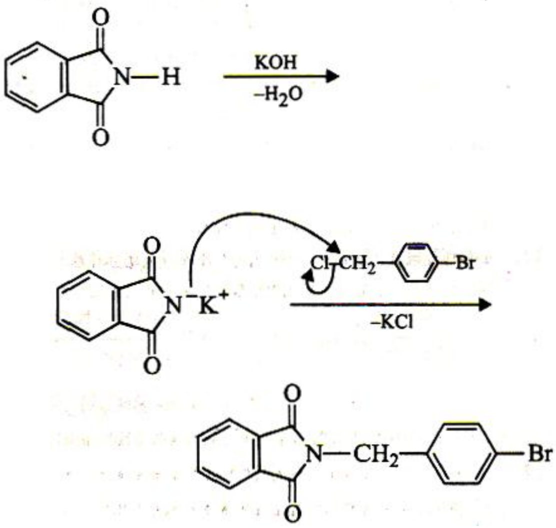
61. $-NO_2$ is a powerful deactivating group. It reduces the electron density in the benzene ring considerably. As a result, it does not undergo F.C. reactions.

62. – NO_2 is a *m*-directing group and hence 1,3-dinitrobenzene is formed.

63. 2° Alkyl bromides undergo dehydrohalogenation to yield alkenes.

64.-

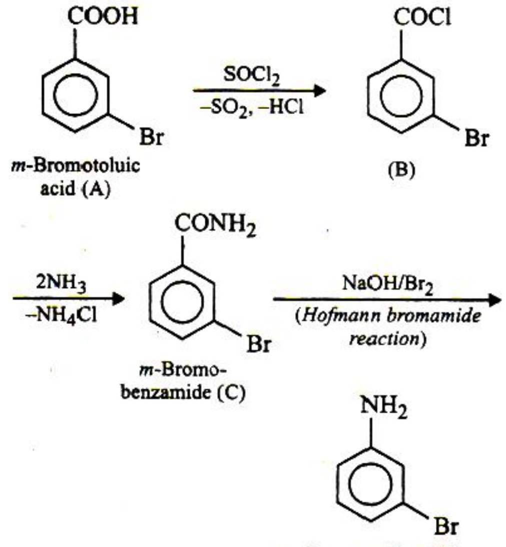
65. Aralkyl halides are more reactive than aryl halides towards nucleophilic substitution reaction. Therefore, reaction occurs at the more reactive CH_2Cl instead of at Br as shown below :



66. N-Methylbenzylamine ($CH_3NHCH_2C_6H_5$) being a 2° amine cannot be prepared by Gabriel's synthesis.

67. $$\underset{\text{Acetamide}}{CH_3CONH_2} \xrightarrow[\text{(Hofmann bromamide reaction)}]{Br_2-NaOH} \underset{\text{Methylamine}}{CH_3NH_2}$$

68.

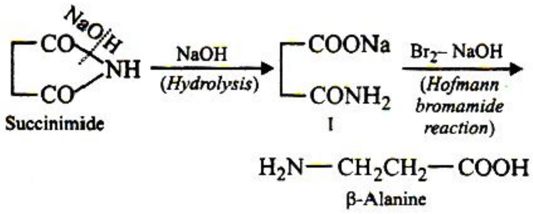


69.

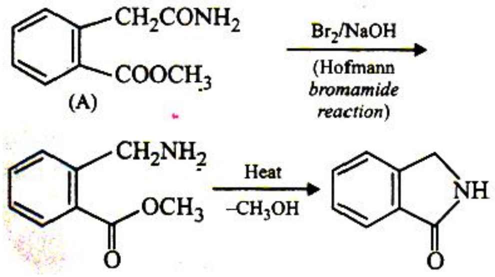
$$\underset{\substack{\text{Propanoic acid}\\ \text{(A)}}}{CH_3CH_2COOH} \xrightarrow{NH_3} \underset{\substack{\text{Amm. propananoate}\\ \text{(B)}}}{CH_3CH_2COONH_4} \xrightarrow[-H_2O]{\Delta}$$

$$\underset{\text{Propanamide (C)}}{CH_3CH_2CONH_2} \xrightarrow[\text{(Hofmann bromamide reaction)}]{Br_2-KOH} \underset{\text{Ethanamine}}{CH_3CH_2NH_2}$$

70.



71.



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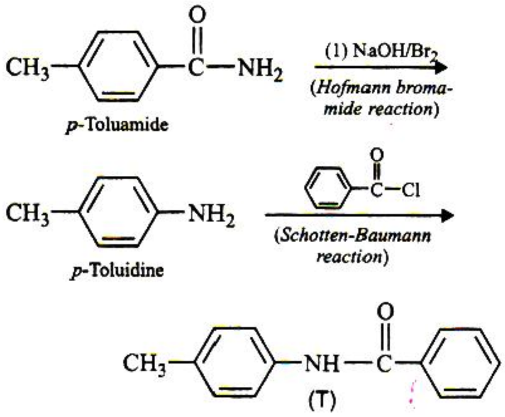


73.

$$\underset{\text{Toluene}}{C_6H_5-CH_3} \xrightarrow[\text{(Oxidation)}]{[O]} \underset{\text{Benzoic acid (A)}}{C_6H_5-COOH}$$

$$\xrightarrow[-SO_2,\,-HCl]{SOCl_2} \underset{\text{Benzoyl chloride (B)}}{C_6H_5COCl} \xrightarrow[-NaCl]{NaN_3}$$

$$\underset{\substack{\text{Benzoyl}\\ \text{azide (C)}}}{C_6H_5CON_3} \xrightarrow[\text{(Curtius rearrangement)}]{\text{Heat}} \underset{\substack{\text{Phenyl}\\ \text{isocyanate (D)}}}{C_6H_5-N=C=O}$$

74.-

75.

In the gaseous phase, basicity increases as the + I-effect of the alkyl groups increases, *i.e.*, CH_3NH_2 (I) < $(CH_3)_2NH$ < $(CH_3)_3N$ (III). However, due to –I-effect of the C_6H_5– group, $C_6H_5CH_2NH_2$ (IV) is even a weaker base than CH_3NH_2 (I). Thus, the overall, basic character increases in the order : IV < I < II < III.

76.

In the gaseous phase, basicity increases as the +I-effect of the alkyl groups increases. Thus, option (*b*) is correct.

77.

All aliphatic amines (*i.e.*, methanamine, ethanamine dimethylaniline) are more basic than benzenamine (aniline). Further, due to the presence of two CH_3 groups on N in N,N-dimethylaniline, it is more basic than aniline or benzenamine. Hence, benzenamine is the weakest base and hence has the highest pK_b value.

78.

$C_6H_5CH_2NH_2$ is the strongest base since the lone pair of electrons on the N-atom is not delocalized over the benzene ring while in all the remaining amines, it is delocalized over the benzene ring.

79.

In (*c*), electrons on the N atom are delocalized over two double bond but in (*d*), electrons are more strongly delocalized over the benzene ring but in (*b*), electrons are not delocalized, at all, therefore, it is the strongest base. Further, being a 2° amine, it is more basic than even NH_3. Thus, option (*b*) is correct.

80.

A weak base has a strong conjugate acid. Since aniline is the weakest base, therefore, its conjugate acid is the strongest acid.

81.

2° Amines are more basic than 1° and 3° amines. Among the 2° amines, (*b*) and (*c*) ; (*b*) is less basic since the lone pair of electrons on the nitrogen atom is contributed towards the aromatic sextet formation. Hence, piperidine, *i.e.*, option (*c*) is correct.

82. ----

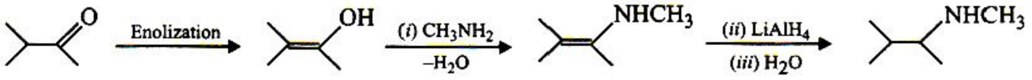
83.

Amines are more basic than ethers, therefore, (*d*) is least basic. Out of (*a*), (*b*) and (*c*) ; (*c*) is least basic due to donation of its lone pair of electrons towards aromatic sextet formation. Out of (*a*) and (*b*), since 2° amines are more basic than 3° amines, therefore, (*a*) is the most basic amine.

84.----

85.----

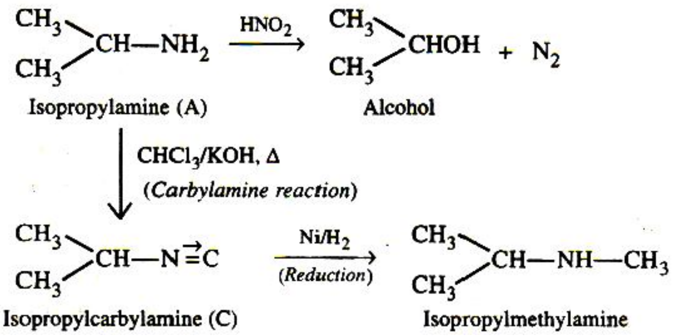
86.



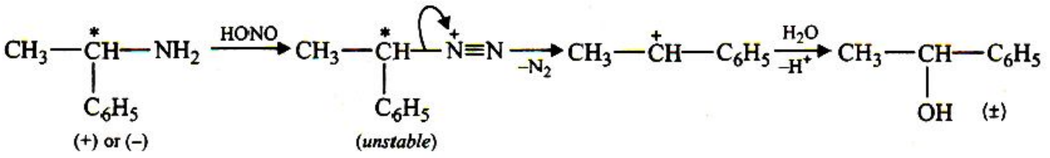
87.

88.

Since compound A (C_3H_9N) reacts with HNO_2 to give alcohol and N_2 gas, therefore, it must be a *primary aliphatic amine.* Further, since 1° aliphatic amine (A) on warming with $CHCl_3$ and caustic potash gave compound (C) which on reduction gave isopropylmethylamine, therefore, 1° amine (A) must be isopropylamine, *i.e.*, option (*a*) is correct.



89.



Since carbocations are planar species, therefore, nucleophilic attack by H_2O gives a racemic mixture of alcohols.

90.

Diazonium salts of benzylamine is not stable, it decomposes, *in situ*, to form benzyl alcohol.