AVIRAL
JEE | NEET | FOUNDATIONS

WEEKLY TEST MEDICAL PLUS - 01& 02 Balliwala
SOLUTION Date 02 -02-2020

[PHYSICS]

1. **(a)** $e = -\frac{N(B_2 - B_1)A\cos 0°}{\Delta t}$

$\Rightarrow 0.1 = \frac{-50 \times (0 - 2\times 10^{-2}) \times 100 \times 10^{-4} \times \cos 0°}{t}$

$\Rightarrow \quad t = 0.1$ sec.

2. **(d)** $e = -\frac{NBA(\cos\theta_2 - \cos\theta_1)}{\Delta t}$

$= -\frac{800 \times 4 \times 10^{-5} \times 0.05\,(\cos 90° - \cos 0°)}{0.1}$

$= 0.016$ V

3. **(a)** $|e| = L\frac{di}{dt} \Rightarrow I = \frac{L \times \{10 - (-10)\}}{0.5}$

$\Rightarrow L = 25$ mH

4. **(d)** $U = \frac{1}{2}Li^2 = U = \frac{1}{2} \times 5 \times \left(\frac{100}{10}\right)^2 = 250$ J

5. **(d)** $e = -\frac{d\varphi}{dt} = -\frac{d}{dt}\,3(t^2 + 4t + 9) = -(6t + 4)$

$= -[6(2) + 4] = -16 \Rightarrow |e| = 16$ volt

6. **(a)** $e = Bvl = 5 \times 10^{-5} \times \frac{360 \times 1000}{3600} \times 20 = 0.1$ V

7. **(b)** The emf induced in the circuit $e = \frac{\Delta\varphi}{\Delta t}$

If R is the resistance of the circuit, then

$i = \frac{e}{R} = \frac{\Delta\varphi}{R\Delta t}$

Thus, charge passes through the circuit,

$Q = i \times \Delta t$

$\Rightarrow Q = \frac{\Delta\varphi}{R\Delta t} \times \Delta t$

$\Rightarrow Q = \frac{\Delta\varphi}{R}$

8. **(a)** Induced emf

work done in taking a charge

$= \frac{Q \text{ once along the loop}}{\text{charge } Q}$

i.e., is $V = \frac{W}{Q}$

$\Rightarrow \quad W = VQ$

9. **(c)** When the total flux associated with one coil links with the other, *i.e.*, a case of maximum flux linkage, then

$M_{12} = \frac{N_2\phi_{B_2}}{i_1}$ and $M_{21} = \frac{N_1\phi_{B_1}}{i_2}$

Similarly, $L_1 = \frac{N_1\phi_{B_1}}{i_1}$ and $L_2 = \frac{N_2\phi_{B_2}}{i_2}$

If all the flux of coil 2 links coil 1 and vice versa, then

$\phi_{B2} = \phi_{B1}$

Since, $M_{12} = M_{21} = M$, hence we have

$M_{12}M_{21} = M^2 = \frac{N_1N_2\phi_{B_1}\phi_{B_2}}{i_1i_2} = L_1L_2$

$M_{max} = \sqrt{L_1L_2}$

Given, $L_1 = 2$ mH, $L_2 = 8$ mH

$M_{max} = \sqrt{2 \times 8} = \sqrt{16} = 4$ mH

10. **(c)** Inductance of a coil is numerically equal to the emf induced in the coil when the current in the coil changes at the rate of 1 As^{-1}.

If I is the current flowing in the circuit, then flux linked with the circuit is observed to be proportional to I, i.e.,

$\phi \propto I$

or $\phi = LI$ ... (i)

Where L is called the self-inductance or coefficient of self-inductance or simply inductance of the coil.

Net flux through solenoid,

$\phi = 500 \times 4 \times 10^{-3} = 2$ Wb

or $2 = L \times 2$ [after putting values in Eq. (*i*)]

or $L = 1$ H

11. **(b)** Area coming out per second from the magnetic field is not constant for elliptical and circular loops, so induced emf, during the passage of these loops, out of the field region will not remain constant for the circular and the elliptical loops.

12. **(a)** According to Faraday's second law of electromagnetic induction, the induced emf is given by the rate of change of magnetic flux linked with the circuit.

Here, $B = 0.04\ T$ and $\frac{-dr}{dt} = 2\ ms^{-1}$

Induced emf, $e = \frac{d\phi}{dt} = \frac{-BdA}{dt} = -B\frac{d(\pi r^2)}{dt}$

$= -B\pi 2r\frac{dr}{dt}$

Now, $r = 2$ cm

$e = -0.04 \times \pi \times 2 \times 2 \times 10^{-2} \times 2 \times 10^{-3}$

$= 3.2\ \pi\mu V$

13. **(b)** Magnetic flux $\phi = B.A$

$= B.\ \pi r^2$

Induced emf, $|e| = \frac{d\phi}{dt} = B\pi 2r\frac{dr}{dt}$

$= 0.025 \times \pi \times 2 \times 2 \times 10^{-2} \times 1 \times 10^{-3}$

$= \pi\mu V$

14. **(d)** We know induced emf $e = -L\frac{di}{dt}$

During 0 to $\frac{T}{4}, \frac{di}{dt}$ = constant

So, induced emf e = –ve

For $\frac{T}{4}$ to $\frac{T}{2}, \frac{di}{dt} = 0$

Induced emf $e = 0$

For $\frac{T}{2}$ to $\frac{3T}{4}, \frac{di}{dt}$ = constant

So induced emf e = +ve

15. **(b)** Induced emf of coil $E = \left|-\frac{d\phi}{dt}\right|_t$

Given, $\phi = 50t^2 + 4$ and $R = 400\Omega$

$E = \left|-\frac{d\phi}{dt}\right|_{t=2} = |100t|_{t=2} = 200$ V

Current in the coil $i = \frac{E}{R} = \frac{200}{400} = \frac{1}{2} = 0.5$ A

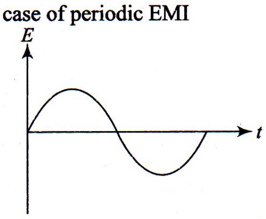
16. **(b)** $I = \left|\frac{1}{2}\frac{d\phi}{dt}\right|$

$|d\phi| = |IRdt|$

$d\phi$ = (area of triangle) $\times R$

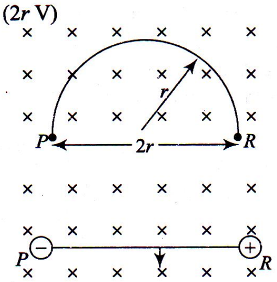
$= \left(\frac{1}{2} \times 4 \times 0.1\right) \times 10 = 2\ Wb$

17. **(b)** This is the case of periodic EMI



From graph, it is clear that direction is changing once in $\frac{1}{2}$ cycle.

18. **(d)** The semicircular conducting ring (PQR) can be replaced with a straight rod of length $2r$.
Hence motional emf induced across the rod
$e = B\,(2r\,V)$

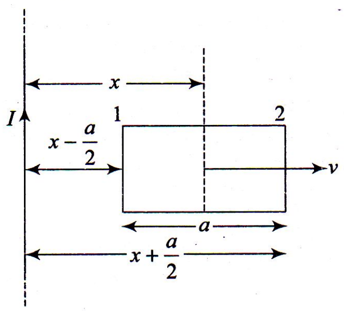


19. **(d)** The emf induced in side 1 of frame $e_1 = B_1 V\ell$

$B_1 = \frac{\mu_0 I}{2\pi(x - a/2)}$

The emf induced in side 2 of frame $e_2 = B_2 V\ell$

$B_1 = \frac{\mu_0 I}{2\pi(x + a/2)}$



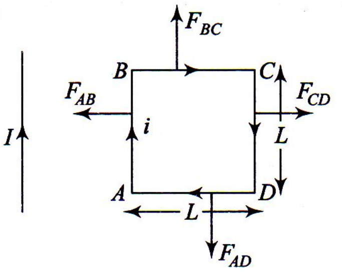
Net emf induced in square frame $e = B_1 V\ell - B_2 V\ell$

$$= \frac{\mu 0 I}{2\pi(x - a/2)}\ell v - \frac{\mu 0 I}{2\pi(x + a/2)}\ell v$$

or, $e \propto \frac{1}{(2x - a)(2x + a)}$

20. **(d)** First current develops in the direction of ***abcd*** **but** when electron moves away, then magnetic field **inside** loop decreases and current changes its direction.

21. **(a)**



$F_{AB} = i\ell B$ (Attractive)

$$F_{AB} = i(L).\frac{\mu_0 I}{2\pi\left(\frac{L}{2}\right)}(\leftarrow) = \frac{\mu_0 il}{\pi}(\leftarrow)$$

F_{BC} (↑) and F_{AD} (↓) ⇒ These cancel each other

$F_{CD} = i\ell B$ (Repulsive)

$$F_{CD} = i(L)\frac{\mu_0 I}{2\pi\left(\frac{3L}{2}\right)}(\rightarrow) = \frac{\mu_0 il}{3\pi}(\rightarrow)$$

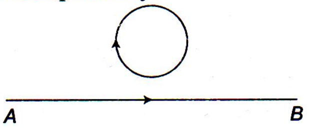
$$\Rightarrow F_{net} = \frac{\mu_0 il}{\pi} - \frac{\mu_0 il}{3\pi} = \frac{2\mu_0 il}{3\pi}$$

22. **(a)** Flux linked with each turn = 4×10^{-3} *Wb*

∴ Total flux linked = $1000[4 \times 10^{-3}]$ *Wb*

$f_{total} = 4 \Rightarrow Li = 4 \Rightarrow L = 1$ H

23. **(a)** The direction of the induced emf or current is such as to oppose the charge that produces it, this is also known as Lenz's law. If electron is moving from left to right, the flux linked with the loop (which is into the page) will first increase and then decrease as the electron passes by. So the induced current in the loop will be first anticlockwise and will change direction as the electron passes by.



24. **(c)** Choke coil is a high inductance coil made of thick insulated copper wire wound closely in a large number of turns over a soft-iron laminated core. Since, the wire is of copper and is thick, its resistance (*R*) is almost zero, but due to large number of turns and high permeability of iron core its inductance is quite high. The coil, therefore offers a large reactance and contributes to the impedance of the circuit. This reduces alternating current appreciably. Thus, current in an alternating circuit is reduced by means of a choke coil.

25. **(c)** Coefficient of mutual induction of two coils is equal to the number of magnetic flux (ϕ) linkages in one coil when a unit current (i) flows in the other.

Therefore, $M = \frac{\phi}{i}$

Given, $\phi = 2 \times 10^{-2}$ Wb, $i = 0.01$ A

$$\therefore \quad M = \frac{2 \times 10^{-2}}{0.1} = 2 \text{ H}$$

26. **(b)** $P = \frac{1}{2}V_o i_o \cos\phi \quad \Rightarrow \quad P = P_{Peak}.\cos\phi$

$$\Rightarrow \frac{1}{2}(P_{peak}) = P_{peak}\cos\phi$$

$$\Rightarrow \cos\pi = \frac{1}{2} \Rightarrow \phi = \frac{\pi}{3}$$

27. **(c)** From Faraday's law of electromagnetic induction the induced emf is equal to negative rate of change of magnetic flux.

That is $e = -\frac{\Delta\phi}{\Delta t}$

Flux induced = $2BA\cos\phi$

where B is magnetic field, A is area.

Given, $\theta = 0° = \Delta t = \frac{1}{100}$ s

$\Delta f = 2 \times 0.01 \times \pi \times (1)^2 \times 200 \times \cos 0°$

$$\therefore \quad e = \frac{-2 \times 0.01 \times \pi \times (1)^2 \times 200}{100} = -4\pi \text{ volt}$$

Circumference of a circle of radius r is $2\pi r$.

∴ Induced electric field E is

$$E = \frac{|e|}{2\pi r} = \frac{4\pi}{2\pi r} = \frac{2}{1} = 2 \text{ V/m}$$

28. **(a)** When north pole of magnet approaches the one face of coil, then the force of the coil becomes a north pole to oppose this motion and current flows anticlockwise. Thus, in this case emf is developed in the coil and when it completes one half motion it is momentarily at rest and no emf is present. Now south pole approaches the other face of coil making this face a south pole. The current now flows in clockwise direction and again an emf is developed in the coil. This variation is shown in figure (a).

29. **(b)** In a constant magnetic field conducting ring oscillates with a frequency of 100 Hz.

i.e. $T = 1/100$ s, in time $T/2$ flux links with coil changes from BA to zero.

$$\therefore \text{Induced emf} = \frac{\text{change in flux}}{\text{time}} = \frac{BA}{T/2} = \frac{2BA}{T} = \frac{2B \times \pi r^2}{T} = \frac{2 \times 0.01 \times \pi \times 1^2}{1/100} = 4\pi \text{ V}$$

Induced electric field along the circle, using Maxwell equation $\oint E.dl = -\frac{d\phi}{dt} = A\frac{dB}{dt} = e$

$$\therefore E = \frac{1}{2\pi r} \times \left(\pi r^2 \times \frac{dB}{dt}\right) = \frac{e}{2\pi r} = \frac{4\pi}{2\pi r} = 2 \text{ V/m}$$

30. **(d)** During free fall of ring through a magnetic field, when ring enters the constant and horizontal magnetic field, the induced current flows in the ring in such a direction that opposes the cause producing it. Now when ring leaves the magnetic field, again current is induced in the ring but in opposite direction. Also during the stay of ring completely in the field there is no induction. Hence, correct graph will be (d).

31. **(a)** $|dq| = \frac{d\phi}{R} = i\,dt =$ Area under $i - t$ graph

$\therefore d\phi =$ (Area under $i - t$ graph) R

$= \frac{1}{2} \times 4 \times 0.1 \times (10) = 2$ Wb.

32. **(a)** $\frac{N_s}{N_p} = \frac{V_s}{V_p} \Rightarrow \frac{200}{100} = \frac{V_s}{120} \Rightarrow V_s = 240$ V

Also $\frac{V_s}{V_p} = \frac{i_p}{i_s} \Rightarrow \frac{240}{120} = \frac{10}{i_s} \Rightarrow i_s = 5$ A

33. **(d)** Conductor cuts the flux only when, if it moves in the direction of M.

34. **(c)** If the current increases with time in loop A, then magnetic flux in B will increase. According to Lenz's law, loop-B is repelled by loop-A.

35. **(d)** Mutual inductance between two coils in the same plane with their centers coinciding is given by

$$M = \frac{\mu_0}{4\pi}\left(\frac{2\pi^2 R_2^2 N_1 N_2}{R_1}\right)$$

36. **(c)** $e = B_v vl = 0.2 \times 10^{-4} \times \left(\frac{180 \times 1000}{3600}\right) \times 1$

$= 10^{-3}$ V

37. **(c)** Inductors obey the laws of parallel and series combination of resistors.

38. **(b)** There will be self-induction effect when soft iron core is inserted.

39. **(c)** When loop is entering in the field, magnetic flux linked with the loop increases so induced emf in it $e = Bvl = 0.6 \times 10^{-2} \times 5 \times 10^{-2} = 3 \times 10^{-4}$ V (Negative).

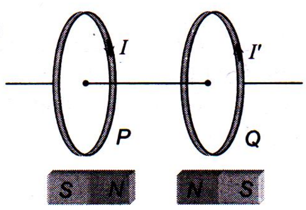
When loop completely entered in the field (after 5 sec) flux linked with the loop remains constant so $e = 0$.

After 15 sec, loop begins to exit out, linked magnetic flux decreases so induced emf $e = 3 \times 10^{-4}$ V (Positive).

40. **(a)** With rise in current in coil A flux through B increases. According to Lenz's law repulsion occurs between A and B.

41. **(d)** $e = B.\frac{dA}{dt} = L\frac{di}{dt} \Rightarrow 1 \times \frac{5}{10^{-3}} = L \times \frac{(2-1)}{2 \times 10^{-3}} \Rightarrow L =$ 10 H

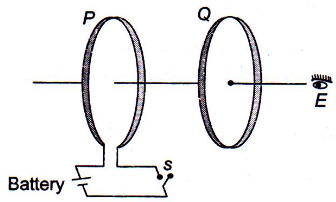
42. **(b)**



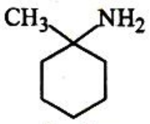
43. **(b)** $i = \frac{e}{R} = \frac{-N}{R}\frac{(\varphi_2 - \varphi_1)}{\Delta t} = \frac{-n(W_2 - W_1)}{5Rt}$

44. **(d)** Both AD and BC are straight conductors moving in a uniform magnetic field and emf will be induced in both. This will cause electric fields in both, but no net current flows in the circuit.

45. **(d)** When switch S is closed magnetic field lines passing through Q increases in the direction from right to left. So, according to Lenz's law induced current in Q *i.e.*, I_{Q_1} will flow in such a direction so that the magnetic field lines due to I_Q passes from left to right through Q. This is possible when I_{Q_3} flows in anticlockwise direction as seen by E. Opposite is the case when switch S is opened i.e., I_{Q_2} will be clockwise as seen by



[CHEMISTRY]

46. 

1° amine

$(C_2H_5)_3N$ — 3° amine

$(CH_3)_3C—NH_2$ — 1° amine

$C_6H_5—NH(CH_3)$ — 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. $R—NH_2 + RCHO \xrightarrow[\text{amination}]{\text{Reductive}} [R—N = CHR] \xrightarrow{H_2/Pt} R—NH—CH_2R$ (2° Amine)

50. $C_6H_5—CH(CH_3)—CONH_2 \xrightarrow[\text{(Hofmann bromamide reaction)}]{Br_2/NaOH} C_6H_5—CH(CH_3)—NH_2$

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

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

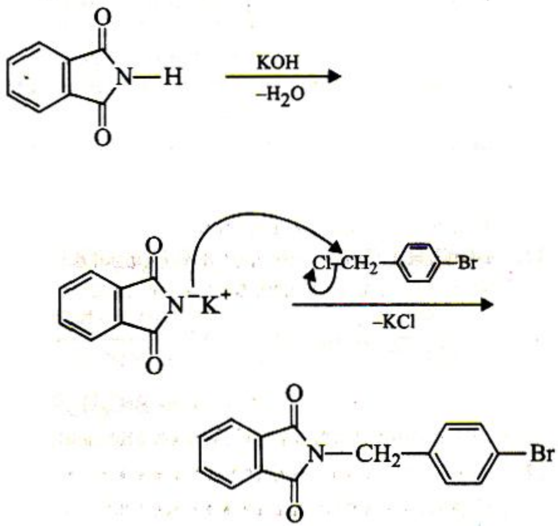
61. $-NO_2$ is a powerful deactivating group. It reduces the electron density in the benzene ring considerably. As a result, it does not undergo F.C. reactions.

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.-

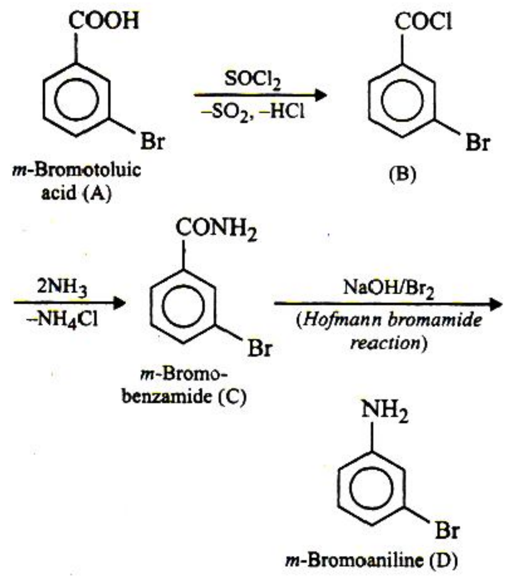
65. Aralkyl halides are more reactive than aryl halides towards nucleophilic substitution reaction. Therefore, reaction occurs at the more reactive CH_2Cl instead of at Br as shown below :



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

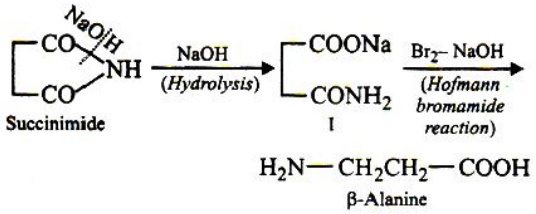
67. CH_3CONH_2 (Acetamide) $\xrightarrow[\text{(Hofmann bromamide reaction)}]{Br_2-NaOH}$ CH_3NH_2 (Methylamine)

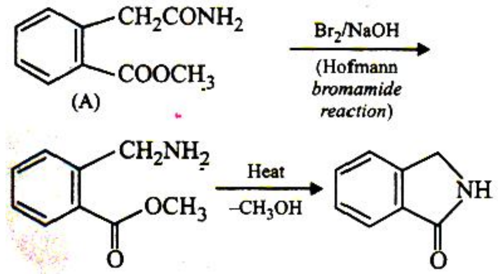
68.

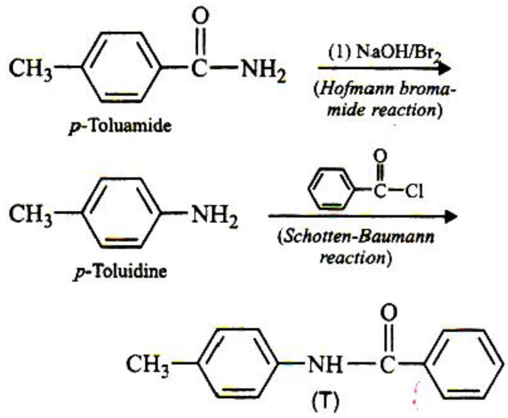


69. $\underset{\text{Propanoic acid (A)}}{CH_3CH_2COOH} \xrightarrow{NH_3} \underset{\text{Amm. propananoate (B)}}{CH_3CH_2COONH_4} \xrightarrow[-H_2O]{\Delta}$

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

70. 

71. 

72. 

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

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

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

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.

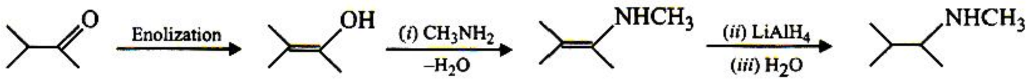
81. 2° Amines are more basic than 1° and 3° amines. Among the 2° amines, (*b*) and (*c*) ; (*b*) is less basic since the lone pair of electrons on the nitrogen atom is contributed towards the aromatic sextet formation. Hence, piperidine, *i.e.*, option (*c*) is correct.

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.--

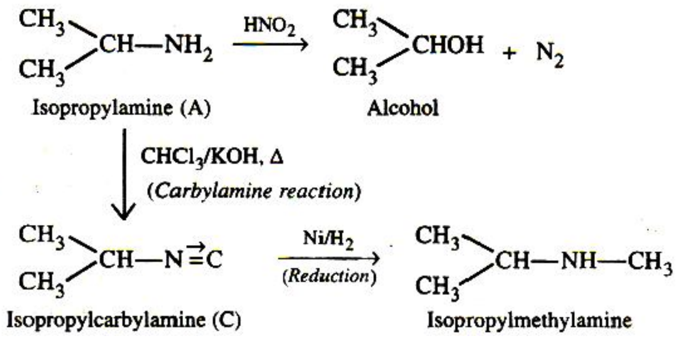
86.



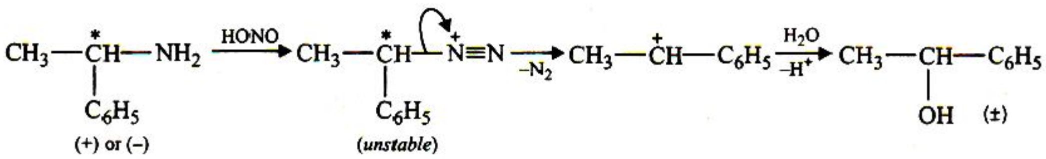
87.

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.