Sri Chaitanya IIT Academy.,India.

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A right Choice for the Real Aspirant

ICON Central Office - Madhapur - Hyderabad

SEC: Sr.S60_Elite, Target & LIIT-BTs JEE-MAIN Date: 01-01-2025
Time: 09.00Am to 12.00Pm GTM-12/07 Max. Marks: 300

KEY SHEET

MATHEMATICS

1	**3**	2	**1**	3	**1**	4	**3**	5	**4**
6	**2**	7	**3**	8	**1**	9	**4**	10	**1**
11	**1**	12	**2**	13	**2**	14	**1**	15	**2**
16	**1**	17	**2**	18	**3**	19	**4**	20	**4**
21	**42**	22	**75**	23	**34**	24	**75**	25	**8**

PHYSICS

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

CHEMISTRY

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

SOLUTION
MATHEMATICS

1. Given that PQ = kI

$|P|.|Q| = k^3 \quad \Rightarrow |P| = 2k \neq 0 \Rightarrow P$ is an invertible matrix

$\because PQ = kI \quad \therefore Q = kP^{-1}I \quad \left[\because P^{-1}P = I\right]$

$\therefore Q = \dfrac{adj.P}{2} \qquad \because q_{23} = -\dfrac{k}{8}$

$\therefore -\dfrac{(3\alpha+4)}{2} = \dfrac{k}{8} \Rightarrow 12\alpha + 16.....(i)$

$\therefore |P| = 2k \Rightarrow k = 10 + 6\alpha$

From (i) and (ii) we get $\alpha = -1$, k = 4 $\therefore \alpha^2 + k^2 = 17$

2. α is 7^{th} root of unity $\Rightarrow 1+\alpha+a^2+...+a^6 = 0, p+q = -1$

$pq = \alpha^4 + a^6 + \alpha^5 + \alpha^7 + \alpha^8 + \alpha^7 + \alpha^9 + \alpha^{10} = 3 + \left(\alpha + \alpha^2 + \alpha^3 + ... + \alpha^6\right) = 3 + (1) = 2$

$\Rightarrow x^2 + x + 2 = 0$

Both I and II are true and II is the correct explanation.

3.

M	A	N	K	I	N	D

$\left(\dfrac{4\times 6!}{2!}\right) + (5!\times 0) + \left(\dfrac{4!\times 3}{2!}\right) + (3!\times 2) + (2!\times 1) + (1!\times 1) + (0!\times 0) + = 1492$

$\Rightarrow 1440 + 36 + 12 + 4 = 1492$

4. (A) No. of such triangles = 10 $^6C_1$ + = 60

(B) No. of such triangles = 10

(C) No. of such quadrilaterals = 10 $^5C_1$ + = 75

(D) No. of such quadrilaterals = 10 (when four consecutive points are taken)

5. Let $p(E_1) = x.p(E_2) = y \ and \ p(E_3) = z$

$\alpha = p\left(E_1 \cap \overline{E_2} \cap \overline{E_3}\right) = p(E_1).p\left(\overline{E_2}\right).p\left(\overline{E_3}\right)$

$\Rightarrow \alpha = x(1-y)(1-z)$ .....(i)

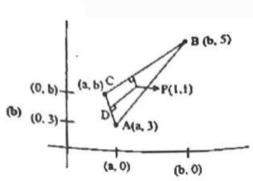
Similary,

$\beta = (1-x).y(1-z)$ ......(ii)

$\gamma = (1-x)(1-y).z$ .....(iii)

$p = (1-x)(1-y)(1-z)$ .....(iv) and solve equation.

6.



slope of $AC = \infty$

Slope of $PD = 0$

$D\left(\dfrac{a+a}{2}, \dfrac{b+3}{2}\right) = D\left(a, \dfrac{b+3}{2}\right)$

$\frac{b+3}{2}-1=0, b+3-2=0 \Rightarrow b=-1$

$b=-1$

$E\left(\frac{b+a}{2},\frac{5+b}{2}\right)=\left(\frac{a-1}{2},2\right)$

slope of $BC\times$ slope of $EP=-1$

$$\left(\frac{5-b}{b-a}\right)\times\left(\frac{2-1}{\frac{a-1}{2}-1}\right)=-1\Rightarrow\left(\frac{6}{-1-a}\right)\times\left(\frac{2}{a-3}\right)=-1\Rightarrow 12=(1+a)(a-3)$$

$\Rightarrow 12=a^2-3a+a-3\Rightarrow a^2-2a-15=0$

$a=-3$ accept

Equation of AP $A(-3,3),P(1,1)$

$y-1=\left(\frac{3-1}{-3-1}\right)(x-1)\Rightarrow x+2y=3$

Equation of BC $B(-1,5),C=(-3,-1)$

$Y+1=\left(\frac{5+1}{-1+3}\right)(x+3)=3x+9$ $3x-y+8=0$

$Q\equiv\left(\frac{-13}{7},\frac{17}{7}\right)$

7. Given equation is

$e^{4x}+4e^{3x}-58e^{2x}+4e^{x}+1=0$

Take, $f(x)=\left(e^{2x}+\frac{1}{e^{2x}}+4\left(e^{x}+\frac{1}{e^{x}}\right)-58\right)$

Let $e^{x}+\frac{1}{e^{x}}=p(>0)$ .....(i)

$p^2+4p-60=0$ $p=6$ or $=-10$

Only p = is allowed $e^{x}+\frac{1}{e^{x}}=6$

Two real and distinct value od x

8. Since, given $\ell_1+\ell_2=20\Rightarrow\frac{d\ell_2}{d\ell_1}=-1$

Now, $A_1=\left(\frac{\ell_1}{4}\right)$ and $A_2=\pi\left(\frac{\ell_2}{2\pi}\right)^2$

Let $S=2A_1+3A_2=\frac{\ell_1^2}{8}+\frac{3\ell_2^2}{4\pi}$

For max or min

$\frac{ds}{d\ell_1}=0\Rightarrow\frac{2\ell_1}{8}+\frac{6\ell_2}{4\pi}.\frac{d\ell_2}{d\ell_1}=0\Rightarrow\frac{\ell_1}{4}=\frac{6\ell_2}{4\pi}\Rightarrow\frac{\pi\ell_1}{\ell_2}=6$

9. Let $f(x)=4x^3-11x^2+8x-5\forall x\in R$

$\Rightarrow f'(x) = 12x^2 - 22x + 8 \quad and \quad f'(x) > 0$

10. Since, we know $\overline{AB} + \overline{BC} + \overline{CA} = \overline{0} \quad \Rightarrow \alpha = 2, \beta = 4, \gamma - \delta = 3$

Now, $\frac{1}{2}\left|\overline{AB} \times \overline{AC}\right| = 5\sqrt{6}$

$(\delta - 9)^2 + (2\delta + 12)^{12} + 100 = 600 \Rightarrow \delta = 5, \gamma = 8$

Hence, $\overline{CB}.\overline{CA} = 60$

11. Given points and direction ratios are shown below.

$a_1 = (1,2,3), a_2 = (2,4,5), \overrightarrow{b_1} = 2\hat{i} + 3\hat{j} + \lambda\hat{k}$

$\overrightarrow{b_2} = \hat{i} + 4\hat{j} + 5\hat{k}$

Apply shortest distance formula,

12. $15\sin^4\alpha + 10\left(1 - \sin^2\alpha\right)^2 = 6, 25\sin^4\alpha - 20\sin^2\alpha + 4 = 0$

$\Rightarrow 25\sin^4\alpha - 10\sin^2\alpha - 10\sin^2 a + 4 = 0$

$\Rightarrow \left(5\sin^2 a - 2\right) = 0 \Rightarrow \sin^2 a = \frac{2}{5}$

13. For, S_1 we have $\quad \Rightarrow \frac{(x+1)\left(x^2 + 3x + 5\right)}{x^2 - 3x + 2} \le 0$

$\Rightarrow x \in (-\infty, -2) \cup (1, 2)$

For S_2, we have

$3^x\left(3^x - 3\right) - 3^2\left(3^x - 3\right) \le 0$

For S_2, $x \in [1,2] \quad \Rightarrow (-\infty, -2) \cup [1,2]$

14. $\int \frac{x^2}{(x\sin x + \cos x)}dx \qquad \because \frac{d}{dx}(\sin x + \cos x) = x\cos x$

$\int \frac{x\cos x}{(x\sin x + \cos x)^2}\left(\frac{x}{\cos x}\right)dx = \frac{x}{\cos x}\left[\frac{-1}{x\sin x + \cos x}\right]$

Use by parts method

15. Area: $\int_1^4 \left(2\sqrt{2}\sqrt{x} - \sqrt{2}x\right)dx$

16. Given, $\left(1 + x^2\right)dy = y(x - y)dx$

Where, $y(0) = 1, y\left(2\sqrt{2}\right) = \beta$

$dy = \left(\frac{yx - y^2}{1 + x^2}\right)dx$

$\frac{dy}{dx}+y\left(\frac{-x}{1+x^2}\right)=\left(\frac{-1}{1+x^2}\right)y^2$,divide by y^2 both sides and proceed

17. First common term of both the series is 23 and common difference is 7 x 4 = 28

$\because$ Last term $\le 407 \Rightarrow 23+(n-1)\times 28 \le 407 \Rightarrow (n-1)\times 28 \le 384$

$\Rightarrow n \le \frac{384}{28}+1 \Rightarrow n \le 14.71$

Hence, number of terms common are 14

18. N = (26 + a + b), $f_i x_i$ = (504 + 3a + 9b)

19. $\underset{i=1}{\overset{50}{U}} X_i = \underset{i=1}{\overset{50}{U}} Y_i = T ; \because n(X_i)=10, n(Y_i)=5$

So, $\underset{i=1}{\overset{50}{U}} X_i = 500, \underset{i=1}{\overset{50}{U}} Y_i = 5n \Rightarrow \frac{500}{20}=\frac{5n}{6} \Rightarrow n=30$

20. Given function is

$$\lim_{x\to 0}\frac{(5x+...)-\ln(1+\alpha x)}{x}=0$$

$$f(x)=\begin{cases}\frac{\ln(1+5x)-\ln(1+\alpha x)}{x} & : \quad x\ne 0\\ 10 & : \quad x=0\end{cases}$$

Applying expansion of ln $(1+x)$.

$\lim_{x\to 0}(5-\alpha)=10 \qquad 5-\alpha=10 \Rightarrow \alpha=-5$

21. Given matrix is $A=\begin{pmatrix}\alpha & \beta & \gamma\\ \alpha^2 & \beta^2 & \gamma^2\\ \beta+\gamma & \lambda+\alpha & \alpha+\beta\end{pmatrix}$

$R_3 \to R_3+R_1$

$$\Rightarrow |A|=|\alpha+\beta+\gamma|\begin{vmatrix}\alpha & \beta & \gamma\\ \alpha^2 & \beta^2 & \gamma^2\\ 1 & 1 & 1\end{vmatrix}$$

$\Rightarrow |A|=(\alpha+\beta+\gamma)(\alpha-\beta)(\beta-\gamma)(\gamma-\alpha) \quad \because |adjA|=|A|^{n-1}$

$|adj(adjA)|=|A|^{(n-1)2}$

$|adj(adj(adj(adjA)))|=|A|^{(n-1)4}=|A|^{2^4}=|A|^{16} \therefore (\alpha+\beta+\gamma)=2^{32}.3^{16}$

22. $0\le\frac{1-d}{4}\le 1 \Rightarrow -3\le d\le 1 \qquad .....(i)$

$0\le\frac{1+2d}{4}\le 1 \Rightarrow -\frac{1}{2}\le d\le\frac{3}{2} \qquad .....(ii)$

$0\le\frac{1-4d}{4}\le 1 \Rightarrow -\frac{3}{4}\le d\le\frac{1}{4} \qquad .....(iii)$

$0\le\frac{1+3d}{4}\le 1 \Rightarrow -\frac{1}{3}\le d\le 1 \qquad .....(iv)$

From $(i),(ii),(iii)$ and (iv)

$-\frac{1}{3} \le d \le \frac{1}{4}$ minimum value of $d = -\frac{1}{3}$

Mean $= 0 + \frac{1+2d}{4} + \frac{2(1-4d)}{4} + \frac{3(1+3d)}{4}$

$X = \frac{6+3d}{4} = \frac{1}{4}\left(6 - 3\times\frac{1}{3}\right) = \frac{5}{4} \Rightarrow 60\overline{X} = 60\times\frac{5}{4} = 75$

23. It has infinitely many solutions.

24. we have $x^2 + 4y^2 + 2x + 8y - \lambda = 0$

$\Rightarrow \frac{(x+1)^2}{\lambda+5} + \frac{(y+1)^2}{\frac{\lambda+5}{4}} = 1 \quad \because \frac{2b^2}{a} = 4$

$\frac{2(\lambda+5)}{4} = 4\left(\sqrt{\lambda+5}\right)$

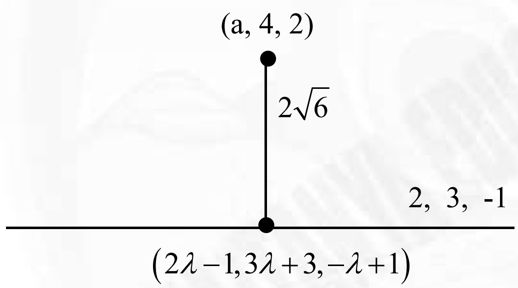
On solving $\Rightarrow \lambda = 59$

$\lambda = -5$

$1 = 2a = 2\sqrt{\lambda+5} = 2\sqrt{65} = 16$

$\Rightarrow \lambda + l = 59 + 16 + 75$

25.



Given line $\frac{X+1}{2} = \frac{Y-3}{3} = \frac{Z-1}{-1} = \lambda$

$X = 2\lambda - 1, Y = 3\lambda + 3, Z = -\lambda + 1$

$(2\lambda - 1 - a)2 + (3\lambda - 1)3 + (-\lambda - 1)(-1) = 0$

$\Rightarrow 4\lambda - 2 - 2a + 9\lambda - 3 + \lambda + 1 = 0$

$14\lambda - 4 - 2a = 0 \Rightarrow 7\lambda - 2 - a = 0$

$\Rightarrow (5\lambda - 1)^2 + (3\lambda - 1)^2 + (\lambda - 1)^2 = 24$

$35\lambda^2 - 14\lambda - 21 = 0 \Rightarrow (\lambda - 1)(35\lambda + 21) = 0$

For, $\lambda = 1 \Rightarrow a = 5$

Let $(\alpha_1, \alpha_2, \alpha_3)$ be reflection point P

$\alpha_1 + 5 \quad \alpha_2 + 4 = 12 \quad \alpha_3 + 2 = 0$

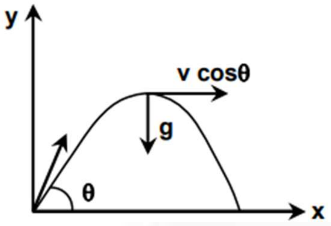
$\alpha_1 = -3 \quad \alpha_2 = 8 \quad \alpha_3 = -2$

$a + \alpha_1 + \alpha_2 + \alpha_3 = 8$

PHYSICS

26. $M^1L^{-3}T^0 = \left(M^1L^1T^{-2}\right)^a \left(LT^{-1}\right)^b T^c \quad a=1, b=-4, \ c=-2$

27. Rate of change of speed is minimum at highest point. Since at highest position.



$R = \frac{(v\cos\theta)^2}{g}$

28. Inside a closed Guassian surface $Q_{enc} = 0$

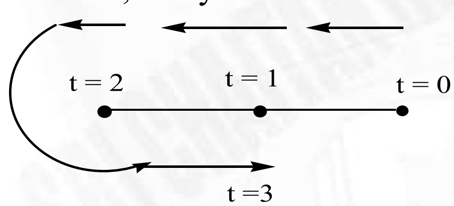
29. In 1D collisions formula for $v_1 = \frac{m_1 - m_2}{m_1 + m_2} v_1 + \frac{2m_2}{m_1 + m_2} v_2$, when $m_1 << m_2, \vec{v_1} = -\vec{u_1} + 2\vec{u_2}$.

30. $\vec{E} \times \vec{B}$ gives direction of $\vec{V}$

31. Time period becomes $2\pi\sqrt{\frac{R}{g}}$ in statement 1. We can't neglect roundness of earth for pendulum of infinite length.

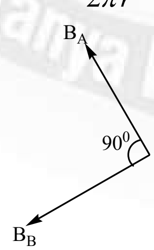
32. $V_T = \frac{2}{9} \frac{r^2 g(\rho_B - \rho_l)}{\eta}, Power = \vec{F}.\vec{V}$

33. T = 4sec, Body starts at extreme position and ends at mean position as shown



34. For dropped body $L - x = \frac{1}{2}gt^2$, for pulse $t = 2\sqrt{\frac{x}{g}}$ .x is the distance from bottom free end of row.

35. For infinitely long wire $B = \frac{\mu_0 I_0}{2\pi r}$, $r = a\sqrt{2}, B_{Res} = \sqrt{2}B$



36. Above curie temperature ferro becomes para.
37. Distance between any two points when only increase.
38. V_{avg}, V_{rms} , V_{mp} will all exist at a particular temperature.

39. IN resonance $V_L = V_C, V_{res} = V_R, Z = R$ $i_{Rms} = \frac{V_{Rms}}{Z}$

40. $emf \in = A\frac{dB}{dt}, i = \frac{\in}{R}$.

41. $E_n = -13.6\frac{Z^2}{n^2}ev$, $r_n = 0.529\frac{n^2}{z}A^0$, $V_n = 2.2\times10^6\frac{z}{n}m/s$, $T = \frac{2\pi r_n}{v_n}$.

42. $\frac{R_{Ge}}{R_{Be}} = \left(\frac{X}{9}\right)^{1/3}$ X = 72, Number of neutron = 72 – 32 = 40

43. Zener current will be maximum, when V = 15V ,15 – (i × 2.5k) = 5, i = 4 mA ,i_z = 3 mA

44. In uniform pure rolling, the linear velocity is constant. If no external force or torque is applied, the body will remain in a state of uniform pure rolling. In this case, the friction force is always zero, so there will not be any effect of the frictional force on the body.

45. $\frac{I_{coherent}}{I_{Incoherent}} = \frac{4I}{2I} = 2$

46. $\frac{1}{2}mv_0^2 = \frac{1}{2}mv^2 + mgl(1-\cos\theta)$ $T - mg\cos\theta = \frac{mv^2}{R}$.

47. $E = \frac{KQx}{\left(R^2+x^2\right)^{3/2}}, \frac{dE}{dx} = 0$ is maximum $x = \frac{R}{\sqrt{2}}$.

48. $\frac{E}{2} = E - ir, 2E = i(3+r)$,r = 1.

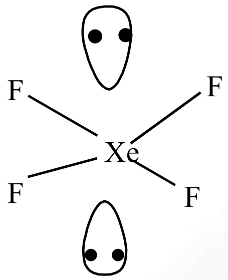
49. $(1)\sin 90^0 = \mu \sin 30^0$

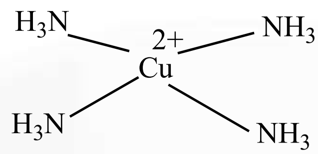
50. $I = \frac{ML^2}{3}\sin^2\theta$,angle is with vertical

CHEMISTRY

51. Stability of complex $\propto$ chelation

52.





53. Statement 2 is the reason for statement 1

54. Oxidation power order : $F_2 > Cl_2 > Br_2 > I_2$

55. Energy $\propto (n+l)$

$$(n+l)\begin{bmatrix} e_3 & > & e_2 & > & e_4 & > & e_1 \\ 3+2 & & 4+0 & & 3+1 & & 3+0 \\ 5 & & 4 & & 4 & & 3 \end{bmatrix}$$

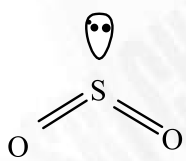
56. $S_R + O2 \longrightarrow SO_2 \Delta H, = -70960 Cal$ ____(i)

$S_M + O2 \longrightarrow SO_2 \Delta H, = -71030 Cal$ ____(ii)

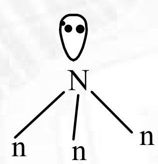
Subtracting eqn (II) from (i) we get ,

$\Delta H = \Delta H_1 - \Delta H_2 = (-70960) - (-71030) = +70 Cal$

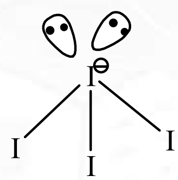
57.



Bent



Pyramidal



Bent

58. The correct statement for B is 5f electrons have much lower shielding effect as compared to 4f electrons because 5f- orbitals more diffused than 4f-orbitals

59. **Correct assertion** The bond enthalpies of the two O-H bonds in H-O-H are not equal. **Correct reason** This is because electronic environment around O is not same after breakage of one O-H bond.

60. $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g); K_c$

$2NH_3(g) \rightleftharpoons N_2(g) + 3H_2(g); \dfrac{1}{K_c}$

Multiplying by $\dfrac{1}{2}$, reaction becomes

$NH_3(g) \rightleftharpoons \dfrac{1}{2} N_2(g) + \dfrac{3}{2} H_2(g)$

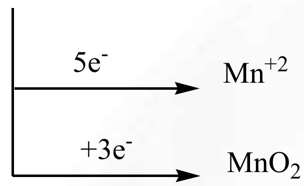
$$\therefore New\ K_c = \left(\frac{1}{K_c}\right)^{\frac{1}{2}} = \left(\frac{1}{64}\right)^{\frac{1}{2}} = \frac{1}{8}$$

61. Both assertion and reason are true but reason is not correct explanation of assertion. Ammonium acetate is a salt of weak acid (CH_3COOH) and weak base (NH_4OH).

62. $C_6H_{12}O_6$ **(GLUCOSE)** monosaccharide.

63. Ethanol and hexane forms positively deviated non-ideal solution.

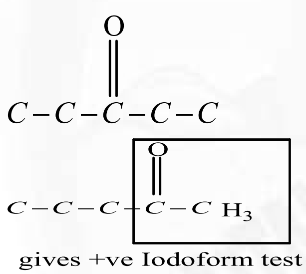
64. $MnO_4^- + e^- \longrightarrow MnO_4^{2-}$



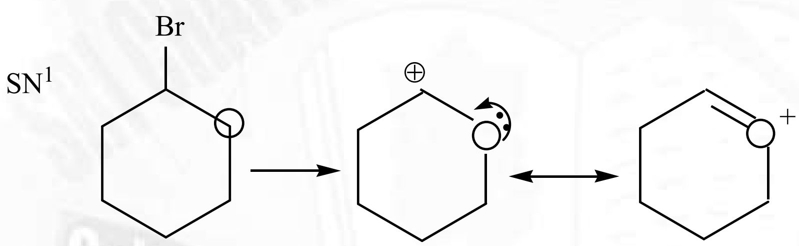
65. $n_m = \frac{k \times 1000}{m}$

Specific conductance = $\frac{1}{specific\ resis\tan ce}$ $= \left(\frac{1}{x}\right)$ $n_m = \frac{1}{x} \times \frac{1000}{y}$

66.

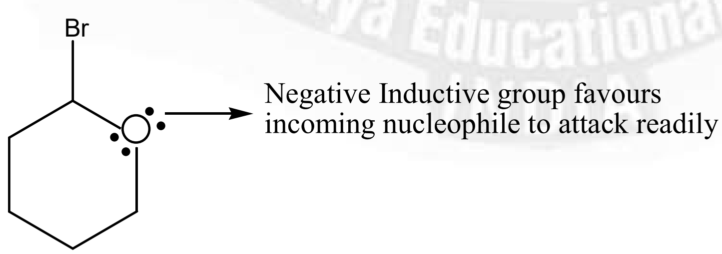


67.



[Carbocation isstablized by resonance & Br is good leaving group]

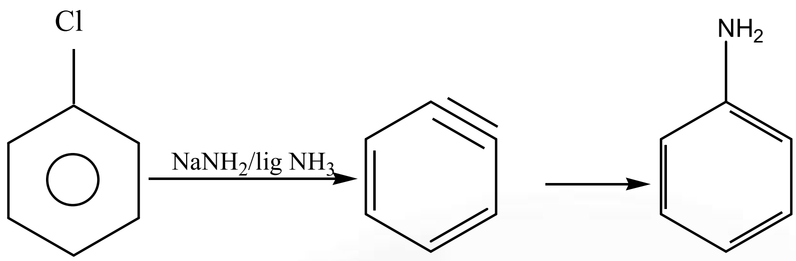
S_N^2



68. Compound (Y) is 1^0-amine.

69. Basic strength $\propto \frac{1}{stability\ of\ Anion}$

70.



71. $\dfrac{4mL}{M} = \left(\dfrac{\%(w/w)\times d\times 10}{molar\,mass}\right) \quad = \dfrac{(29.2)\times 1.25\times 10}{36.5} = 10M$

According to dilution, eqn, $M_iV_i = M_fV_f$

$V_f = \dfrac{0.4\times 100}{10} = 4mL$

72. $\dfrac{16/3}{4/3} = 4$

73. (i),(ii),(iv),(vi)

74. $C_4H_{10}O$

$H_3C-CH_2-CH_2-CH_2-OH$

$H_3C-\overset{\displaystyle CH_3}{\underset{\displaystyle OH}{C}}-C-CH_3$

$H_3C-CH_2-CH-CH_3$

$H_3C-\overset{\displaystyle CH_3}{\underset{\displaystyle H}{C}}-CH_2-OH$

75. (i),(iii),(iv),(v)