SOLUTIONS

Joint Entrance Exam | IITJEE-2025

24th JANUARY 2025 | Evening Shift

MATHEMATICS

SECTION – 1

1.(2) The number of points where function is not continuous is 4 namely –1, 0, 1, 2

$\Rightarrow m = 4$

And the number of points where function is non-differentiable is 4, namely –1, 0, 1, 2

$\Rightarrow n = 4$

$m + n = 8$

2.(1) Assuming S_n is the sum to n terms.

$S_{40} = 1030 \Rightarrow S_{12} = 57$

Set a be the first term and d be the common difference

$$\frac{40}{2}(2a + 39d) = 1030$$

$4a + 78d = 103$ ...(A)

$$\frac{12}{2}(2a + 11d) = 57$$

$12a + 66d = 57$ ...(B)

Solving (A) and (B)

$$a = \frac{-7}{2}, d = \frac{3}{2}$$

$$S_{30} = 15\left(-7 + 29 \cdot \frac{3}{2}\right) \quad \Rightarrow \quad S_{10} = 5\left(-7 + 9 \cdot \frac{3}{2}\right)$$

$S_{30} - S_{10} = 515$

3.(4) $f(x) = 2\log(x - 2) - x^2 + ax + 1$

Obviously $x > 2$

$$f'(x) = \frac{2}{x - 2} - 2x + a$$

$f'(3) = 0$

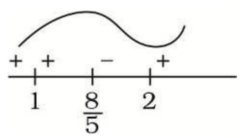
$2 - 6 + a = 0 \quad \Rightarrow \quad a = 4$

$g(x) = (x - 1)^3 (x - 2)^2$

$$g'(x) = 3(x - 1)^2 (x - 2)^2 + 2(x - 1)^3 (x - 2)$$

$$= (x - 1)^2 (x - 2)(3(x - 2) + 2(x - 1))$$

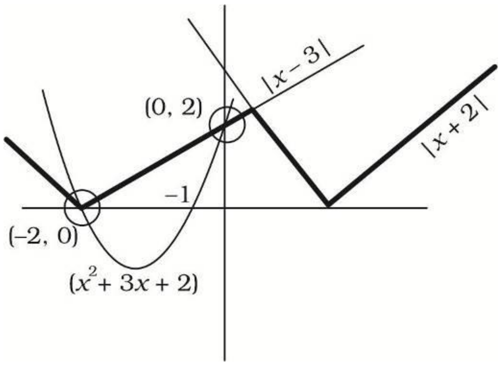
$$= (x - 1)^2 (x - 2)(5x - 8)$$



$$b = \frac{8}{5}, c = 2$$

$$100(a + b - c) = 100\left(4 + \frac{8}{5} - 2\right) = 100\left(2 + \frac{8}{5}\right) = 200 + 160 = 360$$

4.(4)



5.(2) The equation of the chord is $T = S_1$

$$\frac{3x}{25}+\frac{y}{16}=\frac{9}{25}+\frac{1}{16}$$

$48x + 25y = 144 + 25 \quad \Rightarrow \quad 48x + 25y = 169$

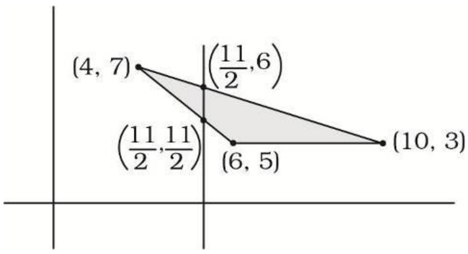
6.(4) $7 = 5+\frac{1}{7}(5+\alpha)+\frac{1}{7^2}(5+2\alpha)+\frac{1}{7^3}(5+3\alpha)+\ldots \quad \Rightarrow \quad 2=\frac{1}{7}(5+\alpha)+\frac{1}{7^2}(5+2\alpha)+\frac{1}{7^3}(5+3\alpha)+\ldots$

$\Rightarrow \frac{2}{7}= \quad +\frac{1}{7^2}(5+\alpha)+\frac{1}{7^3}(5+2\alpha)+\ldots \quad \Rightarrow 2-\frac{2}{7}=\frac{1}{7}(5+\alpha)+\frac{1}{7^2}\alpha+\frac{1}{7^3}\alpha+\ldots$

$\Rightarrow 1=\frac{\alpha}{7}+\frac{\alpha}{7^2}+\frac{\alpha}{7^3}+\ldots=\frac{\frac{\alpha}{7}}{1-\frac{1}{7}} \quad \Rightarrow 1=\frac{\alpha}{6}$

$\Rightarrow \alpha = 6$

7.(2) Least value



$$\frac{\alpha-5}{\frac{11}{2}-6}=\frac{7-\alpha}{4-\frac{11}{2}}$$

$\Rightarrow \frac{\alpha-5}{-1}=\frac{7-\alpha}{-3}$

$\Rightarrow 3(\alpha-5)=7-\alpha$

$\Rightarrow 4\alpha = 22 \Rightarrow \alpha=\frac{11}{2}$

Max value

$$\frac{\alpha-3}{\frac{11}{2}-10}=\frac{7-\alpha}{4-\frac{11}{2}}$$

$\Rightarrow \frac{\alpha-3}{-9}=\frac{7-\alpha}{-3} \quad \Rightarrow \alpha-3=3(7-\alpha)$

$\Rightarrow 4\alpha = 24$

$\Rightarrow \alpha = 6$

Product $=\frac{11}{2}\cdot 6 = 33$

8.(1) Possible cases

A	*B*
$4B, 1G$ $(7C_4 \cdot 3C_1)$	$0B, 3G$ $(5C_3)$
$3B, 2G$ $(7C_3 \cdot 3C_2)$	$1B, 2G$ $(6C_1 \cdot 5C_2)$
$2B, 3G$ $(7C_2\ 3C_3)$	$2B, 1G$ $(6C_2 \cdot 5C_1)$

Adding all of these cases, we get number of ways to be 8925

9.(4) $x^2 f'(x) = 2x.f(x) + 3$

$$\Rightarrow \quad \frac{f'(x)}{x^2} - \frac{2}{x^3} f(x) = \frac{3}{x^4}$$

$$\frac{d}{dx}\left(\frac{f(x)}{x^2}\right) = \frac{3}{x^4}$$

$$\Rightarrow \quad \frac{f(x)}{x^2} = \frac{3}{-3} \cdot \frac{1}{x^3} + C$$

$$\frac{f(x)}{x^2} = -\frac{1}{x^3} + C$$

$$\Rightarrow \quad f(x) = -\frac{1}{x} + Cx^2$$

$$f(1) = 4$$

$\Rightarrow 4 = -1 + C \qquad \Rightarrow C = 5$

$f(x) = -\frac{1}{x} + 5x^2 \qquad \Rightarrow \qquad f(2) = -\frac{1}{2} + 20$

$2f(2) = -1 + 40 = 39$

10.(2) $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$

Total number of matrices possible = $2^4 = 16$

For det(A) = 0

$ad - bc = 0$

number of invertible matrices possible = 3·3 + 1·1 = 10

Probability of A being non-invertible matrix, $P(E) = \frac{6}{16} = \frac{3}{8}$

11.(2) $\vec{a} = 3\hat{i} - \hat{j} + 2\hat{k}$

$$\vec{b} = \vec{a} \times (\hat{i} - 2\hat{k}) = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 3 & -1 & 2 \\ 1 & 0 & -2 \end{vmatrix} = 2\hat{i} + 8\hat{j} + \hat{k}$$

$$\vec{c} = \vec{b} \times \hat{k} = -2\hat{j} + 8\hat{i}$$

Projection of $(\vec{c} - 2\hat{j})$ on $\vec{a} = (\vec{c} - 2\hat{j}) \cdot \frac{(3\hat{i} - \hat{j} + 2\hat{k})}{\sqrt{14}} = (8\hat{i} - 4\hat{j}) \cdot \frac{(3\hat{i} - \hat{j} + 2\hat{k})}{\sqrt{14}} = \frac{24 + 4}{\sqrt{14}} = \frac{28}{\sqrt{14}} = 2\sqrt{14}$

Projection $= 2\sqrt{14}$

12.(2) $A = {}^{2n-1}C_{29}$

$B = {}^{2n-1}C_{11}$

$2 \cdot {}^{2n-1}C_{29} = 5 \cdot {}^{2n-1}C_{11}$

$\frac{2.(2n-1)!}{29!(2n-30)!} = \frac{5 \cdot (2n-1)!}{11!(2n-12)!} \quad \Rightarrow (2n-29)(2n-28).....(2n-12) = 13 \cdot 14 \cdot 15.....29 \cdot 30$

$2n - 12 = 30 \qquad \Rightarrow n = \frac{42}{2} = 21$

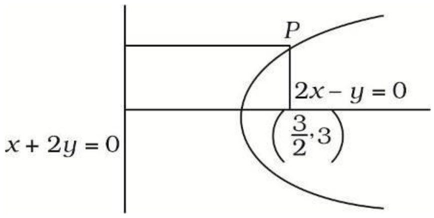
13.(4) The latus rectum is $= \frac{4\left|\frac{3}{2}+6\right|}{\sqrt{5}} = \frac{30}{\sqrt{5}}$

Equation of axis

$2x - 4 + C = 0$

$3 - 3 + C = 0$

The parabola is



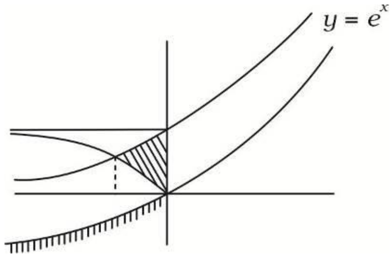
$\left(\frac{2x-y}{\sqrt{5}}\right)^2 = \frac{30}{\sqrt{5}} \frac{|x+2y|}{\sqrt{5}}$

$(2x-y)^2 = 30\,|\,(x+2y)\,|$

$\alpha = 4, \beta = 1, \gamma = 4$

$\alpha + \beta + \gamma = 9$

14.(4) $e^x = 1 - e^x \qquad \Rightarrow e^x = \frac{1}{2} \qquad \Rightarrow x = \log\left(\frac{1}{2}\right)$



Area $= \int_{\log\left(\frac{1}{2}\right)}^{0} e^x dx - \int_{\log\left(\frac{1}{2}\right)}^{0} (1-e^x)dx$

$= 2\int_{\log\frac{1}{2}}^{0} e^x dx - \int_{\log\frac{1}{2}}^{0} dx = 2\left[e^x\right]_{\log\frac{1}{2}}^{0} - \left[x\right]_{\log\frac{1}{2}}^{0} = 2\left(1-\frac{1}{2}\right) - \log\frac{1}{2} = 1 - \log\frac{1}{2}$

15.(3) $\log_{\frac{2}{\pi}} |\sin x \cos x| = 2$

$|\sin x \cos x| = \left(\frac{2}{\pi}\right)^2$

$|\sin 2x| = \frac{8}{\pi^2} < 1$

$2x \in (0, 2\pi)$

So 4 such elements

$(\sqrt{x} - 2 + 2)(\sqrt{x} - 2 - 2) - 3\left|\sqrt{x} - 2\right| + 6 = 0$

Say $\sqrt{x} - 2 = t$

$t^2 - 4 - 3\,|\,t\,| + 6 = 0$

$|\,t\,|^2 - 3\,|\,t\,| + 2 = 0$

$|\,t\,| = 1$ or $|\,t\,| = 2$

$\sqrt{x} - 2 = \pm 1$ or $\sqrt{x} - 2 = \pm 2 \qquad \Rightarrow x = 9, 1$ or $= 0, 16$

$n\left(A \cup B\right) = 8$

16.(4) For the equations to have infinitely many solution

$$4(x+2y-3z-2)+5(2x+\lambda y+5z-5)=14x+3y+\mu z-33$$

$$\Rightarrow\ 8+5\lambda=3 \quad \Rightarrow\ \lambda=-1$$

$$-12+25=\mu$$

$$\Rightarrow\ \mu=13$$

$$\lambda+\mu=12$$

17.(1) $$\lim_{x\to 0} f(x)=\begin{vmatrix} a+1 & 1 & b \\ a & 2 & b \\ a & 1 & b+1 \end{vmatrix}=a+b+2$$

$$(\lambda+\mu+\upsilon)^2=16$$

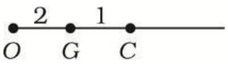
18.(1) $$\tan^{-1}\left(\frac{\alpha-\beta}{1+\alpha\beta}\right)+\tan^{-1}\left(\frac{\beta-\gamma}{1+\beta\gamma}\right)$$

$$\pi+\tan^{-1}\left(\frac{\gamma-\alpha}{1-\gamma\alpha}\right)=\pi$$

19.(2) Centroid $=\left(\dfrac{\vec{p}+\vec{q}+\vec{r}}{3}\right)$

Orthocentre $=\left(\dfrac{\vec{p}+\vec{q}+\vec{r}}{4}\right)$

Circumcentre $=\alpha\vec{p}+\beta\vec{q}+\gamma\vec{r}$



$$\frac{2(\alpha\vec{p}+\beta\vec{q}+\gamma\vec{r})+\left(\dfrac{\vec{p}+\vec{q}+\vec{r}}{4}\right)}{3}$$

$$=\frac{(\vec{p}+\vec{q}+\vec{r})}{3} \quad \Rightarrow\ 2\alpha+\frac{1}{4}=1 \quad \Rightarrow\ 2\beta+\frac{1}{4}=1 \quad \Rightarrow\ 2\gamma+\frac{1}{4}=1$$

$$\alpha+2\beta+5\gamma=8\alpha=3$$

Assume $\vec{p}, \vec{q}, \vec{r}$ are linearly independent

20.(1) $$f(x)=\frac{2^x-2^{-x}}{2^x+2^{-x}}$$

Say $2^x=t$

$$t\in(0,\infty)=\frac{t^2-1}{t^2+1}=1-\frac{2}{t^2+1}$$

One-one and odd function so range $(-1,\ 1)$

SECTION – 2

21.(957) $(2\lambda+1, 3\lambda-1, 4\lambda)$

$2(2\lambda-6)+3(3\lambda+1)+4(4\lambda-5)=0$

$29\lambda-29=0$

$\lambda=1$

(3, 2, 4)

Image = $P \equiv (-1, 6, 3)$

$R \equiv (5, 5, 8) \quad \Rightarrow \quad Q \equiv (7, -2, 5)$

$(\text{Area})^2 = 957$

22.(1) $2\cos x \dfrac{dy}{dx} + 4y\sin x = \sin 2x \quad \Rightarrow \quad \cos x \dfrac{dy}{dx} + 2y\sin x = \sin xGx$

$\sec^2 x \dfrac{dy}{dx} + 2\tan x \sec^2 x)y = \tan x \sec x \quad \Rightarrow \quad \dfrac{d}{dx}(y\sec^2 x) = \dfrac{d}{dx}(\sec x)$

$y\sec^2 x = \sec x + C \quad \Rightarrow \quad y = C\cos^2 x + \cos x$

$y\left(\dfrac{\pi}{3}\right) = \dfrac{C}{4} + \dfrac{1}{2} = 0$

$C = -2$

$y = \cos x - 2\cos^2 x$

$\dfrac{dy}{dx} = -\sin x + 4\cos x \sin x$

$y\left(\dfrac{\pi}{4}\right) + y'\left(\dfrac{\pi}{4}\right) = 1$

23.(392) $2^2 \times 98_{C_1} = 392$

24.(55) $\dfrac{2b^2}{a} = 15\sqrt{2} \quad \Rightarrow \quad e^2 = 1 + \dfrac{b^2}{a^2} = \dfrac{5}{2} \Rightarrow \dfrac{b^2}{a^2} = \dfrac{3}{2}$

Similarly $\dfrac{2B^2}{A} = 12\sqrt{5}$

$e_2^2 = 1 + \dfrac{A^2}{B^2}$ and it is given that

$2a \cdot 2B = 100\sqrt{10}$

Solve to get $25e_2^2 = 55$

25.(16) $\int \frac{2x^2+5x+9}{\sqrt{x^2+x+1}}dx = \int \frac{2\left(x^2+x+1\right)+3x+7}{\sqrt{x^2+x+1}}dx = 2\int \sqrt{x^2+x+1}\,dx + \int \frac{(3x+7)dx}{\sqrt{x^2+x+1}}$

$\frac{\int \frac{3}{2}\left(2x+1\right)+\left(7-\frac{3}{2}\right)}{\sqrt{x^2+x+1}}dx$

$= \frac{7}{2}\sqrt{1+x+x^2} + x\sqrt{1+x+x^2} + \frac{25}{4}\sin^{-1}\left(\frac{1+2x}{\sqrt{3}}\right)$

$\alpha + 2\beta = \frac{7}{2} + \frac{25}{2} = 16$

PHYSICS

SECTION – 1

26.(1) $\left(1-\frac{2x}{x_0}\right) = \cos t \Rightarrow \qquad x_{(L)} = \frac{x_0}{2}\left(1-\cos t\right)$

$\frac{dx}{dt} = \upsilon = \frac{x_0}{2}\left(+\sin t\right)$

$\upsilon = \frac{x_0}{2}\sin t$

$\upsilon = \frac{x_0}{2}\sqrt{1-\left(\frac{1-2x}{x_0}\right)^2} \quad \Rightarrow \quad \upsilon^2 = \frac{x_0^2}{4}\left(1-1-\frac{4x^2}{x_0^1}+\frac{4x}{x_0}\right) \quad = \frac{x_0^2}{4}\left(-4\frac{x^2}{x_0^2}+\frac{4x}{x_0}\right)$

Coefficient of x is –ve hence

27.(3) I_B = bigger circle = zero as $i_{enclosed}$ zero

$I_B \frac{n\times q\times \omega}{2\pi}$

$I_A - I_B = \frac{Nq\omega}{2\pi}$

28.(1) Theoretical

29.(3) $Q = \Delta U + W \quad \Rightarrow \quad Q = \frac{\pi\times(100)^2}{2}$

30.(1) $\frac{kg^2}{r^2} = 9\times 10^{-3}$

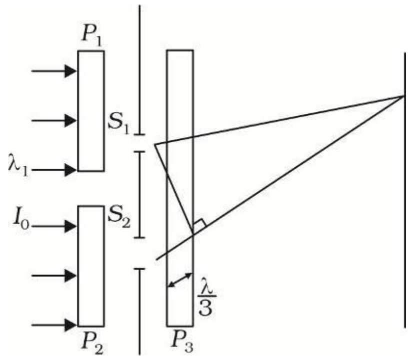
$\frac{9\times 10^9\times(2\times 10^{-8})^2}{r^2} = 9\times 10^{-3}$

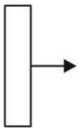
31.(2) $r = 5t^2\hat{i} - 5t\hat{j}$

$\frac{d\vec{r}}{dt} = 10t\hat{i} - 5\hat{j} \quad \Rightarrow \quad \vec{\upsilon} = 20\hat{i} - 5\hat{j}$

$|\vec{\upsilon}| = \sqrt{400+25}$

32.(3) $I_0 \cos^2 \phi$



 $\frac{I_0}{2} \to \frac{I_0}{2}\cos^2 45 = \frac{I_0}{2} \times \frac{1}{2}$

$\frac{I_0}{4}$

$\Delta x = \frac{\lambda}{3} \Rightarrow \Delta\phi = \frac{2\pi}{\lambda} \times \frac{\lambda}{3} = \frac{2x}{3}$

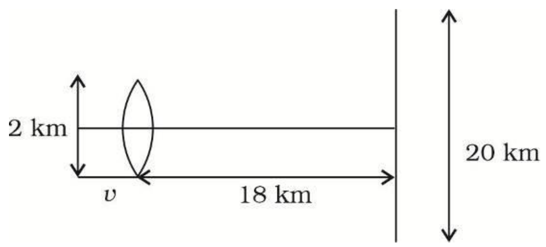
$I_{net} = 4\left(\frac{I_0}{4}\right)\cos^2\left(\frac{\pi}{3}\right) = \frac{I_0}{4}$

33.(4) $h\upsilon - eV_0 = KE_{max}$

$eV_0 = h\upsilon - KE_{max}$

$V_0 = \frac{h\upsilon}{e} - \frac{KE_{max}}{e}$

34.(2) $h_0 = 10^1 m$



$h_i = 10^{-2} m$

$\mu = 18 \times 10^3 m$

$\frac{\upsilon}{u} = \frac{h_i}{h_0} \Rightarrow \upsilon = \frac{10^{-2}}{10^4} \times 18 \times 10^3$

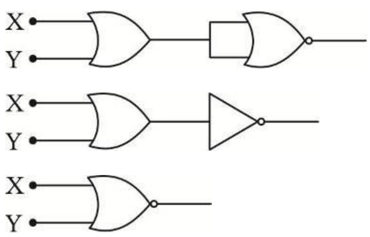
$\approx 18 \times 10^3 m = 1.8 cm$

35.(2) Theoretical

36.(4) $\frac{L.D}{dy} = \frac{690 \times 10^{-9} \times 0.72}{1.5 \times 10^{-3}}$

Wave length $= \frac{L}{4}$

37.(2)



X	Y	Output
0	0	1
0	1	0
1	0	0
1	1	0

38.(4) $\sqrt{\left(\frac{a}{2}\right)^2+\left(\frac{a}{2}\right)^2} \Rightarrow \sqrt{2\frac{a^2}{4}}=\frac{a}{\sqrt{2}} \Rightarrow \sqrt{\left(\frac{a}{\sqrt{2}}\right)^2+\left(\frac{a}{\sqrt{2}}\right)^2}=\sqrt{\frac{a^2}{2}+\frac{a^2}{2}}$

Case-I

$$4\frac{Kq_0^2}{a}+\frac{Kq_0^2}{\sqrt{2}a}\times 2$$

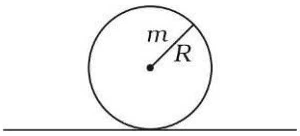
$$\frac{Kq_0^2}{q}\left(4+\sqrt{2}\right)$$

Case-2

$$\frac{Kq_0^2}{a}\times\sqrt{2}\times 4+\frac{Kq_0^2}{a}\times 2 \Rightarrow \frac{Kq_0^2}{a}\left(4\sqrt{2}+2\right)$$

$$\frac{Kq_0^2}{a}\left\{4\sqrt{2}+2-4=\sqrt{2}\right\} \Rightarrow \frac{Kq_0^2}{a}\left\{3\sqrt{2}-2\right\}$$

39.(2) $T.KE=\frac{1}{2}mv^2$



$$R.KE=\frac{1}{2}I_{com}\omega^2$$

$$=\frac{1}{2}\times\frac{2mR^2}{5}\times\left(\frac{V}{R}\right)^2$$

$$\frac{mV^2}{5}$$

40.(2) $E^2=pc^2+m^2c^4$

41.(4) $I_{com}=KMR^2$

$$S=\frac{1}{2}at^2 \Rightarrow a=\frac{g\sin\theta}{1+\frac{I_{com}}{MR^2}} \Rightarrow a=\frac{g\sin\theta}{1+k}$$

Solid sphere $k=\frac{2}{5}$

Hollow sphere $k=\frac{2}{3}$

$$a_{ss}>a_{hs}\Rightarrow t_{(ss)_1}<t_{(hs)_2}$$

42.(2) $-\frac{dT}{at}=K(T-T_0) \Rightarrow -\frac{164}{4}=K(32-16)$

$$K=\frac{4}{16}=\frac{1}{4}$$

$$\frac{(24-\tau')}{4}=\frac{1}{4}\left(\frac{24+\tau'}{2}-16\right)$$

$$T'=\frac{56^\circ}{3}$$

43.(2) $^{\circ}C = \frac{5}{9} \times F^{\circ} - 32 \times \frac{5}{9}$

$y = mx + C$

44.(2) $F = q(\vec{V} \times \vec{B})$

$\vec{v} \parallel B$

$F = 0$

45.(4) $\times PV^{r} = \text{const}$

$PV = nRT$

Free expansion is fast and irreversible

SECTION – 2

46.(250) $\mu_0 ni = B$

$q(\vec{V} \times \vec{B}) = \frac{mv^2}{R} \quad \Rightarrow \quad v = \frac{qBR}{m}$

$T = \frac{2\pi R}{v} = \frac{2\pi Rm}{qBR} = \frac{2\pi m}{Bq} \quad \Rightarrow \quad 75 \times 10^{-9} = \frac{2\pi m}{\mu_0 niq}$

47.(43) $B = \frac{P}{\left(-\frac{dV}{V}\right)} \Rightarrow 2.15 \times 10^{9} = \frac{P}{0.002}$

48.(9) $\frac{GM}{R^2} = g \qquad 4\frac{GM}{\left(\frac{D}{3}\right)^2} = 9g \quad \Rightarrow \quad \frac{GM}{\left(\frac{D}{2}\right)^2} = g \quad \Rightarrow \quad g = \frac{GM}{D^2} \times 4$

49.(5) $\text{Power} = \frac{\text{Energy}}{\text{time}} \qquad \frac{P_1}{P_2} = 2$

$\frac{P_1 = 2 \times 10^{15} \times \frac{h \times c}{600 \times 10^{-9}}}{P_2 = n \times \frac{h \times c}{300 \times 10^{-9}}} \quad \Rightarrow \quad \frac{P_1}{P_2} = 2 = \frac{2 \times 10^{15}}{n} \times \frac{1}{2} \quad \Rightarrow \quad n = 5 \times 10^{14}$

50.(36) $\frac{3}{\pi} \times 2\pi rad/\sec$

$6\ rad/sec$

$T \sin\theta = \frac{mv^2}{R}$

$T \cos\theta = mg$

$T \times \frac{R}{L} = m \times \frac{w^2 R^2}{R}$

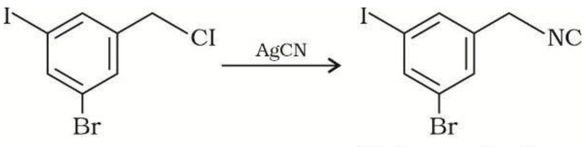
$T = mw^2 L = 36\ L$

CHEMISTRY

SECTION – 1

51.(3) Activating groups like $-OCH_3, -NHCOCH_3$ and $OH^{\ominus}$ are ortho and para directing groups.
Deactivating groups like $-CN$ and $-SO_3H$ are meta directing group.

52.(4)

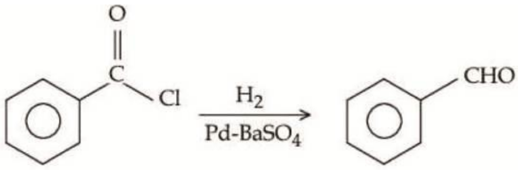


(Major product)

Nucleophilic substitution at sp^3 carbon is faster than nucleophilic substitution at sp^2 carbon.

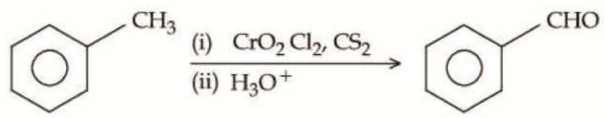
53.(3) **(A)** $RCN \xrightarrow[(ii)\,H_3O^+]{(i)\,SnCl_2, HCl} RCHO$ Stephen reaction

(B)



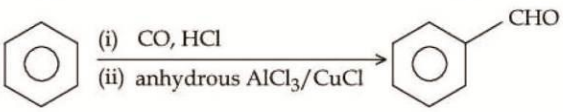
Rosenmund reduction

(C)



Etard reaction

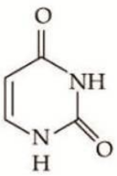
(D)



Gatterman-Koch reaction

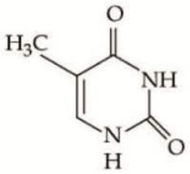
54.(2)

(I)



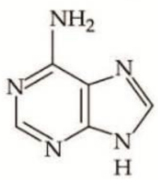
Uracil

(II)



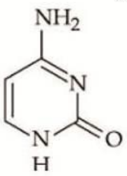
Thymine

(III)



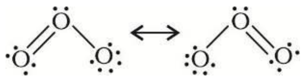
Adenine

(IV)



Cytosine

55.(4) The two oxygen-oxygen bond lengths in the ozone molecule are identical (128 pm) and the molecule is angular as expected with a bond angle of about 117°. It is a resonance hybrid of two main forms:



56.(2)

%Composition			Simplest ratio
C = 54.2%	$\frac{54.2}{12}$	4.5	$\frac{4.5}{2.28} \approx 2$
H = 9.2%	$\frac{9.2}{1}$	9.2	$\frac{9.2}{2.28} \approx 4$
0 = 36.6%	$\frac{36.6}{16}$	2.28	$\frac{2.28}{2.28} = 1$

Empirical formula: C_2H_4O

Molar mass = 132 g/mol

Molecular formula : $C_6H_{12}O_3$

57.(1) Concentration of $H_2(g)$ and $I_2(g)$ will decrease with time and concentration of HI will increase till equilibrium.

58.(2) Weak field ligand and high spin complex.

59.(4) More the number of equivalents neutralized, more will be the amount of energy released. Hence the temperature rise is more.

60.(1)

Ti^{3+} = $3d^1$ 1.73
V^{2+} = $3d^3$ 3.87
Ni^{2+} = $3d^8$ 2.84
Sc^{3+} = $3d^\circ$ 0.00

Spin only magnetic moment $\mu = \sqrt{n(n+2)}$ B.M

61.(1) $S(g) + \frac{3}{2}O_2(g) \rightarrow SO_3(g) \quad \Delta H = -2x\,Kcal$

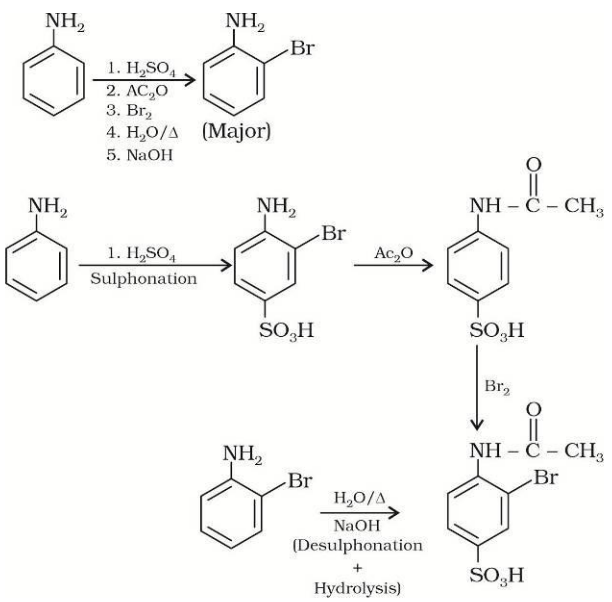
$SO_2(g) + \frac{1}{2}O_2(g) \rightarrow SO_3(g) \quad \Delta H = -y\,Kcal$

$S(g) + O_2(g) \rightarrow SO_2(g) \quad \Delta H = y - 2x\,Kcal$

62.(4) $CoS \xrightarrow{\text{aqua-regia}} \xrightarrow[(2)\,CH_3COOH]{(1)\,KNO_2/NH_4OH} \underset{\text{Yellow ppt}}{K_3[CO(NO_2)_6]}$

63.(4) Group 13 (Boron)

64.(2)



65.(1) $t_{1/2}$ is independent of initial concentration.

$$\ln\frac{[R]}{[R]_0} = \frac{-K}{2.303}(t)$$

66.(3) For single electron species;

$3P_x, 3d_{x^2-y^2}$ and $3d_{z^2}$ orbitals have lowest energy

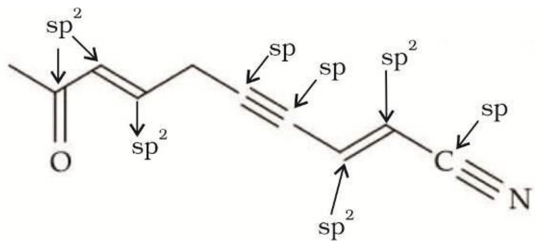
67.(4) $\underset{\text{Green}}{[Ni(H_2O)_6]Cl_2} \xrightarrow{en} \text{Pale Blue} \xrightarrow{en} \text{Blue} \xrightarrow{en} \text{Violet}$

68.(4)

		Si	Ge
First I.E (kJ / mol)	:	786	761

69.(3) $E^\circ_{Cr/Cr^{+3}} = +0.74\,V$ strongest reducing agent.

70.(4)



sp = 3

$sp^2 = 5$

SECTION – 2

71.(3) Hydrocarbon : Molar mass = 80 g/mol.

C : 90% = 72 g

H : 10% = 8 g

C_6H_8

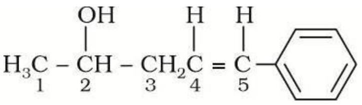
Degree of unsaturation = (6 + 1) – (8/2) = 7 – 4 = 3

72.(255) $\%\text{ of Bromine} = \frac{80 \times 0.15}{188 \times 0.25} \times 100 = 25.53$

73.(20) $K = \sqrt{\frac{K_1 \cdot K_3}{K_2}}$

Overall energy of activation $= \frac{1}{2}(60) + \frac{1}{2}(10) - \frac{1}{2}(30) = 30 + 5 - 15 = 20$ kJ/mol

74.(4) 5-Phenyl pent-4-en-2-ol



Number of stereocentres = 2

Possible isomers $= 2^2 = 4$

75.(75) $MX_2 \rightarrow M^{2+} + 2X^-$ $\qquad n = 3$

$$i = \frac{65.6}{164} = 2.5$$

$$i = 1 + (n-1)\alpha$$

$$i = 1 + 2\alpha$$

$$2.5 = 1 + 2\alpha$$

$$\alpha = 0.75$$

=75%