Sri Chaitanya IIT Academy.,India.

✪ A.P ✪ T.S ✪ KARNATAKA ✪ TAMILNADU ✪ MAHARASTRA ✪ DELHI ✪ RANCHI

A right Choice for the Real Aspirant

ICON Central Office - Madhapur - Hyderabad

SEC: Sr. Super60 NUCLEUS-BT | JEE-MAIN | Date: 21-06-2025
Time: 09.00Am to 12.00Pm | WTM-33 | Max. Marks: 300

KEY SHEET

MATHEMATICS

1)	3	2)	2	3)	2	4)	4	5)	3
6)	1	7)	3	8)	3	9)	1	10)	4
11)	1	12)	4	13)	1	14)	4	15)	3
16)	2	17)	3	18)	1	19)	4	20)	4
21)	4	22)	1	23)	3	24)	5	25)	1

PHYSICS

26)	3	27)	3	28)	2	29)	1	30)	2
31)	1	32)	2	33)	3	34)	1	35)	4
36)	1	37)	1	38)	1	39)	1	40)	3
41)	3	42)	4	43)	4	44)	3	45)	1
46)	3	47)	6	48)	5	49)	30	50)	4

CHEMISTRY

51)	1	52)	3	53)	2	54)	1	55)	4
56)	3	57)	1	58)	2	59)	3	60)	2
61)	3	62)	3	63)	2	64)	4	65)	4
66)	4	67)	3	68)	4	69)	3	70)	1
71)	2	72)	5	73)	4	74)	12	75)	9

SOLUTIONS

MATHEMATICS

1. $\underset{x\to 0}{Lt}\left(\frac{a^x+b^x}{2}\right)^{2/x}=6 \qquad =e^{\underset{x\to 0}{Lt}\left(\frac{a^x-1}{x}\right)+\left(\frac{b^x-1}{x}\right)}=6 \quad =e^{\log a+\log b}=6 \quad ab=6$

$(a,b)=(1,6),(6,1),(2,3),(3,2)$

Required probability $=\frac{4}{6\times 6}=\frac{1}{9}$

2. $E\to$ first boys can be arranged in $\lfloor 4$ ways, then there are 5-gaps between boys in 5-gaps, 5-girls can be arranged in $\lfloor 5$ ways

$P(E)=\frac{\lfloor 5\lfloor 4}{\lfloor 9}=\frac{5\times 4\times 3\times 2}{5\times 6\times 7\times 8\times 9}=\frac{1}{126}$

3. Among every 6-consecutive integers one divisible by 6 and other integers leaves remainders 1,2,3,4,5 when divided by 6

The numbers which leave the remainder 1 and 5 are relatively prime to 6

Required probability $\frac{2}{6}=\frac{1}{3}$

4. Out of 20 shoes 4 be taken in ${}^{20}P_4$.

Ways of getting no. pair $=20\times 18\times 16\times 14$

Probability of no.pair$=\frac{224}{323}$

5. If $x_i\in A$ $then$ $x_i\in P, xi\in Q$

$x_i\notin P,\ xi\notin Q$

$x_i\notin p, x_i\in Q$

$x_i\in P, x_i\notin Q$

A. $P\cap Q=\phi\Rightarrow x_i\in P, x_i\notin Q$

$x_i\notin P, x_i\notin Q$

$x_i\notin P, x_i\in Q$

$n(E)=3^n,\ n(S)=4^n$

B. $P\cap Q\, is\, a \sin gle ton$ $\qquad x_i\in P, x_i\in Q$

$n(E)={}^nC_1(1)3^{n-1}, n(s)=4^n$

C. $P\cap Q$ contain 2 elements $\qquad n(E)={}^nc_2(1)^2 3^{n-2}$

D. $n(P)=n(Q)\Rightarrow P(E)=\dfrac{{}^nC_0{}^nC_0+{}^nC_1{}^nC_1+...+{}^nC_n.{}^nC_n}{2^n.2^n}$

6. $P(B\cap C)=P(B)-P(A\cap B\cap \overline{C})-P(\overline{A}\cap B\cap \overline{C})=\dfrac{3}{4}-\dfrac{1}{3}-\dfrac{1}{3}=\dfrac{3}{4}-\dfrac{2}{3}=\dfrac{1}{12}$

7. Required prob. $=\dfrac{2\times2\times2(3!)}{6\times6\times6}=\dfrac{2}{9}$

8. $\therefore$ 3 letters can be posted to any one of the 5 address

$=5^3$

$\therefore$ *3 letters can be posted to exactly two address is*

$5_{C_2}(2^3-2)$

Required probability

$\dfrac{5_{C_2}(8-2)}{5\times5\times5}=\dfrac{5\times2\times6}{5\times5\times5}=\dfrac{12}{25}$

9. Required probability $=\dfrac{3}{2(2n-1)}$ *here* $2n=20$

10. $P(A\cup B)=1-\dfrac{1}{6}=\dfrac{5}{6},P(A)=1-\dfrac{1}{4}=\dfrac{3}{4}$

$P(A+P()=P(A\cup B)+P(A\cap B)=\dfrac{5}{6}+\dfrac{1}{4}=\dfrac{13}{12}\therefore P(B)=\dfrac{13}{12}-\dfrac{3}{4}=\dfrac{1}{3}$

$P(A)\neq P(B)\Rightarrow A,B\,are\,not\,equally\,likely$

$P(A)P(B)=\dfrac{3}{4}.\dfrac{1}{3}=\dfrac{1}{4}=P(A\cap B)\Rightarrow A,B\,are\,independent$

11. P (exactly one of events A, B occur) $P(A)+P(B)-2P(A\cap B)$

Given that $P(A)+P(B)-2P(A\cap B)=P$ -------------- (1)

$P(B)+P(C)-2P(B\cap C)=P$ -------------- (2)

$P(A)+P(C)-2P(A\cap C)=P$ -------------- (3)

$(1)+(2)+(3)\Rightarrow 2(P(A)+P(B)+P(C)-P(A\cap B)-P(B\cap C)-P(A\cap C))=3P$

$P(A)+P(B)+P(C)-P(A\cap B)-P(B\cap C)-P(C\cap A)=\dfrac{3P}{2}$

$\therefore\quad P(A\cup B\cup C)=\dfrac{3P}{2}+P^2=\dfrac{3P+2P^2}{2}$

12. $E=\dfrac{(x-20)(x-40)}{(x-30)}$

$E<0$ If $0<x<20$ or $30<x<40$

$n(E)=28 \quad n(S)=100 \quad P(E)=\dfrac{28}{100}=\dfrac{7}{25}$

13. The system of equations has a solution if and only if $\Delta=\begin{vmatrix} a & b \\ c & d \end{vmatrix}=ad-bc\neq 0$

As $a,b,c,d\in\{0,1\}$ The system has a solution if

$\begin{vmatrix} a & b \\ c & d \end{vmatrix}=\begin{vmatrix} 1 & 0 \\ 0 & 1 \end{vmatrix},\begin{vmatrix} 1 & 1 \\ 0 & 1 \end{vmatrix},\begin{vmatrix} 1 & 0 \\ 1 & 1 \end{vmatrix},\begin{vmatrix} 0 & 1 \\ 1 & 0 \end{vmatrix},\begin{vmatrix} 0 & 1 \\ 1 & 1 \end{vmatrix},\begin{vmatrix} 1 & 1 \\ 1 & 0 \end{vmatrix}$

$\therefore n(E)=6, n(S)=16 \ \& \ P(E)=\dfrac{3}{8}$

Since $x=y=0$ satisfy the system of equations irrespective of the values of a,b,c,d

$\therefore$ The probability that the system has a solution is 1

14. $1-\left[\dfrac{{}^{7}C_2}{{}^{11}C_2}\right]$

15. Req. $=2$ children's and 2 others $=\dfrac{{}^{4}C_2\times{}^{5}C_2}{{}^{9}C_4}=\dfrac{10}{21}$

16. A number has exactly 3 factors if the number is square of a prime number ,

squares of 11,13,17,19,23,29,31 are 3 digit numbers, required probability $=\dfrac{7}{900}$

17. Let $P(A)=x$ and $P(B)=y. x>\dfrac{1}{2}, y>\dfrac{1}{2}$

$P(A-B)=x-xy=\dfrac{3}{25}$ and $P(B-A)=y-xy=\dfrac{8}{25}$

18. Let S be the sample space of the composite experiment of drawing 6 in the first draw and then four in second draw then $|S|={}^{10}C_6\times{}^{10}C_4$

$\therefore$ Required Probability $=\dfrac{{}^{10}C_6\times{}^{6}C_3\times{}^{4}C_1}{{}^{10}C_6\times{}^{6}C_4}=\dfrac{80\times 24}{10\times 9\times 8\times 7}=\dfrac{8}{21}$

19. Since $a+b+c=6$, the possible digit selections are

$(1,2,3),(1,1,4),(2,2,2),(0,1,5),(0,2,4),(0,3,3),(0,0,6)$

The required number of ways $6+3+1+4+4+2+1=21$

Required probability $=\dfrac{21}{9\times 10\times 10}=\dfrac{7}{300}$

20. Required Probability $=\dfrac{{}^5C_2\times6\times6\times6}{7\times7\times7\times7\times7}$

21. No. of ways $=\dfrac{\underline{|8}}{\underline{|2}\,\underline{|2}\,\underline{|3}}=1680\Rightarrow\dfrac{P}{420}=4$

22. Required probability $=\dfrac{{}^{33}C_2+{}^{33}C_1\,{}^{67}C_1}{{}^{100}C_2}=\dfrac{83}{150}$

23. x^3+y^3 is divisible by $3\Rightarrow x+y$ is divisible by $3\Rightarrow x,y$ are multiples of 3 or one leaves remainder 1 and the other 2 when divided by 3.

$3,6,9\ldots30$ are multiple of $3;1,4,7,\ldots\ldots\ldots.,28$ leave remainder 1

$2,5,8,\ldots\ldots..,29$ leave remainder 2

Probability $=\dfrac{\binom{10}{1}\binom{10}{1}+\binom{10}{2}}{\binom{30}{2}}=\dfrac{145}{15\times29}=\dfrac{1}{3}$

24.

$p^2\geq4q\Rightarrow$

p	q
2	1
3	1, 2
4	1 to 4
5	1 to 6
6	1 to 9
7, 8, 9, 10	1 to 10

The total number of pairs (p,q) *is* $1+2+4+6+9+40=62$

Probability $=\dfrac{62}{10.10}=\dfrac{31}{50}$

25. $0\leq\dfrac{1+4P}{4}\leq1,\ 0\leq\dfrac{1-P}{4}\leq1,\ 0\leq\dfrac{1-2P}{2}\leq1$ and $0\leq\dfrac{1+4P}{4}+\dfrac{1-P}{4}+\dfrac{1-2P}{2}\leq1$

$\Rightarrow-\dfrac{1}{4}\leq P\leq\dfrac{3}{4},\ -1\leq P\leq1,\ -\dfrac{1}{2}\leq P\leq\dfrac{1}{2}$ and $\dfrac{1}{2}\leq P\leq\dfrac{5}{2}$

Max $\left\{-\dfrac{1}{4},-1,-\dfrac{1}{2},\dfrac{1}{2}\right\}\leq P\leq$ min $\left\{\dfrac{3}{4},1,\dfrac{1}{2},\dfrac{5}{2}\right\}$ $\quad\dfrac{1}{2}\leq P\leq\dfrac{1}{2}\Rightarrow P=\dfrac{1}{2}$

PHYSICS

26. $n = n > 1 \;\; to \;\; n = 1$ Lyman

$n = n > 2 \;\; to \;\; n = 2$ Balmer

$n = n > 3 \;\; to \;\; n = 3$ Paschen

27. $f = Rc\left(\dfrac{1}{n_1^2} - \dfrac{1}{n_2^2}\right)$

28. $a = \dfrac{v^2}{r}$ $\quad \therefore a \propto \dfrac{(z)^2}{(1/z)}$ (for $n = 1$) or $a \propto z^3 \;\; \therefore \dfrac{a_1}{a_2} = \left(\dfrac{2}{1}\right)^3 = 8$

29. conceptual

30. $\dfrac{1}{\lambda} = R\left[\dfrac{1}{n_1^2} - \dfrac{1}{n_2^2}\right] \Rightarrow \dfrac{1}{\lambda_{3\to2}} = R\left[\dfrac{1}{(2)^2} - \dfrac{1}{(3)^2}\right] = \dfrac{5R}{36}$

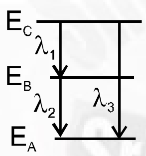
and $\dfrac{1}{\lambda_{4\to2}} = R\left[\dfrac{1}{(2)^2} - \dfrac{1}{(4)^2}\right] = \dfrac{3R}{16}$

$\dfrac{\lambda_{4\to2}}{\lambda_{3\to2}} = \dfrac{20}{27} \Rightarrow \lambda_{4\to2} = \dfrac{20}{27}\lambda_0$

31. $\dfrac{mv^2}{r} = \dfrac{K}{r}$ ....(1)

$mvr = \dfrac{nh}{2\pi}$ ....(2)

32. $E_C - E_A = (E_C - E_A) + (E_B - E_A) \;\Rightarrow\; \dfrac{hc}{\lambda_3} = \dfrac{hc}{\lambda_1} + \dfrac{hc}{\lambda_2}$



$\Rightarrow \;\; \lambda_3 = \dfrac{\lambda_1 \lambda_2}{\lambda_1 + \lambda_2}$

33. If one decides to work in a frame of reference where the electron is at rest, the given expression is not true as it forms the non- intertial frame of reference.

34. According Bohr's second postulates states that the electron evolves around the nucleus only in those orbits for which the angular momentum is some integral multiple of $\dfrac{h}{2\pi}$ where h is the Planck's constant $(6.6\times10^{-34}\,J - s)$. So, the magnitude of angular momentum is kept equal to some integral multiple of $\dfrac{h}{2\pi}$, where, h is Planck's constant and thus, the Bohr model does not gives correct value of angular momentum.

35. Conceptual

36. $\lambda_{\min} = \dfrac{hc}{eV} \Rightarrow \lambda \propto \dfrac{1}{V}$

$\therefore\ \lambda_2 > \lambda_1$ (see graph) $\Rightarrow\ V_1 > V_2$

$\sqrt{v} = a(Z-b)$ Moseley's law

$v \propto (Z-1)^2 \Rightarrow \lambda \propto \dfrac{1}{(Z-1)^2}\left(\because\ v \propto \dfrac{1}{\lambda}\right)$

$\lambda_1 > \lambda_2$ (see graph for characteristic lines) $\Rightarrow Z_2 > Z_1$

37. Increase in temperature increases the rate of the thermonicemmision, no. of e^- emitted increases.

38. The maximum K.E of ejected photoelectron is

$(KE)_{\max} = 2hv - \phi_0$

If the frequency of photon is doubled, maximum kinetic energy of photon electron becomes

$(KE)_{\max} = 2hv - \phi_0$

$$\Rightarrow \frac{(KE)_{\max}}{(KE)_{\max}} = \frac{2\left(hv - \dfrac{\phi_0}{2}\right)}{hv - \phi_0} > 2$$

Photo current $\propto \dfrac{\text{intensity of beam}}{hv}$

If intensity and frequency both are doubled, the photocurrent remains same

39. $F = \dfrac{du}{dr} = -\dfrac{d}{dr} k \log_e r = -\dfrac{k}{r}\dfrac{mv^2}{r} = \dfrac{k}{r}$

Then $v = \sqrt{\dfrac{k}{m}}$ then $mvr = \dfrac{nh}{2\pi} \to r = \dfrac{nh}{2\pi}\dfrac{1}{m}\sqrt{\dfrac{m}{k}} = \dfrac{nh}{2\pi\sqrt{mk}}$

Then write energy expression.

40. Conceptual

41. Total number of α-particles used for bombardment

=1mole

1 mole =6 $\times 10^{23}$ particles.

Total number of α-particles used for bombardment

=1mole =6 $\times 10^{23}$ particles

Number of α-particles deflected at angles greater than

50°(>50°)=1%(Given)

∴ Number of α-particles deflected at the angles less than

50°=100-1=99%

∴ Actual number of α-particles deflected at the angles less than

50°=99/100×6×10^{23}=5.94×10^{23}

42. Distance of closest approach to $r_0 = \dfrac{2Ze^2}{4\pi \in_0 K_0}$

$\therefore\ r_0 \propto \dfrac{1}{K_0}$ where K_0 is initial kinetic energy

Now $K_0 \propto = \dfrac{1}{2}mv_0^2 \qquad \therefore\ K_0 \propto \dfrac{1}{\upsilon_0^2}$

$\therefore\ r_0 \propto \dfrac{1}{\upsilon_0^2}\ \therefore\ \dfrac{(r_0)_2}{(r_0)_1} = \left(\dfrac{\upsilon_{01}}{\upsilon_{02}}\right)^2 = \dfrac{\upsilon^2}{(2\upsilon)^2} = \dfrac{1}{4}$

$\therefore\ (r_0)_2 = \dfrac{r}{2} \qquad [\therefore\ (r_0)_1 = r]$

43. As the first particle approaches the second due to repulsion it recedes away from it along the same line of approach. The separation between them is minimum when their velocities are equal. Applying conservation of linear momentum.

$mv = mv_1 + mv_f v_f = V/2$

$\Rightarrow\ \dfrac{1}{2}mv^2 = \dfrac{1}{2}(m+m)v^2 f + \dfrac{q^2}{4\pi\varepsilon_0 r}$

$\dfrac{1}{2}mv^2 = \dfrac{1}{2}2m\dfrac{v^2}{4} + \dfrac{q^2}{4\pi\varepsilon_0 r}\dfrac{1}{4}mv^2 = \dfrac{q^2}{4\pi\varepsilon_0 r} \qquad r = \dfrac{q^2}{\pi\varepsilon_0 mv^2}$

44. Conceptual

45. Conceptual

46. $mVr = \dfrac{h}{2\pi};\dfrac{kq(3q)}{r^2} = \dfrac{mv^2}{r}$

47. $Z^2\left(\dfrac{1}{4} - \dfrac{1}{n^2}\right) = 2\ ;Z^2\left(\dfrac{1}{9} - \dfrac{1}{n^2}\right) = \dfrac{3}{4}$

48. Given $51 = 13.6\left[\dfrac{1}{1^2} - \dfrac{1}{n^2}\right]Z^2$

$2.6 = 13.6\left[\dfrac{1}{(n-1)^2} - \dfrac{1}{n^2}\right]Z^2$

$Z = 2,\ N = 4$ this corresponds to 3rd excited state

49. $\sqrt{v} = a(Z-b) \qquad = \sqrt{\dfrac{C}{\lambda}} = a(z-b)$

$\sqrt{\dfrac{\lambda_2}{\lambda_1}} = \dfrac{a(27-1)}{a(Z-1)} \qquad Z = 30$

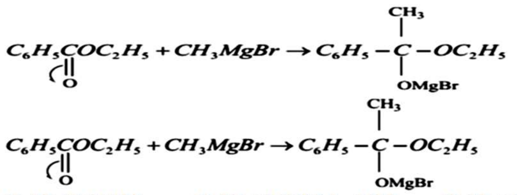
50. $E_{photon} = 13.6\left(1 - \dfrac{1}{25}\right)eV = 13.0\,eV$

$E/c = mv$ (momentum conserved)

$v = \dfrac{E}{mc} = \dfrac{(13\times1.6\times10^{-19})}{(1.67)\times10^{-27}\times3\times10^{8})} = 4\,m/s$

CHEMISTRY

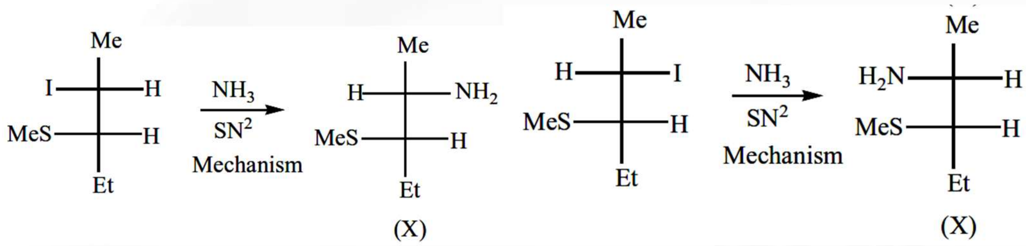
51.



$C_6H_5COCH_3 \rightarrow C_6H_5C(CH_3)_2OH \rightarrow C_6H_5CHCH_3 = CH_2$ on ozonolysis gives

$C_6H_5-\overset{CH_3}{\overset{|}{C}}=O+HCHO$

52.



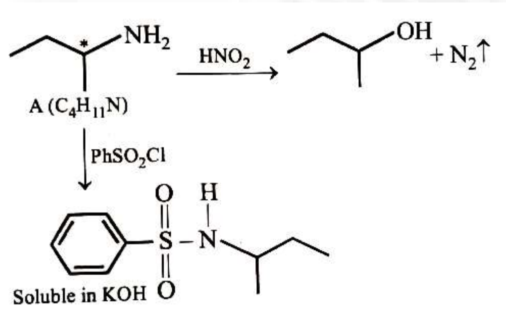
53. EWG groups increases and +I and +m group decreases

54. (P) Gabriel phthalimide synthesis is used for the preparation of aliphatic primary amines. Aromatic primary amines cannot be prepared by this method.

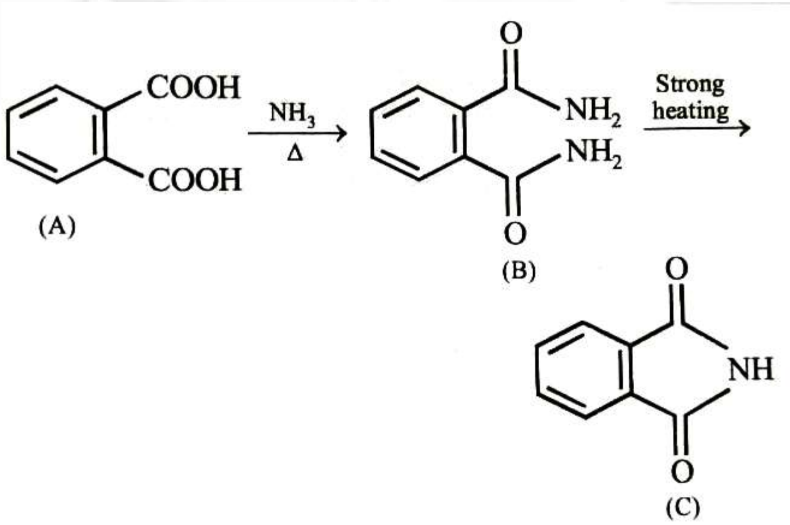
(Q) 2^0 - amines reacts with Hinsberg's reagent to give solid which is insoluble in $NaOH$

(R) Aromatic primary amines react with nitrous acid at low temperature (273 – 298K) to form diazonium salts, which form dye with $\beta-$ Naphthol

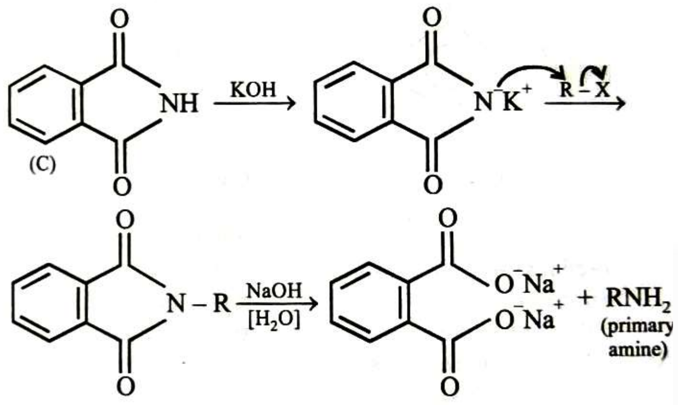
55.



56.



Gabriel phthalimide synthesis:



57.

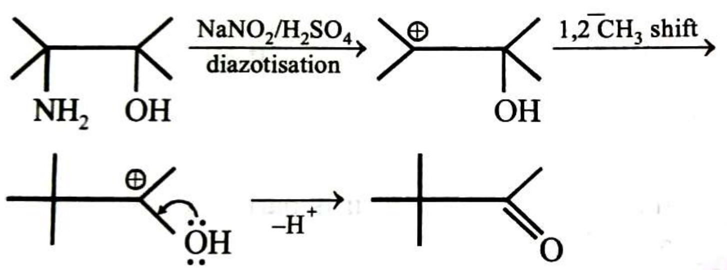
$CH_3-CH_2-CH_2-OH \longrightarrow CH_3-CH_2-CH_2-CH_2NH_2$

Propanol $\quad$ *n*-Butanamine

$SOCl_2 \downarrow \qquad \uparrow H_2/Ni,\ Na(Hg)/C_2H_5OH$

$CH_3-CH_2-CH_2-Cl \xrightarrow{KCN} CH_3-CH_2-CH_2-CN$

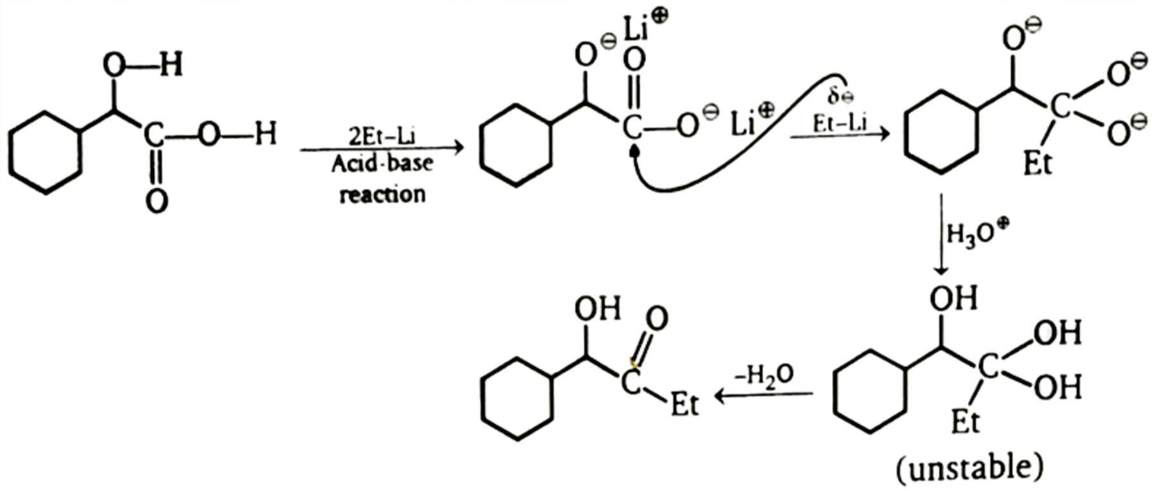
58.



Positive charge better stabilized due to +M effect

59. (3) Rate determining step is formation of carbanion, more the stable carbanion more is the rate of reaction.
3>4>2>1.
(2) Has more rate of reaction than a because of d-orbital resonance of chlorine.

60.



61. The yield in sandmeyer reaction is found to be better than Gattermann reaction

62. Benadryl is antihistaminic drug contains tertiary amino group.

63. $(CH_3)_2CH-NH_2$ - propan–2– amine

64. Aliphatic amines are more basic than aromatic amines.

65.

66. Benzene diazonium chloride is soluble and Benzene diazonium fluoroborate is water insoluble crystalline solid.
The yield of chlorobenzene preparation in Sandmeyer reaction is found to be more than Gattermann reaction.

67. Acetenilide (Q) is very weak acid, in (S), due to $-I$ effect of $-Br$, basic strength decreases

68. Generally acidic compounds are soluble in alkaline solutions.

69. Quarternary ammonium salts are obtained with excess of alkyl halide with ammonia

70. A – Isopropyl amine, which gives carbyl amine reaction.

71. Product 'X' has one chiral centre gives two optical active isomers**.**

72. (iii),(iv),(v),(vii),(viii) are more basic than aniline

73. (i), (ii), (iii), (v)

74. A – Aniline, B – Sulphanilic acid, C – 2,4,6 – tribromo anline

75. A – Diazonium salt, B – P-amino azobenzene
It is coupling reaction