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04-Apr-2026 Shift-I JEE Main-2026 Session-II (Apr)

MATHEMATICS **Max Marks: 100**

SECTION-I
(SINGLE CORRECT ANSWER TYPE)

This section contains **20 Multiple Choice Questions.** Each question has 4 options (1), (2), (3) and (4) for its answer, out of which ONLY ONE option can be correct.

Marking scheme: +4 for correct answer, 0 if not attempted and –1 in all other cases.

1. Let [.]denote the greatest integer function. If the domain of the function $f(x)=\cos^{-1}\left(\frac{4x+2[x]}{3}\right)$ Is$[\alpha,\beta]$, then $12(\alpha+\beta)$ is equal to:

1) 6 2) 8 3) 9 4) 4

Key: 1

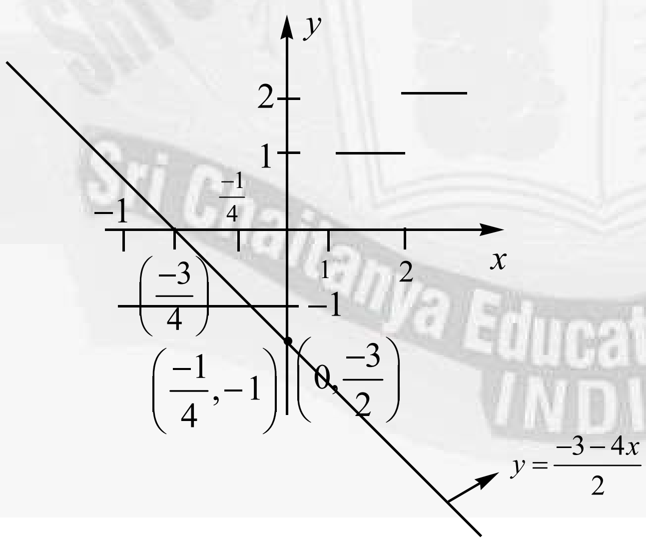
Sol: $-1\le\frac{4x+2[x]}{3}\le 1$

$\Rightarrow -3\le 4x+2[x]\le 3$

$\Rightarrow \frac{-3-4x}{2}\le[x]\le\frac{3-4x}{2}$

Case – (i):

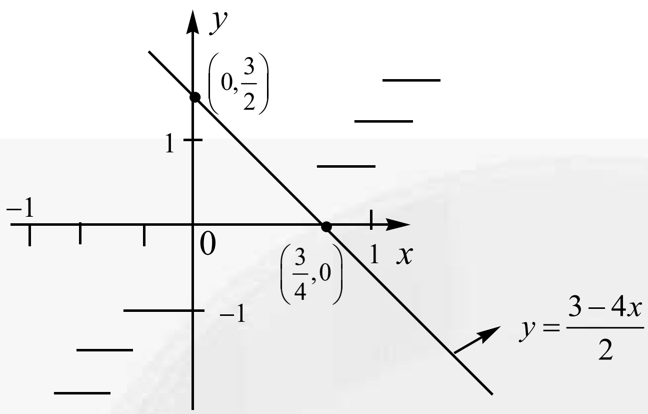
$\frac{-3-4x}{2}\le[x]$From the graphs of $y=\frac{-3-4x}{2}$and $y=[x]$



$x\ge\frac{-1}{4}$ ----(1)

Case – (ii):

$[x] \le \frac{3-4x}{2}$



$x \le \frac{3}{4}$ - - - - (2)

From (1) and (2) $x \in \left[\frac{-1}{4},\frac{3}{4}\right]=[\alpha,\beta]$

2. If the set of all solutions of $\left|x^2+x-9\right|=|x|+\left|x^2-9\right|$ is $[\alpha,\beta]\cup[\gamma,\beta)$ then $\left(\alpha^2+\beta^2+\gamma^2\right)$ is equal to:

1) 9 2) 18 3) 36 4) 72

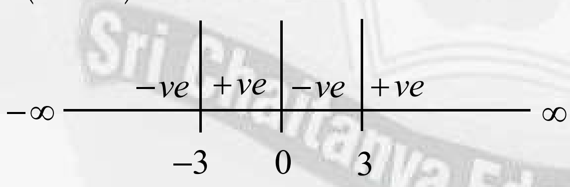
Key: 2

Sol: $\left|x^2+x-9\right|=|x|+\left|x^2-9\right|$

$\left|x^2-9+x\right|=|x|+\left|x^2-9\right|$, $|a+b|=|a|+|b|$ is true for a,b are of same sign

Here $x,\left(x^2-9\right)$ are of same sign

$x\left(x^2-9\right)\ge 0 \Rightarrow (x+3)(x)(x-3)\ge 0$



$x\in[-3,0]\cup[3,\infty)=[\alpha,\beta]\cup[\gamma,\infty)$

$\alpha=-3, \beta=0, \gamma=3$

So $\alpha^2+\beta^2+\gamma^2=18$

3. Let z be a complex number such that $|z+2|=|z-2|$ and arg $\left(\frac{z+3}{z-i}\right)=\frac{\pi}{4}$. Then $|z|^2$ is equal to:

1) 9 2) 4 3) 5 4) 1

Key: 1

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Sol: Let $z = x + iy$

$|z+2| = |z-2|$

$\Rightarrow (x+2)^2 + y^2 = (x-2)^2 + y^2$

$\Rightarrow x = 0$

$z = iy$

$$Arg\left(\frac{iy+3}{iy-i}\right) = \frac{\pi}{4} \Rightarrow Arg\left(\frac{-i(iy+3)}{y-1}\right) = \frac{\pi}{4}$$

$$Arg\left(\frac{y-3i}{y-1}\right) = \frac{\pi}{4}$$

$$Arg\left(\frac{y}{y-1} + i\left(\frac{-3}{y-1}\right)\right) = \frac{\pi}{4} \Rightarrow \frac{-3}{y-1} \times \frac{y-1}{y} = 1 \Rightarrow y = -3$$

So $z = 0 + i(-3) = -3i, |z| = 3 \Rightarrow |z|^2 = 9$

4. The number of functions $f:\{1,2,3,4\} \to \{a,b,c\}$, which are not onto, is:

1) 48 2) 45 3) 51 4) 35

Key: 2

Sol: $f:\{1,2,3,4\} \to \{a,b,c\}$

On to functions $= 3^4 - {}^3C_1 \cdot 2^4 + {}^3C_2 \cdot 1^4 - 0$

$= 81 - 48 + 3 = 36$

so Not on to functions = Total functions – on to functions

$= 3^4 - 36 = 81 - 36 = 45$

5. Let $S = \left\{ A = \begin{bmatrix} a & b \\ c & d \end{bmatrix} : a,b,c,d \in \{0,1,2,3,4\} \text{ and } A^2 - 4A + 3I = 0 \right\}$ be a set of 2×2 matrices. Then the number of matrices on S, for which the sum of the diagonal elements is equal to 4, is:

1) 20 2) 17 3) 21 4) 19

Key: 4

Sol: $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$, $a,b,c,d \in \{0,1,2,3,4\}$

$A^2 - 4A + 3I = 0$

$\Rightarrow a + d = Tr(A) = 4, \det(A) = 3 \Rightarrow ad - bc = 3$

Case (i): $a = 0, d = 4 \Rightarrow bc = -3$ as $b,c \in \{0,1,2,3,4\}, bc = -3$ Not possible

Case (ii): $a = 1, d = 3 \Rightarrow bc = 0 \Rightarrow b \in \{0,1,2,3,4\}$ & $c = 0 \to 5$

$c \in \{0,1,2,3,4\}$ & $b = 0 \to 5$

but $(b,c) = (0,0)$ repeated in both

So in this case we get No. of $A = 5+5-1 = 9$

Case (iii): $a = 3, d = 1 \Rightarrow bc = 0$, no. of $A = 5+5-1 = 9$

Case (iv): $a = 2, d = 2 \Rightarrow bc = 1$, no. of $A = 1$

So total number of A in set $S = 0+9+9+1 = 19$

6. Let $A = \begin{bmatrix} 1 & 1 & 2 \\ -2 & 0 & 1 \\ 1 & 3 & 5 \end{bmatrix}$. Then the sum of all elements of the matrix $adj\left(adj\left(2\left(adjA\right)^{-1}\right)\right)$ is equal to:

1) 3 2) 4 3) -4 4) -3

Key: 4

Sol: We know that $\left(AdjA\right)^{-1} = \frac{A}{|A|}$, $adj\left(adj\left(kA\right)\right) = k^{(n-1)^2} \cdot |A|^{n-2} \cdot A$

Here order of $A = n = 3, |A| = -4$

$\left(AdjA\right)^{-1} = \frac{A}{-4}$

So G.E $= adj\left(adj\left(2 \cdot \frac{A}{-4}\right)\right) = adj\left(adj\left(-\frac{A}{2}\right)\right)$

$= \left(-\frac{1}{2}\right)^4 \cdot (-4)^1 \cdot A = \frac{1}{16} \cdot -4 \cdot A = \frac{-1}{4} A$

Sum of elements of $\frac{-A}{4} = \frac{-1}{4}\left(1+1+2-2+0+1+1+3+5\right) = \frac{-12}{4} = -3$

7. The first term of an A.P. of 30 non-negative terms is $\frac{10}{3}$. If the sum of this A.P. is the cube of its last term, then its common difference is:

1) $\frac{5}{87}$ 2) $\frac{25}{83}$ 3) $\frac{15}{29}$ 4) $\frac{5}{29}$

Key: 1

Sol: $n = 30, a = \frac{10}{3}$, sum $= \frac{n}{2}\left(a + l\right) = l^3\left(Given\right)$

$15\left(\frac{10}{3} + l\right) = l^3 \Rightarrow l^3 - 15l - 50 = 0 \Rightarrow l = 5$

$a + \left(n-1\right)d = 5$

$\frac{10}{3} + 29d = 5 \Rightarrow d = \frac{5}{87}$

8. The number of ways, of forming a queue of 4 boys and 3 girls such that all the girls are not together

1) 5040 2) 3050 3) 3410 4) 4320

Key: 4

Sol: Required arrangements = total – all 3 girls together

$= 7! - 5!\cdot 3! = 5!(42-6) = 36\times 120 = 4320$

9. Let the smallest value of $k \in N$, for which the coefficient of x^3 in $(1+x)^3+(1+x)^4+(1+x)^5+...+(1+x)^{99}+(1+kx)^{100}, x\neq 0$ is $\left(43n+\frac{101}{4}\right)\left({}^{100}C_3\right)$ for some $n\in N$, be p. then the value of $p+n$ is

1) 10 2) 11 3) 12 4) 13

Key: 2

Sol: coefficient of $x^3 = {}^3C_3+{}^4C_3+{}^5C_3+{}^6C_3+{}^7C_3+------+{}^{99}C_3+{}^{100}C_3 k^3$

$= {}^4C_0+{}^4C_1+{}^5C_2+{}^6C_3+{}^7C_4+------+{}^{99}C_6+{}^{100}C_3k^3$

$=\left(use\ {}^nC_r+{}^nC_{r-1}={}^{(n+1)}C_r\right)$ we get ${}^{100}C_4+{}^{100}C_3k^3={}^{100}C_3\left(43n+\frac{101}{4}\right)$

${}^{100}C_4+{}^{100}C_3k^3={}^{100}C_3\cdot 43n+{}^{101}C_4$

${}^{100}C_3\left(k^3-43n\right)={}^{101}C_4-{}^{100}C_4={}^{100}C_4+{}^{100}C_3-{}^{100}C_4$

$\Rightarrow {}^{100}C_3\left(k^3-43n\right)={}^{100}C_3$

$k^3-43n=1$

$k^3=43n+1$

If $n=5, 43n+1=215+1=216=6^3$

So $P=6, n=5, n+p=11$

10. Suppose that the mean and median of the non-negative numbers $21,8,17,a,51,103,b,13,67,(a>b)$, are 40 and 21, respectively. If the mean deviation about the median is 26, then $2a$ is

1) 109 2) 117 3) 161 4) 131

Key: 4

Sol: $\frac{21+8+17+a+51+103+b+13+67}{9}=40$

$\Rightarrow a+b+280=360\Rightarrow a+b=80$ ….(1)

$8,13,17,b,21,51,a,67,103(a>b)$

Mean deviation about median $=26$

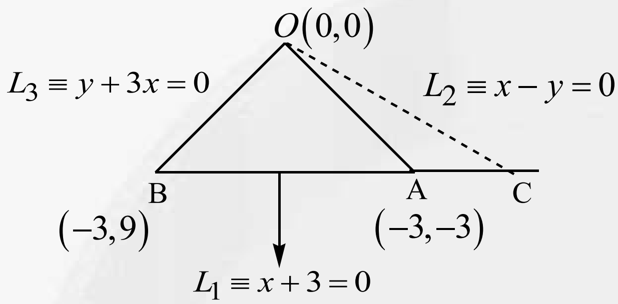
$\Rightarrow \sum\frac{|x_i-21|}{9}=26\Rightarrow a-b=51$ Solving (1) &(2) $2a=131$

11. Let the line $L_1 : x+3=0$ intersect the lines $L_2 : x-y=0$ and $L_3 : 3x+y=0$ at the points A and B, respectively. Let the bisector of the obtuse angle between the lines L_2 and L_3 intersect the line L_1 at the point C. Then $BC^2 : AC^2$ is equal to:

1) $5:1$ 2) $1:5$ 3) $2:3$ 4) $3:2$

Key: 1

Sol:



$OA=\sqrt{9+9}=3\sqrt{2}, OB=\sqrt{81+9}=3\sqrt{10}$

$\left(C:\overline{BA}\right)=CB:CA=OB:OA$ (Externally) $=3\sqrt{10}:3\sqrt{2}=\sqrt{5}:\sqrt{1}$ (Externally)

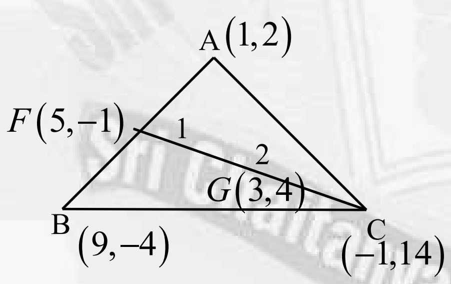
$\frac{BC^2}{CA^2}=\frac{5}{1}=5:1$

12. Let the vertex A of a triangle ABC be $(1,2)$, and the mid-point of the side AB be $(5,-1)$. If the centroid of this triangle is $(3,4)$ and its circumcenter is (α,β), then $21(\alpha+\beta)$ is equal to:

1) 309 2) 403 3) 497 4) 524

Key: 3

Sol:



From the given data we get $B(9,-4)$, $C(-1,14)$

Given $S(\alpha,\beta)$ be the circum centre so use $SA=SB=SC$

We get $4\alpha-3\beta=23$ and $-5\alpha+9\beta=25$

Solve these two equations we get $(\alpha,\beta)=\left(\frac{94}{7},\frac{215}{21}\right)$

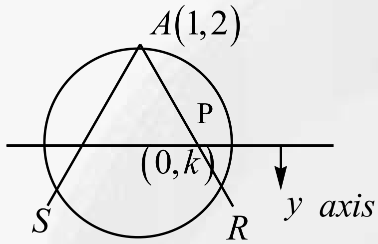
G.E $=21(\alpha+\beta)=\frac{21}{7}\left(94+\frac{215}{3}\right)=\frac{3}{3}(282+215)=497$

13. Suppose that two chords, drawn from the point $(1,2)$ on the circle $x^2+y^2+x-3y=0$ are bisected by the y-axis. If the other ends of these chords are R and S, and the midpoint of the line segment RS is (α,β), then $6(\alpha+\beta)$ is equal to:

1) 1 2) 3 3) 4 4) 6

Key: 2

Sol: Clearly $(1,2)$ lies on the circle $x^2+y^2+x-3y=0$



Let $p(0,k)$ point on y axis which is midpoint of $\overline{AR}$

Let $R(2.0-1,2k-2)=(-1,2k-2)$ lies on the circle $x^2+y^2+x-3y=0$

We get $k=1,\frac{5}{2}$

So $R(-1,0),S(-1,3)$

Midpoint of RS= $\left(-1,\frac{3}{2}\right)=(\alpha,\beta)$

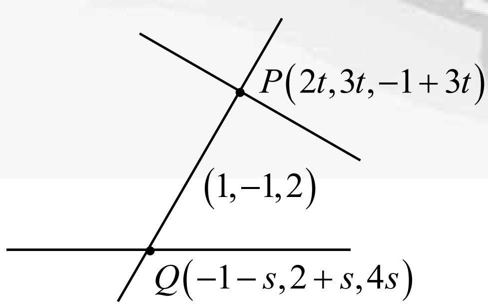
$So\ \ 6(\alpha+\beta)=6\left(\frac{1}{2}\right)=3$

14. A line with direction ratios $1,-1,2$ intersects the lines $\frac{x}{2}=\frac{y}{3}=\frac{z+1}{3}$ and $\frac{x+1}{-1}=\frac{y-2}{1}=\frac{z}{4}$ at the points P and Q, respectively. If the length of the line segment PQ is α, then $225\alpha^2$ is equal to:

1) 1024 2) 1014 3) 1104 4) 1204

Key: 2

Sol:



So d.r's of PQ are $(2t+1+s,3t-2-s,3t-1-4s)$

But PQ d.r's are $(1,-1,2)$

So $\frac{2t+1+s}{1}=\frac{3t-2-s}{-1}=\frac{3t-1-4s}{2}$

Solving $t=\frac{1}{5}, s=\frac{-8}{15}$

$P\left(\frac{2}{5},\frac{3}{5},\frac{-2}{5}\right), Q\left(\frac{-7}{15},\frac{22}{15},\frac{-32}{15}\right)$

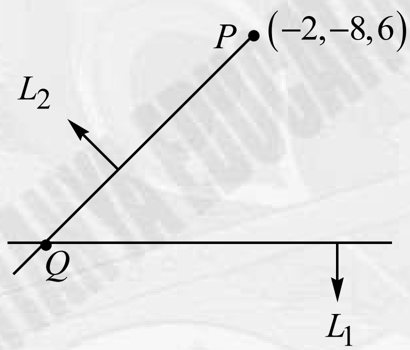
$PQ^2=\alpha^2$ so $225\alpha^2=169(1+1+4)=1014$

15. The square of distance of the point $(-2,-8,6)$ from the line $\frac{x-1}{1}=\frac{y-1}{2}=\frac{z}{-1}$ along the line $\frac{x+5}{1}=\frac{y+5}{-1}=\frac{z}{2}$ is equal to:

1) 3 2) 6 3) 8 4) 12

Key: 2

Sol:



$L_1=\frac{x-1}{1}=\frac{y-1}{2}=\frac{z}{-1}=t$

$L_2=\frac{x+5}{1}=\frac{y+5}{-1}=\frac{z}{2}=s$

Clearly $(-2,-8,6)$ lies on line L_2

Q be the point of intersection of lines L_1, L_2

Let $Q(t+1, 1+2t, -t)=(-5+s, -5-s, 2s)$

$\Rightarrow t=-4, Q=(-3,-7,4), (PQ)^2=1+1+4=6$

16. If $y=\tan^{-1}\left(\frac{3\cos x-4\sin x}{4\cos x+3\sin x}\right)+2\tan^{-1}\left(\frac{x}{1+\sqrt{1-x^2}}\right)$, then $\frac{dy}{dx}$ at $x=\frac{\sqrt{3}}{2}$

1) 3 2) -1 3) 1 4) 2

Key: 3

Sol: $y=\tan^{-1}\left(\dfrac{\frac{3}{5}\cos x-\frac{4}{5}\sin x}{\frac{4}{5}\cos x+\frac{3}{5}\sin x}\right)+2\tan^{-1}\left(\dfrac{x}{1+\sqrt{1-x^2}}\right)$

Put $x=\sin\theta$ in second term

$=\tan^{-1}\left(\dfrac{\sin(\alpha-x)}{\cos(\alpha-x)}\right)+2\tan^{-1}\left(\tan\dfrac{\theta}{2}\right)$

$y=\alpha-x+2\cdot\dfrac{\theta}{2}=\alpha-x+\sin^{-1}x$ where $\alpha=\tan^{-1}\left(\dfrac{3}{4}\right)$

$\dfrac{dy}{dx}=-1+\dfrac{1}{\sqrt{1-x^2}}$ at $x=\dfrac{\sqrt{3}}{2}$, $\left(\dfrac{dy}{dx}\right)_{x=\frac{\sqrt{3}}{2}}=-1+2=1$

17. Let f be a real polynomial of degree n such that $f(x)=f'(x)f''(x)$, for all $x\in\mathbb{R}$. If $f(0)=0$, then $36\left(f'(2)+f''(2)+\int_0^2 f(x)dx\right)$ is equal to:

1) 42 2) 46 3) 56 4) 66

Key: 3

Sol: $f(x)$ is polynomial of degree $'n'$ satisfying $f(x)=f'(x)\cdot f''(x)$

$\Rightarrow n=n-1+n-2 \Rightarrow n=3$

As $f(0)=0$, let $f(x)=ax^3+bx^2+cx$ put $f(x)$ in $f(x)=f'(x)\cdot f''(x)$

We get $a=\dfrac{1}{18},b=0,c=0 \Rightarrow f(x)=\dfrac{x^3}{18}, f'(x)=\dfrac{x^2}{6}, f''(x)=\dfrac{x}{3}$

$\int_0^2 f(x)dx=\dfrac{1}{18}\cdot\dfrac{1}{4}\cdot16=\dfrac{2}{9}$

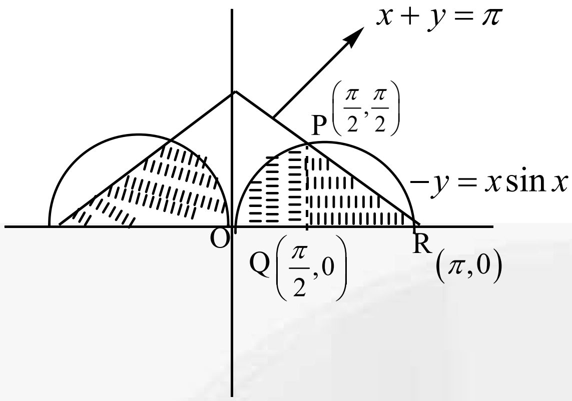
$G.E=36\left(\dfrac{2}{3}+\dfrac{2}{3}+\dfrac{2}{9}\right)=4(6+6+2)=56$

18. The area of the region $\{(x,y): y\le\pi-|x|, y\le|x\sin x|, y\ge0\}$ is

1) $1+\dfrac{\pi^2}{8}$ 2) $2+\dfrac{\pi^2}{4}$ 3) $\dfrac{\pi^2}{8}-1$ 4) $4+\dfrac{\pi^2}{2}$

Key: 2

Sol: Required area



$$= 2\left\{\int_0^{\frac{\pi}{2}} x\sin x dx + \frac{1}{2}.\frac{\pi}{2}.\frac{\pi}{2}\right\}$$

$$= 2\left\{(-x\cos x + \sin x)_0^{\pi/2} + \frac{\pi^2}{8}\right\}$$

$$= 2\left\{1 - (0+0) + \frac{\pi^2}{8}\right\} = 2 + \frac{\pi^2}{4}$$

19. Let $\int_{-2}^{2}\left(|\sin x| + [x\sin x]\right)dx = 2(3-\cos 2) + \beta$, where [.] is the greatest integer function. Then $\beta\sin\left(\frac{\beta}{2}\right)$ equals:

1) 1　　2) 2　　3) 4　　4) 8

Key: 2

Sol: $\int_{-2}^{2}\left(|\sin x| + [x\sin x]\right)dx = 2\int_0^2 \sin x dx + 2\int_0^2 [x\sin x]dx$

$$= -2(\cos x)_0^2 + 2\left\{\int_0^{\alpha} 0.dx + \int_{\alpha}^{2} 1.dx\right\} \quad [x\sin x] = \begin{cases} 0 \text{ if } 0 < x < \alpha \\ 1 \text{ if } \alpha \le x < 2 \end{cases}$$

Where α is such that $\alpha\sin\alpha = 1$

$= -2(\cos 2 - 1)$

$= 2(1-\cos 2) + 2\{0 + 2 - \alpha\}$

$= 2 - 2\cos 2 + 4 - 2\alpha = 6 - 2\cos 2 - 2\alpha$

$= 2(3-\cos 2) + (-2\alpha)$ but given $2(3-\cos 2) + \beta$

So $\beta = -2\alpha$

So $G.E = \beta.\sin\left(\frac{\beta}{2}\right) = (-2\alpha).\sin(-\alpha) = -2\alpha.\left(-\frac{1}{\alpha}\right) = 2$

20. Let $y = y(x)$ be the solution of the differential equation

$\frac{dy}{dx} = \left(1+x+x^2\right)\left(1-y+y^2\right), y(0) = \frac{1}{2}$. Then $\left(2y(1)-1\right)$ is equal to

1) $\sqrt{3}\tan\left(\frac{11\sqrt{3}}{6}\right)$ 2) $\frac{\sqrt{3}}{2}\tan\left(\frac{11\sqrt{3}}{12}\right)$ 3) $\sqrt{3}\tan\left(\frac{11\sqrt{3}}{12}\right)$ 4) $\frac{\sqrt{3}}{2}\tan\left(\frac{11\sqrt{3}}{6}\right)$

Key: 3

Sol: $\frac{dy}{y^2-y+1} = \left(x^2+x+1\right)dx \Rightarrow \int \frac{dy}{\left(y-\frac{1}{2}\right)^2+\left(\frac{\sqrt{3}}{2}\right)^2} = \int\left(x^2+x+1\right)dx$

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

Put $x=0, y=\frac{1}{2} \Rightarrow c=0$

Put $x=1$

$\frac{2}{\sqrt{3}}\tan^{-1}\left(\frac{2y-1}{\sqrt{3}}\right) = \frac{1}{3}+\frac{1}{2}+1+0 = \frac{11}{6} \Rightarrow \frac{2y-1}{\sqrt{3}} = \tan\left(\frac{11\sqrt{3}}{12}\right)$

$\Rightarrow 2y(1)-1 = \sqrt{3}\tan\left(\frac{11\sqrt{3}}{12}\right)$

SECTION-II
(NUMERICAL VALUE TYPE

This section contains **5 Numerical Value Type Questions.** The Answer should be within **0 to 9999.** If the Answer is in **Decimal** then round off to the **Nearest Integer** value (Example i,e. If answer is above **10** and less than **10.5** round off is **10** and If answer is from **10.5** and less than **11** round off is **11).**

Marking scheme: +4 for correct answer, 0 if not attempt and -1 in all other cases.

21. A coin is tossed 8 times. If the probability that exactly 4 heads appear in the first six tosses and exactly 3 heads appear in the last five tosses is p, then 96p is equal to ____

Key: 9

Sol: $n(S) = 2^8 = 256$

Out comes be represented by $X_1, X_2, \ldots X_8$ for each $X_i \in \{H,T\}$

$\sum_{i=1}^{6} X_i = 4$ (i.e) 4 heads in $X_1 \, to \, X_6$, $\sum_{i=4}^{8} X_i = 3$ (3 heads from $X_4 \, to \, X_8$)

X_4, X_5, X_6 are overlapping, Let k be the no of heads in X_4, X_5, X_6 from

$X_1, X_2, X_3 \rightarrow 4-k$ heads X_7, X_8 be $3-k$,

$4-k \le 3, 3-k \ge 0$

$\Rightarrow k \ge 1 \; \& k \le 3$ thus $k \in \{1,2,3\}$

If $k=1 \to$ for X_4, X_5, X_6 in $3c_1 = 3$, 3 heads in $X_1\, to\, X_3$ in ${}^3C_3 = 1$, 2 heads in $X_7, X_8 = {}^2C_2$

So in this case $3\times1\times1=3$

If $k=2$ $\to$ for X_4, X_5, X_6 in $3c_2 = 3$, 2 heads in $X_1\, to\, X_3$ in ${}^3C_2$,12 heads in $X_7, X_8 = {}^2C_1$

So in this case we get $3\times3\times2=18$

If $k=3$ $\to$ for X_4, X_5, X_6 in ${}^3C_3 = 1$, 1 head in $X_1\, to\, X_3$ $= {}^3C_1$,0 heads in $X_7, X_8 = {}^2C_0 = 1$

So in this case $1\times3\times1=3$

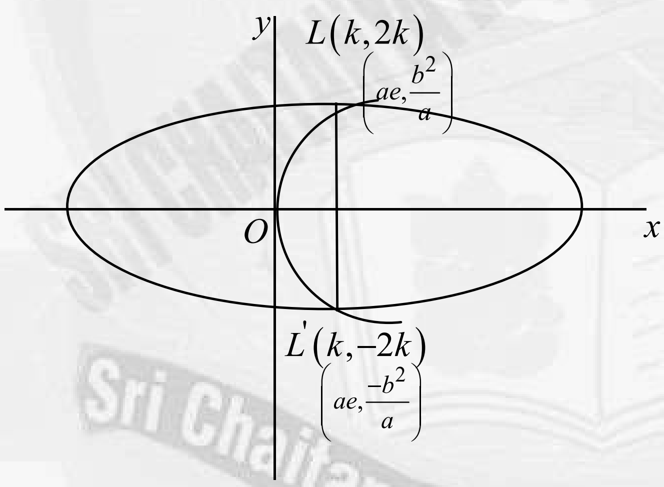
So favourable cases are $=3+18+3=24=n(E)$

$p = P(E) = \frac{24}{256} = \frac{3}{32} \Rightarrow 96p = 9$

22. Consider the parabola $P: y^2 = 4kx$ and the ellipse $E: \frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$. Let the line segment joining the points of intersection of P and E, be their latus rectums. If the eccentricity of E is e, then $e^2 + 2\sqrt{2}$ is equal to ____.

Key: 3

Sol:



$(k,2k) = \left(ae, \frac{b^2}{a}\right)$

$2k = \frac{b^2}{a}$ & $k = ae$

$2ae = \frac{b^2}{a} \Rightarrow 2e = \frac{b^2}{a^2} = 1 - e^2$

$e^2 + 2e + 1 = 2$

$(e+1)^2 = 2 \Rightarrow e = -1 + \sqrt{2}$

$$e^2+2\sqrt{2}=1-2e+2\sqrt{2}=1+2-2\sqrt{2}+2\sqrt{2}=3$$

23. If $A=\frac{\sin 3^\circ}{\cos 9^\circ}+\frac{\sin 9^\circ}{\cos 27^\circ}+\frac{\sin 27^\circ}{\cos 81^\circ}$ and $B=\tan 81^\circ-\tan 3^\circ$, then $\frac{B}{A}$ is equal to

Key: 2

Sol: Consider $\frac{\sin\theta}{\cos 3\theta}=\frac{\sin\theta}{\cos 3\theta}\times\frac{2\cos\theta}{2\cos\theta}=\frac{\sin 2\theta}{2\cos\theta\cos 3\theta}=\frac{\sin(3\theta-\theta)}{2\cos\theta\cos 3\theta}$

$=\frac{1}{2}(\tan 3\theta-\tan\theta)$ put $\theta=3^\circ,9^\circ,27^\circ$ and add

So $A=\frac{1}{2}\left\{\tan 9^\circ-\tan 3^\circ+\tan 27^\circ-\tan 9^\circ+\tan 81^\circ-\tan 27^\circ\right\}$

$=\frac{1}{2}\left\{\tan 81^\circ-\tan 3^\circ\right\}=\frac{1}{2}(B)$

$A=\frac{B}{2}\Rightarrow\frac{B}{A}=2$

24. Let $\overrightarrow{a_k}=(\tan\theta_k)\hat{i}+\hat{j}$ and $\overrightarrow{b_k}=\hat{i}-(\cot\theta_k)\hat{j}$, where $\theta_k=\frac{2^{k-1}\pi}{2^n+1}$, for some $n\in N, n>5$. Then the value of $\frac{\sum_{k=1}^{n}\left|\overrightarrow{a_k}\right|^2}{\sum_{k=1}^{n}\left|\overrightarrow{b_k}\right|^2}$ is ____

Key: 3

Sol: $\left|\overrightarrow{a_k}\right|^2=\sec^2(\theta_k),\left|\overrightarrow{b_k}\right|^2=co\sec^2(\theta_k)$ where $\theta_k=\frac{2^{k-1}\pi}{2^n+1}$

$$G.E=\frac{\sum_{k=1}^{n}\sec^2\theta_k}{\sum_{k=1}^{n}co\sec^2\theta_k}=\frac{\sec^2\alpha+\sec^2(2\alpha)+\sec^2\left(2^2\alpha\right)+\ldots+\sec^2\left(2^{n-1}\alpha\right)}{co\sec^2\alpha+co\sec^2(2\alpha)+co\sec^2\left(2^2\alpha\right)+\ldots+co\sec^2\left(2^{n-1}\alpha\right)}\quad\ldots\text{(i)}$$

Where $\alpha=\frac{\pi}{2^n+1}$

$\sec^2\alpha+\cos ec^2\alpha=4\cos ec^2 2\alpha$

So $\sec^2\alpha=4\cos ec^2 2\alpha-\cos ec^2\alpha$

Consider

$Nr=4\cos ec^2 2\alpha-\cos ec^2\alpha+4\cos ec^2 4\alpha-\cos ec^2 2\alpha+4\cos ec^2 8\alpha-\cos ec^2 4\alpha+\ldots+4\cos ec^2\left(2^n\alpha\right)-\cos ec^2\left(2^{n-1}\alpha\right)$

$=3\left(\cos ec^2 2\alpha+\cos ec^2 4\alpha+\cos ec^2 8\alpha+\ldots\cos ec^2\left(2^{n-1}\alpha\right)\right)+4\cos ec^2(\pi-\alpha)-\cos ec^2\alpha$

Use $2^n\alpha+\alpha=\pi$

$Nr = 3(Dr) \Rightarrow \frac{Nr}{Dr} = 3$

25. The number of points, at which the function $f(x) = \max\left\{6x, 2+3x^2\right\} + |x-1|\cos\left|x^2 - \frac{1}{4}\right|, x \in (-\pi, \pi)$, is not differentiable is ______

Key: 3

Sol: $|x-1|\cos\left|x^2 - \frac{1}{4}\right|$ is not differentiable at $x = 1$

Max $\left\{6x, 2+3x^2\right\}$ is not diff at $6x = 2+3x^2$

$\Rightarrow 3x^2 - 6x + 2 = 0 \Rightarrow x = \frac{6 \pm 2\sqrt{3}}{2\times 3} = \frac{3 \pm \sqrt{3}}{3}$

$x = 1 \pm \frac{\sqrt{3}}{3} \Rightarrow 1 \pm 0.57$

So $1.57, 0.43$ both belongs to $(-\pi, \pi)$

Number of non differentiable points in $(-\pi, \pi)$ are 3

PHYSICS **Max Marks: 100**

SECTION-I

(SINGLE CORRECT ANSWER TYPE)

This section contains **20 Multiple Choice Questions.** Each question has 4 options (1), (2), (3) and (4) for its answer, out of which ONLY ONE option can be correct.

Marking scheme: +4 for correct answer, 0 if not attempted and –1 in all other cases.

26. In a screw gauge when the circular scale is given five complete rotations it moves linearly by $2.5mm$. If the circular scale has 100 divisions, the least count of screw gauge is _____ mm.

1) 1×10^{-2} 2) 1×10^{-3} 3) 5×10^{-2} 4) 5×10^{-3}

Key: 4

Sol: $Pitch=\frac{Total\ dis\tan ce\ moved}{No\ of\ rotations}$

$Pitch=\frac{2.5mm}{5}=0.5mm$

Least count = $\frac{pitch\ of\ screw}{No\ of\ circular\ scale\ division}=\frac{0.5}{100}=5\times10^{-3}\ mm$

27. The increase in the pressure required to decrease the volume (ΔV) of water is $6.3\times10^{7}\ N/m^{2}$. The percentage decrease in the volume is ____.
(Bulk modulus of water $=2.1\times10^{9}\ N/m^{2}$)

1) 2% 2) 3% 3) 6% 4) 4%

Key: 2

Sol: Bulk modulus $B=\frac{\Delta p}{-\left(\frac{\Delta V}{V}\right)}=2.1\times10^{9}\ N/m^{2}$

$\Delta p=6.3\times10^{7}\ N/m^{2}$

$-\frac{\Delta V}{V}=\frac{\Delta p}{B}=\frac{6.3\times10^{7}}{2.1\times10^{9}}=3\times10^{-2}$

Percentage decrease in volume $\frac{\Delta V}{V}\times100=3\times10^{-2}\times100=3\%$

28. The time taken by a block of mass m to slide down from the highest point to the lowest point on a rough inclined plane is 50% more compared to the time taken by the same block on identical inclined smooth plane. Both inclined planes are at 45° with the horizontal. The coefficient of kinetic friction between the rough inclined surface and block is ____.

1) $\frac{3}{4}$ 2) $\frac{2}{3}$ 3) $\frac{5}{9}$ 4) $\frac{4}{9}$

Key: 3

Sol: acceleration on rough inclined plane

$a = g\left[\sin\theta - \mu_k \cos\theta\right]$

acceleration on smooth inclined plane $a = g\sin\theta$

From $s = ut + \frac{1}{2}at^2$

$s = \frac{1}{2}at^2,\ t^2 \propto \frac{1}{a}$

$\frac{a_r}{a_s} = \left(\frac{t_s}{t_r}\right)^2 = \left(\frac{2}{3}\right)^2 = \frac{4}{9}\left(t_s = 100s,\ t_r = 150s\right)$

$\frac{g\left[\sin\theta - \mu_k \cos\theta\right]}{g\sin\theta} = \frac{4}{9}$

$\frac{\sin 45 - \mu_k \cos 45}{\sin 45} = \frac{4}{9} \Rightarrow 1 - \mu_k = \frac{4}{9}$

$\mu_k = 1 - \frac{4}{9} = \frac{5}{9}$

29. Two nuclei of mass number 3 combine with another nucleus of mass number 4 to yield a nucleus of mass number 10. If the binding energy per nucleon for the mass numbers 3, 4 and 10 are 5.6 MeV, 7.4 MeV and 6.1 MeV, respectively, then in the process, $\Delta Mc^2 =$ ____MeV.

1) 6.9 2) 7.9 3) 2.2 4) 4.3

Key: 3

Sol: Energy released in a nuclear reaction is the difference between total binding energy of the products and total binding energy of the reactants.

$\rightarrow$Two nuclei of mass number 3 its binding energy

$B.E = 2\times 3\times 5.6 = 6\times 5.6 = 33.6\ MeV$

$\rightarrow$Nuclei of mass number 4its binding energy $B.E = 4\times 7.4 = 29.6\ MeV$

$\rightarrow$Total reactants $B.E = (33.6 + 29.6)MeV = 63.2\,MeV$

B.E of products $= 10\times 6.1 = 61\,MeV$

$\Delta MC^2 =$(B.E Product)-(B.E. Reactants) $= 61 - 63.2 = -2.2\,MeV$

In magnitude $\Delta Mc^2 = 2.2\,MeV$

30. A solid sphere of mass M and radius R is divided into two unequal parts. The smaller part having mass $\frac{M}{8}$ is converted into a sphere of radius r and the larger part is converted into a circular disc of thickness t and radius $2R$. If I_1 is moment of inertia of a sphere having radius r about an axis through its centre and I_2 is the moment of inertia of a disc about its diameter, the ratio of their moment of inertia $\frac{I_2}{I_1}=$____.

1) 35　　2) 70　　3) 140　　4) 210

Key: 2

Sol: $m_1=\frac{M}{8}(smaller)$

$m_2=M-\frac{M}{8}=\frac{7M}{8}$ (Larger)

Volume of original sphere $V=\frac{4}{3}\pi R^3$

Smaller part $V_1=\frac{V}{8}=\frac{1}{8}.\frac{4}{3}\pi R^3=\frac{4}{3}\pi\frac{R^3}{8}=\frac{4}{3}\pi\left(\frac{R}{2}\right)^3=\frac{4}{3}\pi r^3$

$r=\frac{R}{2}$

The moment of inertia of solid sphere about its centre is $\frac{2}{5}mr^2$

$I_1=\frac{2}{5}\left(\frac{M}{8}\right)\left(\frac{R}{2}\right)^2=\frac{MR^2}{80}$

The moment of inertia of a disc about its diameter is $\frac{1}{4}m_2R_{disc}^2$

$I_2=\frac{1}{4}\left(\frac{7M}{8}\right)(2R)^2=\frac{7}{8}MR^2$

$\therefore\frac{I_2}{I_1}=\frac{\frac{7MR^2}{8}}{\frac{MR^2}{80}}=\frac{7}{8}\times 80=7\times 10=70$

31. The two projectiles are projected with the same initial velocities at the 15° and 30° with respect to the horizontal. The ratio of their range is $1:x$. The value of x is

1) $\sqrt{2}$　　2) $\sqrt{3}$　　3) $2\sqrt{3}$　　4) $\frac{1}{\sqrt{2}}$

Key: 2

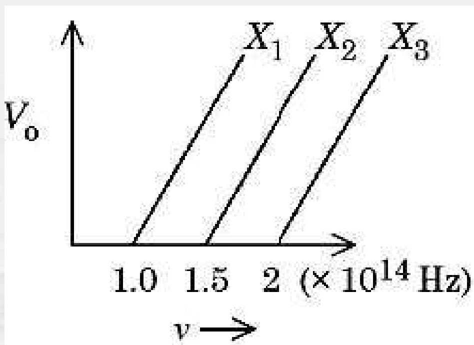
Sol: $Range = \frac{u^2 \sin 2\theta}{g}$

$R \propto \sin 2\theta$ (u constant)

$\frac{R_1}{R_2} = \frac{\sin 2\theta_1}{\sin 2\theta_2} = \frac{\sin 2\times 15}{\sin 2\times 30} = \frac{\sin 30}{\sin 60} = \frac{\frac{1}{2}}{\frac{\sqrt{3}}{2}} = \frac{1}{\sqrt{3}}$

$x = \sqrt{3}$

32. The graph shows variation of stopping potential $V_\circ$ with the frequency v of the incident radiation for three photosensitive metals X_1, X_2 and X_3. Which metal will give out electrons with greater kinetic energy, for the same wavelength of incident radiation?



1) X_1 2) X_2 3) X_3

4) All the metals will give out photo electrons with same kinetic energies.

Key: 1

Sol: From the graph

For X_1 $\vartheta_{01} = 1\times 10^{14}\,Hz$

For X_2 $\vartheta_{02} = 1.5\times 10^{14}\,Hz$

For X_3 $\vartheta_{03} = 2\times 10^{14}\,Hz$

Lower threshold frequency means a lower work function, X_1 has lower work function.

$K_1E_{\max} = h\vartheta - \phi_0$

ϕ_0 is smallest for metal X_1

So $(h\vartheta - \phi_0)$ will be greater so K.E will be greater for X_1

33. A slit of width a is illuminated by light of wavelength λ. The linear separation between 1st and 3rd minima in the diffraction pattern produced on a screen placed at a distance D from the slit system is ____.

1) $\frac{D\lambda}{a}$ 2) $1.5\frac{D\lambda}{a}$ 3) $2\frac{D\lambda}{a}$ 4) $3\frac{D\lambda}{a}$

Key: 3

Sol: For minima diffraction

$y = \frac{n\lambda D}{a}, n = \pm 1, \pm 2$

For 1st minima, $y_1 = \frac{1\times \lambda D}{a}$ for 3rd minima $y_3 = \frac{3\lambda D}{a}$

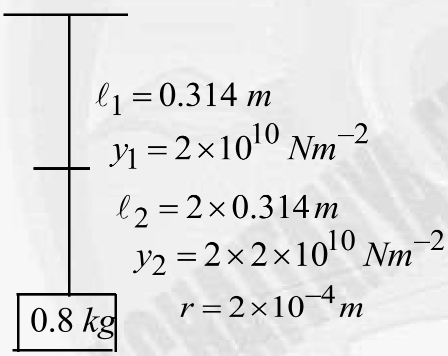
Distance between two minima $(y_3 - y_1) = \frac{3\lambda D}{a} - \frac{\lambda D}{a} = \frac{2\lambda D}{a}$

34. A string A of length $0.314\,m$ and Young's modulus $2\times 10^{10}\,N/m^2$ is connected to another string B of length and Young's modulus both twice of those of A. This series combination of strings is then suspended from a rigid support and its free end is fixed to a load of mass $0.8\,kg$. The net change in length of the combination is ____ mm.
(radius of both the strings is $0.2\,mm$ and acceleration due to gravity $= 10\,m/s^2$)
(Mass of both strings is to be neglected as compared to the mass of load)

1) 3 2) 2 3) 1.9 4) 1

Key: 3

Sol:



$e = e_1 + e_2 = \frac{mg\ell_1}{\pi r^2 y_1} + \frac{mg\ell_2}{\pi r^2 y_2}$

$= \frac{mg}{\pi r^2}\left(\frac{\ell_1}{y_1} + \frac{\ell_2}{y_2}\right)$

$\frac{0.8\times 10\times 7}{22\times 4\times 10^{-8}}\left(\frac{0.314}{2\times 10^{10}} + \frac{2\times 0.314}{2\times 2\times 10^{10}}\right)$

$\frac{8\times 7\times 2\times 0.314}{22\times 4\times 2\times 10^{2}} = \frac{7\times 0.314}{11}\times 10^{-2} = \frac{2.198}{11}\times 10^{-2} = 0.19\times 10^{-2}\,m$

$= 1.9\,mm$

35. One gas of n_1 mole of molecules at temperature T_1, volume V_1, and pressure P_1, and another gas of n_2 mole of molecules at temperature T_2, volume V_2, and pressure P_2, are mixed resulting in pressure P and volume V of the mixture. The temperature of the mixture is _____.

1) $\frac{(T_1 + T_2)}{2}$ 2) $\frac{T_1 T_2 PV}{(T_2 P_1 V_1 + T_1 P_2 V_2)}$ 3) $\frac{(T_2 P_1 V_1 + T_1 P_2 V_2)}{(T_1 T_2 PV)}$ 4) $\frac{|T_1 - T_2|}{2}$

Key: 2

Sol: $PV = nRT, n = \frac{PV}{RT}$

$$n = n_1 + n_2 \Rightarrow \frac{PV}{RT_f} = \frac{P_1V_1}{RT_1} + \frac{P_2V_2}{RT_2} \Rightarrow T_f = \frac{PV}{\frac{P_1V_1}{T_1} + \frac{P_2V_2}{T_2}} = \frac{PV}{\frac{P_1V_1T_2 + P_2V_2T_1}{T_1T_2}}$$

$$T_f = \frac{PV(T_1T_2)}{P_1V_1T_2 + P_2V_2T_1}$$

36. An ideal gas undergoes a process maintaining relation between pressure (P) and volume (V) as $P = P_\circ\left(1+\left(\frac{V_\circ}{V}\right)^2\right)^{-1}$, where $P_\circ$ and $V_\circ$ are constants. If two samples A and B (two moles each) with initial volumes $V_\circ$ and $3V_\circ$ respectively undergo above mentioned process and attain same pressure, then the difference at the temperature of these samples, $T_B - T_A$ is _____. ($R =$ gas constant)

1) $\frac{9P_\circ V_\circ}{8R}$ 2) $\frac{11P_\circ V_\circ}{10R}$ 3) $\frac{7P_\circ V_\circ}{6R}$ 4) $\frac{13P_\circ V_\circ}{11R}$

Key: 2

Sol: $P_A = \frac{P_0}{1+\left(\frac{V_0}{V}\right)^2} = \frac{P_0}{\left(1+\left(\frac{V_0}{V_0}\right)^2\right)} = \frac{P_0}{2}$

$$\frac{P_0}{2}V_0 = nRT_A = 2RT_A \Rightarrow T_A = \frac{P_0V_0}{4R} \quad ....(1)$$

$$P_B = \frac{P_0}{\left(1+\left(\frac{V_0}{3V_0}\right)^2\right)} = \frac{P_0}{1+\frac{1}{9}} = \frac{9P_0}{10}$$

$$\frac{9P_0}{10} \times 3V_0 = nRT_B = 2RT_B \Rightarrow T_B = \frac{27P_0V_0}{20R} \quad ....(2)$$

$$T_B - T_A = \frac{27P_0V_0}{20R} - \frac{P_0V_0}{4R} = \frac{22P_0V_0}{20R}$$

$$T_B - T_A = \frac{11P_0V_0}{10R}$$

37. A voltmeter with internal resistance of $x\Omega$ can be used to measure upto 20 V. In order to increase its measuring range to 30 V, the required modification is to ____.

1) Connect resistor of $\frac{x}{2}\Omega$, in series with voltmeter

2) Connect resistor of $\frac{x}{2}\Omega$, in parallel to voltmeter

3) Connect resistor of $x\,\Omega$, in series with voltmeter

4) Connect resistor of $2x\,\Omega$, in parallel to voltmeter

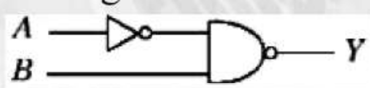
Key: 1

Sol: $R = G(n-1)$

$$G\left(\frac{V}{V_g}-1\right) = x\left(\frac{30}{20}-1\right)$$

$R = \frac{x}{2}$ must be connected in series

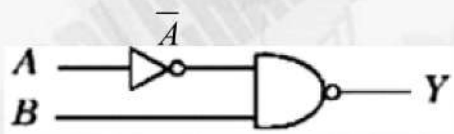
38. Two 4 bits binary numbers, $A = 1101$ and $B = 1010$ are given in the inputs of a logic circuit shown in figure below. The output (Y) will be:



1) $Y = 1101$ 2) $Y = 0010$ 3) $Y = 0111$ 4) $Y = 1000$

Key: 1

Sol:



$Y = \overline{\overline{A}.B} = \overline{\overline{A}} + \overline{B} = A + \overline{B}$

$A = 1101, B = 1010$ as inputs

$Y = A + \overline{B}$

$y = 1101$ output

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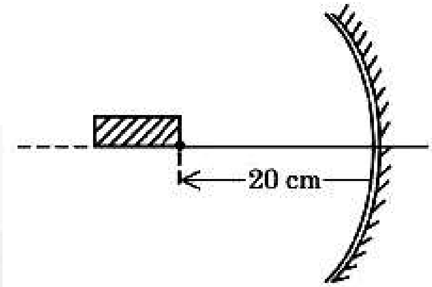
39. A rod of length $10cm$ lies along the principle axis of a concave mirror of focal length $10cm$ as shown in figure. The length of the image is ___ cm.



1) 2.5 2) 5 3) 7.5 4) 7

Key: 2

Sol: $f = -10\ cm$

$R = 20\ cm$

End A $u_A = -20\ cm$. It is at centre of curvature image forms at same point

$V_A = -20\ cm$

End B $u_B = -(10+20) = -30cm$

$$\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$$

$$\frac{1}{V_B}+\frac{1}{-30}=-\frac{1}{10}$$

$V_B = -15cm$

Length of image $= 20-15 = 5cm$

40. A parallel plate air capacitor is connected to a battery. The plates are pulled apart at uniform speed v. If x is the separation between the plates at any instant, then the time rate of change of electrostatic energy of the capacitor is proportional to x^{α}, where α is ____.

1) – 2 2) 1 3) – 1 4) 2

Key: 1

Sol: $U = \frac{1}{2}CV^2$

$$C = \frac{\in_0 A}{x}$$

$$U = \frac{1}{2}\frac{\in_0 A}{x}V^2$$

$$\frac{dU}{dt} = \frac{1}{2}\in_0 AV^2 \frac{d}{dt}\left(\frac{1}{x}\right)$$

$$= \frac{1}{2}\in_0 AV^2\left(-x^{-2}.\frac{dx}{dt}\right)$$

$= \frac{1}{2} \in_0 AV^2 \left(-x^{-2}.v\right)$

$\frac{dU}{dt} \propto x^{-2}$

$n = -2$

41. An insulated wire is wound so that it forms a flat coil with $N = 200$ turns. The radius of the innermost turn is $r_1 = 3cm$, and of the outermost turn $r_2 = 6cm$. If $20mA$ current flows in it then the magnetic moment will be $\alpha \times 10^{-2}\ A.m^2$. The value of α is _____.

1) 4.4 2) 2.64 3) 3.25 4) 1.2

Key: 2

Sol: No of turns per unit length $n = \frac{N}{r_2 - r_1}$

Magnetic moment of small circular element of thickness dr at a distance 'r' is

$dM = I\left(\pi r^2\right)(n.dr)$

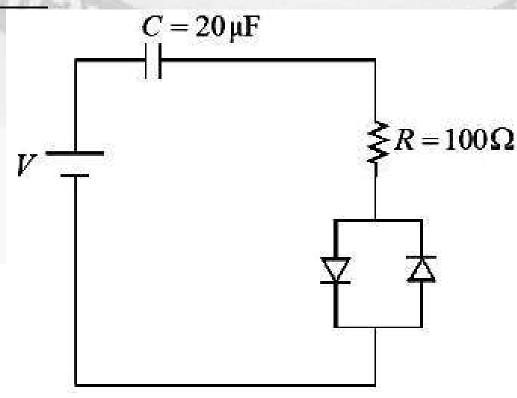
$\int dM = \int_{r_1}^{r_2} I\ \pi r^2 \left(\frac{N}{r_2 - r_1}\right) dr$

$M = \frac{NI\pi}{3(r_2 - r_1)}\left(r_2^3 - r_1^3\right)$

$M = \frac{200 \times 20 \times 10^{-3} \times \pi}{3(6-3) \times 10^{-2}} \times \left[216 \times 10^{-6} - 27 \times 10^{-6}\right]$

$M = 0.0264 = 2.64 \times 10^{-2}\ Am^2$

42. Consider a circuit consisting of a capacitor $(20\,\mu F)$, resistor (100Ω) and two identical diodes as shown in figure. The resistance of diode under forward biasing condition is 10Ω. The time constant of the circuit is $\alpha \times 10^{-3}\,s$. The value of α is ______



1) 2.2 2) 2.0 3) 2.1 4) 2.4

Key: 1

Sol: $R = 100, r_f = 10\Omega$

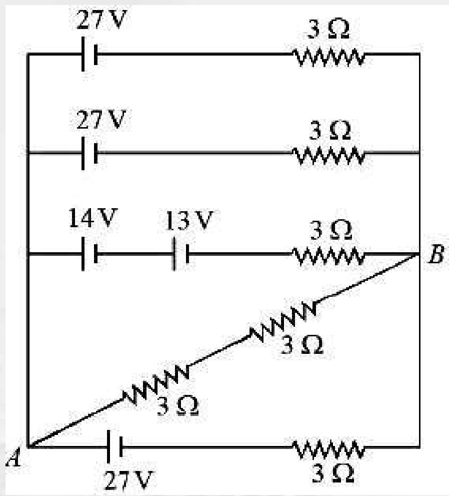
$R_T = 100 + 10 = 110\Omega$ (one diode is forward biased)

$\tau = RC$

$= 110 \times 20 \times 10^{-6}$

$= 2.2 \times 10^{-3} s$

43. The voltage and the current between A and B points shown in the circuit are _____.



1) 24 V, 12 A 2) 24 V, 4 A 3) 18 V, 12 A 4) 27 V, 4 A

Key: 2

Sol: Four 3Ω resistors are in parallel

$r_{eq} = \frac{3}{4}\Omega$

$R = 3 + 3 = 6\Omega$

$i = \frac{V_{AB}}{r_{eq} + R} = \frac{27}{\frac{3}{4} + 6} = \frac{27}{\frac{27}{4}} = 4A$

$V_{AB} = i \times R_{AB}$

$V_{AB} = 4 \times 6 = 24V$

44. A telescope with objective diameter R is used to observe a distant star emitting light of wavelength $500nm$, at a resolution of 5×10^{-7} radian. The value of R is _____ cm.

1) 61 2) 122 3) 244 4) 305

Key: 2

Sol: Resolving limit of telescope $(R.L) = \frac{1.22\lambda}{R}$

$R \to$ diameter of objective lens

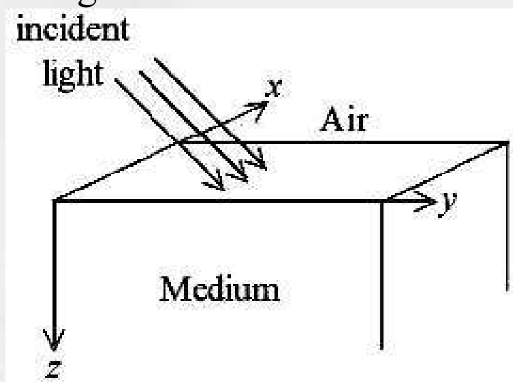
$\lambda = 500 \times 10^{-9} m = 5 \times 10^{-7} m$

$R.L = 5\times10^{-7}\, rad$

$R = \dfrac{1.22\times5\times10^{-7}}{5\times10^{-7}} = 1.22m$

$R = 122\,cm$

45. An unpolarized light is incident on the plane interface of air-dielectric medium shown in figure. If the incident angle is equal to Brewster angle, identify the expression representing reflected wave.



1) $\left(E_x\hat{i}+E_y\hat{j}\right)\sin\left(kx-kz-\omega t\right)$ 2) $\left(E_x\hat{i}+E_z\hat{k}\right)\sin\left(kx+ky-\omega t\right)$

3) $\left(E_x\hat{j}+E_y\hat{k}\right)\sin\left(ky+kz-\omega t\right)$ 4) $\left(E_x\hat{i}+E_y\hat{j}+E_z\hat{k}\right)\sin\left(kx+ky-kz-\omega t\right)$

Key: No key

Sol: When an unpolarized light is incident on a transparent medium at Brewster angle, the reflected light becomes completely polarized in the plane of the surface of transparent medium (XY-plane) and travels in the plane of incident ray (YZ-plane).

Hence equation of reflected ray is $\overline{E}(x,y,t) = \left(E_x\hat{i}+E_y\hat{j}\right)\sin\left(ky-kz-\omega t\right)$

SECTION-II

(NUMERICAL VALUE TYPE

This section contains **5 Numerical Value Type Questions.** The Answer should be within **0 to 9999.** If the Answer is in **Decimal** then round off to the **Nearest Integer** value (Example I,e. If answer is above **10** and less than **10.5** round off is **10** and If answer is from **10.5** and less than **11** round off is **11).**

Marking scheme: +4 for correct answer, 0 if not attempt and -1 in all other cases

46. A $1kg$ block subjected to two simultaneous forces $\left(2\hat{i}+3\hat{j}+4\hat{k}\right)N$ and $\left(3\hat{i}-\hat{j}-2\hat{k}\right)N$ is moved a distance of $25m$ along $\left(3\hat{i}-4\hat{j}\right)$ direction. The work done in this process is ____ J.

Key: 35

Sol: $\overline{F} = \overline{F_1}+\overline{F_2} = \left(2\hat{i}+3\hat{j}+4\hat{k}\right)+\left(3\hat{i}-\hat{j}-2\hat{k}\right)$

$= \left(5\hat{i}+2\hat{j}+2\hat{k}\right)N$

$$\overline{S} = 25\frac{\left(3\hat{i}-4\hat{j}\right)}{\left|3\hat{i}-4\hat{j}\right|} = 25\times\frac{\left(3\hat{i}-4\hat{j}\right)}{5} = \left(15\hat{i}-20\hat{j}\right)m$$

$$\therefore W = \overline{F}.\overline{S} = \left(5\hat{i}+2\hat{j}+2\hat{k}\right).\left(15\hat{i}-20\hat{j}\right)$$

$$= 75-40$$

$$W = 35J$$

47. The surface tension of a soap solution is $3.5\times10^{-2}\ N/m$. The work required to increase the radius of a soap bubble from $1cm$ to $2cm$ is $\alpha\times10^{-6}J$. The value of α is ____. $\left(\pi=\frac{22}{7}\right)$

Key: 264

Sol: $W = 8\pi T\left(R_2^2 - R_1^2\right)$

$$= 8\pi\times3.5\times10^{-2}(4-1)\times10^{-4}$$

$$= 8\times\frac{22}{7}\times3.5\times3\times10^{-6}$$

$$\alpha\times10^{-6} = 264\times10^{-6}$$

$$\therefore \alpha = 264$$

48. The velocity of a particle executing simplee harmonic motion along $x-$axis is described as $v^2 = 50 - x^2$, where x represents displacement. If the time period of motion is $\frac{x}{7}s$, the value of x is ____.

Key: 44

Sol: $v^2 = 50 - x^2 \quad \ldots(1)$

But in SHM $V = \omega\sqrt{A^2 - x^2}$

$V^2 = \omega^2A^2 - \omega^2x^2 \quad \ldots(2)$

Compare (1) & (2)

$\omega^2 = 1 \Rightarrow \omega = 1$

$$T = \frac{2\pi}{\omega} = 2\pi = 2\times\frac{22}{7} = \frac{44}{7}$$

But given $T = \frac{x}{7}$

$x = 44$

49. A body of mass $2kg$ begins to move under the influence of time dependent force $\vec{F}=\left(2t\hat{i}+6t^2\hat{j}\right)N$, where $\hat{i}$ and $\hat{j}$ are unit vectors along x and $y-$axis respectively. The power produced by the force at $t=2s$ is ___W.

Key: 200

Sol: $\vec{F}=2t\hat{i}+6t^2\hat{j}$

$$a=\frac{\vec{F}}{m}=\frac{2t\hat{i}+6t^2\hat{j}}{2}$$

$$\frac{d\vec{v}}{dt}=t\hat{i}+3t^2\hat{j}$$

$$\vec{v}=\int_0^t t\ dt\ \hat{i}+3\int_0^t t^2\ dt\ \hat{j}$$

$$=\frac{t^2}{2}\hat{i}+t^3\hat{j}$$

$$p=\vec{F}.\vec{v}=\left(2t\hat{i}+6t^2\hat{j}\right).\left(\frac{t^2}{2}\hat{i}+t^3\hat{j}\right)$$

$$p=t^3+6t^5$$

$\therefore$ at $t=2s\Rightarrow p=2^3+6\times 2^5=8+6\times 32=8+192$

$p=200\,watt$

50. An inductor of $10mH$, capacitor of $0.1\mu F$ and a resistor of 100Ω are connected in series across an $a.c$ power supply 220V, 70 Hz. The power factor of the given circuit is 0.5. The difference in the inductive reactance and capacitance reactance is $\sqrt{3}\alpha\Omega$. The value of α is ____.

Key: 100

Sol: $\cos\phi=\frac{R}{Z}=\frac{R}{\sqrt{R^2+X^2}}$, where $X=X_L-X_C$

$$0.5=\frac{R}{\sqrt{R^2+X^2}}$$

$$R^2+X^2=4R^2$$

$$X^2=3R^2\Rightarrow X=\sqrt{3}R=\sqrt{3}\times 100$$

But $X=\sqrt{3}\alpha$

$\alpha=100$

CHEMISTRY

Max Marks: 100

SECTION-I
(SINGLE CORRECT ANSWER TYPE)

This section contains **20 Multiple Choice Questions.** Each question has 4 options (1), (2), (3) and (4) for its answer, out of which ONLY ONE option can be correct.

Marking scheme: +4 for correct answer, 0 if not attempted and –1 in all other cases.

51. Number of moles and number of molecules in $1.4187\ L$ of SO_2 at STP

1) $0.1266; 3.812\times 10^{22}$
2) $0.0633; 3.812\times 10^{22}$
3) $0.1266; 7.6238\times 10^{22}$
4) $0.0633; 7.6238\times 10^{22}$

Key: 2

Sol: At STP, 1 mole of gas occupies = 22.4 lit

$$n=\frac{Given\,volume}{Molar\,volume}=\frac{1.4187\,lit}{22.4\ lit/mol}=0.0633\,mol$$

No. Of molecules = $=n\times N_A=0.0633\times 6.022\times 10^{23}=3.812\times 10^{22}\,molecules$

52. What is the ratio of wave number of first line (lowest energy line) of Balmer series of H atomic spectrum to first line of its Bracket series?

1) $5:1$
2) $5:0.81$
3) $5:1.75$
4) $5:27$

Key: 2

Sol: $\overline{V}=R_H\left[\frac{1}{n_1^2}-\frac{1}{n_2^2}\right]$

First line of Balmer series $n_1=2, n_2=3$.

$$\overline{V}_{Balmer}=R_H\left(\frac{1}{2^2}-\frac{1}{3^2}\right)=R_H\left(\frac{1}{4}-\frac{1}{9}\right)=R_H\left(\frac{5}{36}\right)$$

First line of Bracket series $n_1=4, n_2=5$

$$\overline{V}_{Bracket}=R_H\left(\frac{1}{4^2}-\frac{1}{5^2}\right)=R_H\left(\frac{1}{16}-\frac{1}{25}\right)=R_H\left(\frac{9}{400}\right)$$

$$\frac{\overline{V}_{Balmer}}{\overline{V}_{Bracket}}=\frac{R_H\frac{5}{36}}{R_H\frac{9}{400}}=\frac{5}{36}\times\frac{400}{9}=\frac{2000}{324}=500:81=5:0.81$$

53. Which of the following is correct set of 4 quantum numbers of 19th electron in chromium (Atomic number = 24) in accordance with Aufbau principle?

1) $n=3, \ell=2, m=+2, s=+\frac{1}{2}$
2) $n=3, \ell=2, m=-2, s=+\frac{1}{2}$
3) $n=4, \ell=1, m=0, s=+\frac{1}{2}$
4) $n=4, \ell=0, m=0, s=+\frac{1}{2}$

Key: 4

Sol: $Cr = (25)\ 1s^2 2s^2 2p^6 3s^2 3p^6 3d^5\ \underset{(19^{th})}{4s^1}$

4s^1	n	l	m	s
	4	0	0	$+\frac{1}{2}$

54. **Statement I:** for an ideal gas, heat capacity at constant volume is always Greater than the heat capacity at constant pressure.
Statement II: In a constant volume process, no work is produced and all the heat withdrawn goes into the chaotic motion and is reflected by a temperature increase of the ideal gas
In the light of the above statements, choose the correct answer from the options given below
1) Both Statement I and Statement II are true
2) Both Statement I and Statement II are false
3) Statement I is true but Statement II is false
4) Statement I is false but Statement II is true

Key: 4

Sol:
Statement- I: False, Statement- II True.
As at constant pressure heat added is used for both raising the temperature and for expansion.
At constant volume no work is done hence energy will be used only for increase in temperature.

55. At $T(K)$, the equilibrium constant of $A_2(g) + B_2(g) \rightleftharpoons C(g)$ is 2.7×10^{-5}. What is the equilibrium constant for $\frac{1}{3}A_2(g) + \frac{1}{3}B_2(g) \rightleftharpoons \frac{1}{3}C(g)$ at the same temperature?
1) $\left(2.7\times10^{-5}\right)^3$ 2) 6×10^{-2} 3) $\sqrt{2.7\times10^{-3}}$ 4) 3×10^{-2}

Key: 4

Sol: $A_{2(g)} + B_{2(g)} \rightleftharpoons C_{(g)}$ is $2.7\times10^{-5} = k_1$

for $\frac{1}{3}A_{2(g)} + \frac{1}{3}B_{2(g)} \rightleftharpoons \frac{1}{3}C_{(g)}$, $k_2 = ?$

$k_2 = (k_1)^{1/3}$

$k_2 = \sqrt[3]{2.7\times10^{-5}}$

$k_2 = \sqrt[3]{27\times10^{-6}}$

$k_2 = 3\times10^{-2}$

56. In order to oxidise a mixture of 1 mole each of $FeC_2O_4.Fe_2(C_2O_4)_3.FeSO_4$ and $Fe_2(SO_4)_3$ in acidic medium, the number of moles of $KMnO_4$ required is

1) 3 2) 2 3) 5 4) 7

Key: 2

Sol: 1) $FeC_2O_4\ (1mole)$

$Fe^{+2}\rightarrow Fe^{+3}+1e^-$

$C_2O_4^{-2}\rightarrow 2CO_2+2e^-$

Total $n-$factor = 3

2) $Fe_2(C_2O_4)_3\ (1mole)$

$Fe^{+3}\rightarrow Fe^{+3}\quad n=0$

$3C_2O_4^{-2}\rightarrow 6CO_2+6e^-$

Total $n-$factor = 6

3) $FeSO_4\ (1mole)$

$Fe^{+2}\rightarrow Fe^{+3}+1e^-$

Total $n-$factor = 1

4) $Fe_2(SO_4)_3\ (1\ mole)$

$Fe^{+3}\rightarrow Fe^{+3}$

Total $n-$factor = 3 + 6 +1 = 10

Equivalents of $KMnO_4$ = Total equivalent of mixture

Moles of $KMnO_4\times5=10$

Moles of $KMnO_4=2$

57. Consider the first order reaction $R\rightarrow P$. The fraction of molecules decomposed in the given first order reaction can be expressed as

1) $1-e^{k_1t}$ 2) $1+e^{k_1t}$ 3) $1+e^{-k_1t}$ 4) $1-e^{-k_1t}$

Key: 4

Sol: First order reaction = $1-e^{-k_1t}$

58. A monoatomic anion $\left(A^-\right)$ has 45 neutrons and 36 electrons. Atomic mass, group in the periodic table and physical state at room temperature of the element (A) respectively are

1) 80, 17, liquid 2) 81, 16, solid 3) 80, 16, gas 4) 81, 15, gas

Key: 1

Sol: A^-(uni negative) has 45 neutrons and 36 neutrons

Therefore in A (neutral atom) number of electrons are 35, protons are 35 and neutrons are 45.

Atomic Mass = 80 , atomic number = 35

Therefore 17th group and is Bromine. The physical state of bromine is liquid(Br_{35}^{80}).

59. Given below are two statements;

Statement I: The covalency of oxygen is generally two but it can exceed upto four. The oxidation state of oxygen in SO_2 is -2 and in OF_2 it is $+2$.

Statement II: the anomalous behaviour of oxygen when compared to the other elements of group 16 is due to its small size and high electro negativity.

In the light of the above statements, choose the correct answer from the options given below.

1) Both Statement I and Statement II are true
2) Both Statement I and Statement II are false
3) Statement I is true but Statement II is false
4) Statement I is false but Statement II is true

Key: 1

Sol: Statement – I: $SO_2 \Rightarrow o.s\ of\ oxygen = -2$

$OF_2 \Rightarrow o.s\ of\ oxygen = +2$

Statement – II: Abnormal behaviour oxygen with it's family elements. Due to small size and high EN.

60. The correct statements among the following are,

A) $Mo(VI)$ and $W(VI)$ are less stable than $Cr(VI)$.

B) Ce^{4+} and Tb^{4+} are oxidant while Eu^{2+} and Yb^{2+} are reducatnt.

C) Cm and Am have seven unpaired electrons.

D) Actinoid contraction is greater from element to element than lanthanoid contraction.

Choose the correct answer from the options given below:

1) A and B only
2) C and D only
3) B and D only
4) A and C only

Key: 3

Sol: A) False

Stability of the higher oxidation state (+6) increases down the group.

$\therefore Cr\ (+6)$ - Strong oxidising agent

But $Mo\ (+6)$ and $W\ (+6)$ are not

B) True

Lanthanoides stable O.S = + 3

$\therefore Ce^{+4}, Tb^{+4}$ (acting as oxidants)

$\therefore Eu^{+2}, Yb^{+2}$ (reductants)

C) False

${}_{95}Am : 5f^7 7s^2$ (7)

${}_{96}Cm : 5f^7 6d^1 7s^2$ (8)

D) Actinoid contraction > Lanthanoid contraction

$\therefore 5f$ electrons are with poor shielding.

61. Correct statements from the following are

A. Potassium dichromate is an oxidising agent and it oxidises $FeSO_4$ to $Fe_2(SO_4)_3$ in acidic medium.

B. Sodium dichromate can be used as primary standard in volumetric estimation.

C. CrO_4^{2-} and $Cr_2O_7^{2-}$ are interconvertible in aqueous solution by varying the pH of the solution.

D. $Cr-O-cr$ bond angle in $Cr_2O_7^{2-}$ is 126^0

Choose the correct answer from the options given below:

1) A, B and C only
2) A, C and D only
3) A and C only
4) B and D only

Key: 2

Sol: A) Correct

$Cr_2O_7^{-2} + 14H^+ + 6Fe^{+2} \rightarrow 2Cr^{+3} + 6Fe^{+3} + 7H_2O$

$K_2Cr_2O_7 \rightarrow$ powerful oxidising agent in acidic medium

B) Incorrect:

Sodium dichromate is hygroscopic in nature (Absorbs moisture from the air) hence cannot be use as a primary standard

C) Correct

i) low, pH, (Acidic Medium) $\Rightarrow$ Chromate

$CrO_4^{-2} \rightarrow$ Dichromate $\left(Cr_2O_7^{-2}\right)$ (yellow to orange)

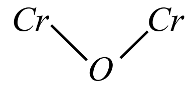
ii) High pH, (Basic Medium) $\Rightarrow$

Di chromate $\rightarrow$ chromate ion (orange to yellow) ion

D) Correct:

In the Dichromate $\left(Cr_2O_7^{-2}\right)$

Two CrO_4^{-2} ions tetrahedral shape

$\therefore$  bond angle to be 126°

62. Match The List-I with List-II

List-I (Complex ion)		List-II (calculated spin only magnetic moment (BM))	
A	$\left[Cr\left(H_2O\right)_6\right]^{2+}$	I	3.87
B	$\left[Co\left(H_2O\right)_6\right]^{2+}$	II	5.92
C	$\left[Cu\left(H_2O\right)_6\right]^{2+}$	III	4.90
D	$\left[Mn\left(H_2O\right)_6\right]^{2+}$	IV	1.73

Choose the correct answer from the options given below:

1) $A-I, B-III, C-IV, D-II$ 2) $A-II, B-I, C-III, D-IV$

3) $A-IV, B-II, C-I, D-III$ 4) $A-III, B-I, C-IV, D-II$

Key: 4

Sol: $\mu_s = \sqrt{n(n+2)}\ BM$

$n =$ no. of un paired electrons

$\therefore$ (H_2O) is a weak field ligand but for +3 state of cobalt it acts as a strong field ligand

A) $\left[Cr\left(H_2O\right)_6\right]^{+2} - Cr^{+2} - 3d^4, n = 4, 4.90\ BM$

B) $\left[Co\left(H_2O\right)_6\right]^{+2} - Ce^{+2} - 3d^7, n = 3, 3.87\ BM$

C) $\left[Cu\left(H_2O\right)_6\right]^{+2} - Cu^{+2} - 3d^9, n = 1, 1.73\ BM$

D) $\left[Mn\left(H_2O\right)_6\right]^{+2} - Mn^{+2} - 3d^5, n = 5, 5.92\ BM$

63. Increasing order of electron power of following functional groups

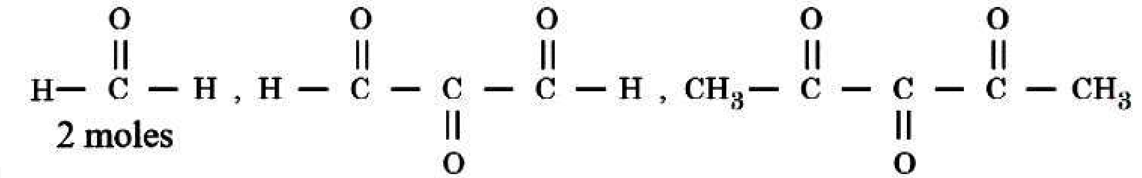
a) $-CN$ b) $-COOH$ c) $-NO_2$ d) $-I$

1) $c < b < d < a$ 2) $c < a < b < d$ 3) $d < b < a < c$ 4) $a < b < c < d$

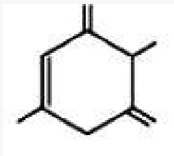
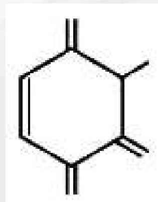
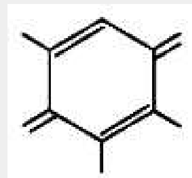
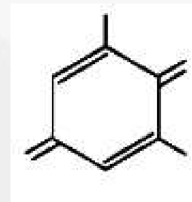
Key: 3

Sol: Electron withdrawing power: $NO_2 > CN > COOH > I$

64. An alkene (X) on ozonolysis followed by reduction gives following products.

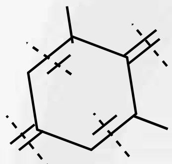


The alkene (X) is:

1)  2)  3)  4) 

Key: 4

Sol:



$$\xrightarrow{O_3 | Zn | H_2O} 2CH_2O + H-\overset{O}{\overset{\|}{C}}-\overset{O}{\overset{\|}{C}}-\overset{O}{\overset{\|}{C}}-H + CH_3-\overset{O}{\overset{\|}{C}}-\overset{O}{\overset{\|}{C}}-\overset{O}{\overset{\|}{C}}-CH_3$$

65. Match the List-I with List-II

List-I (Name of reaction)		List-II (Reagent or catalyst used)	
A	Finkelstein reaction	I	SbF_3
B	Swarts reaction	II	Na, dry ether
C	Sandmeyer's reaction	III	NaI
D	Fittig reaction	IV	$Cu_2C\ell_2$

Choose the correct answer from the options given below:

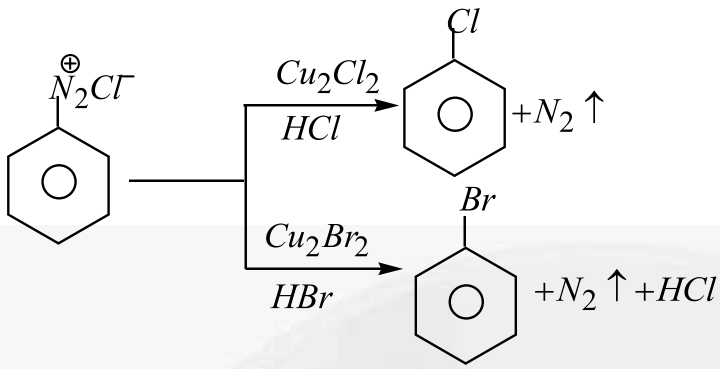
1) $A-I, B-IV, C-III, D-II$
2) $A-III, B-I, C-IV, D-II$
3) $A-IV, B-II, C-I, D-III$
4) $A-I, B-III, C-II, D-IV$

Key: 2

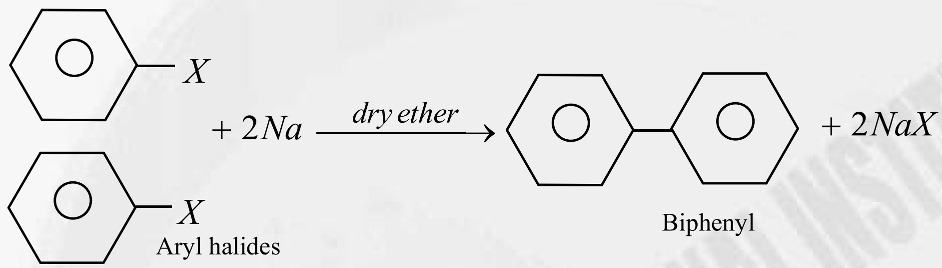
Sol: A) Finkelstein reaction: $R-X+NaI \xrightarrow{Acetone} R-I+NaX, X=Cl/Br$

B) Swarts reaction : $R-X+SbF_3 \longrightarrow R-F, X=Cl(or)Br$

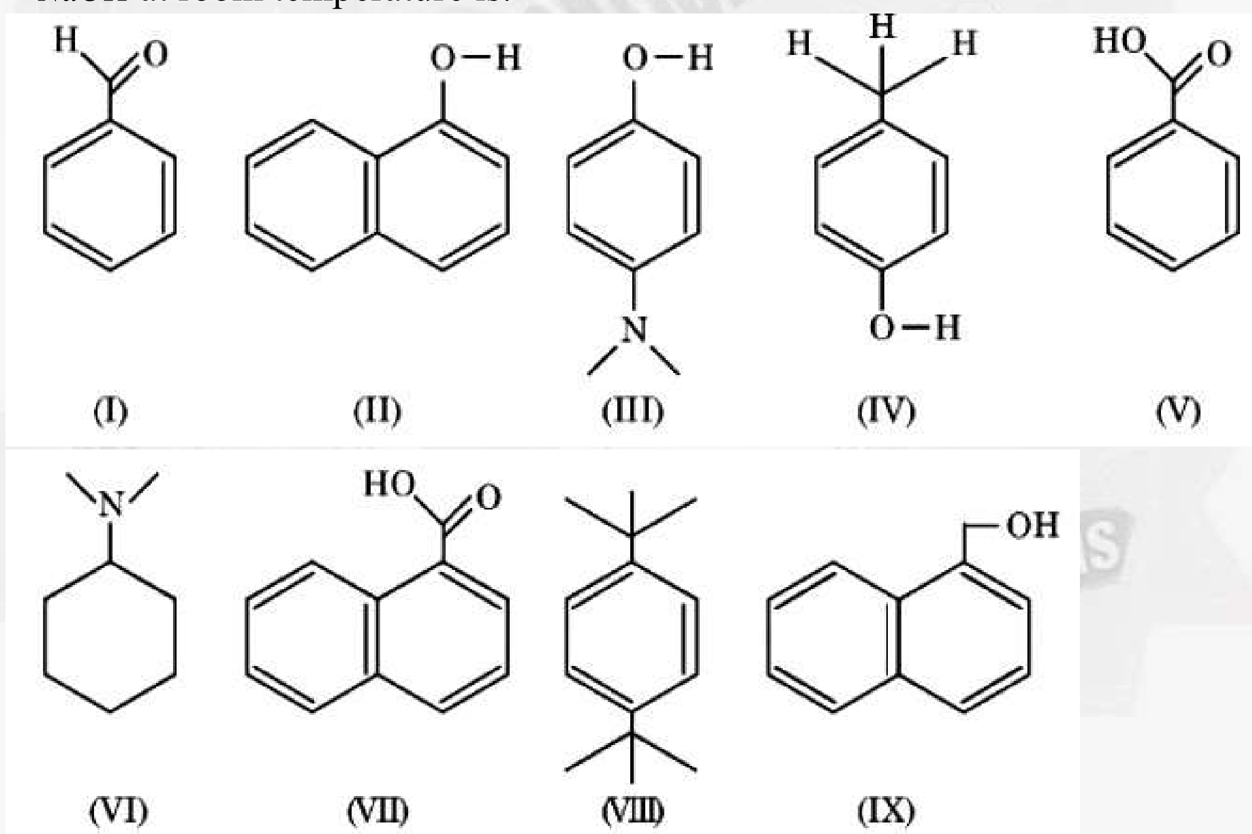
C) Sandmeyer's reaction:



D) Fittig reaction:



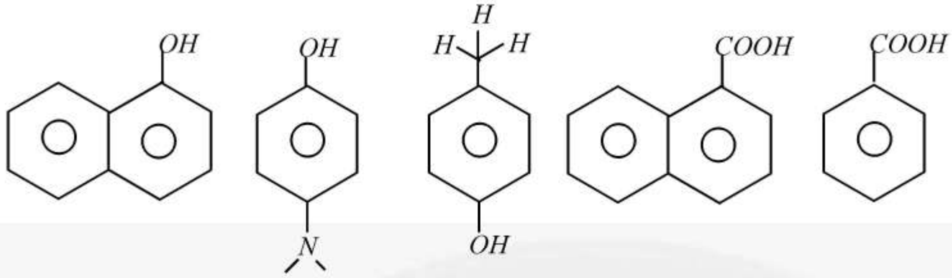
66. Amongst the following the total number of compounds soluble in aqueous $NaOH$ at room temperature is:



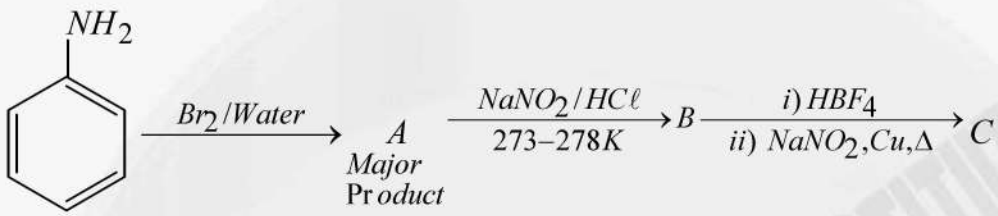
1) 5 2) 4 3) 6 4) 3

Key: 1

Sol: As the following compounds are acidic they are soluble in $NaOH$



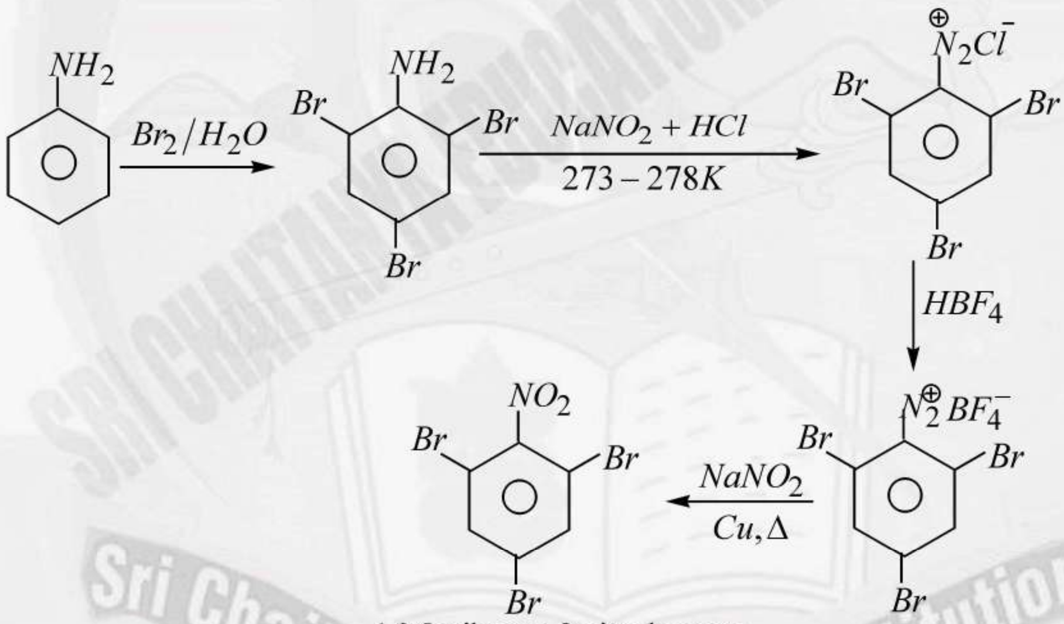
67. Product C of the following reaction sequence will be



1) 1-Bromo-4-nitobenzene
2) 1, 3, 5-Tribromo-2-nitrobenzene
3) 4-Bromo-1-nitrobenzene
4) 1, 3, 5-Tribromobenzene

Key: 2

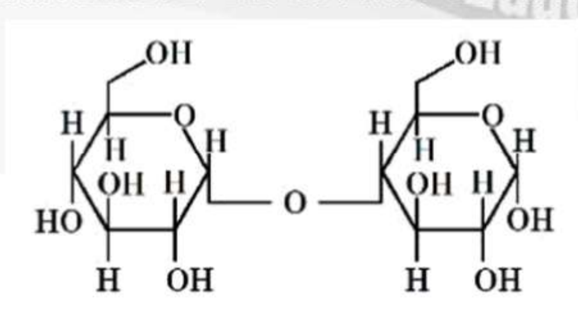
Sol:



1,3,5-tribromo-2-nitro benzene

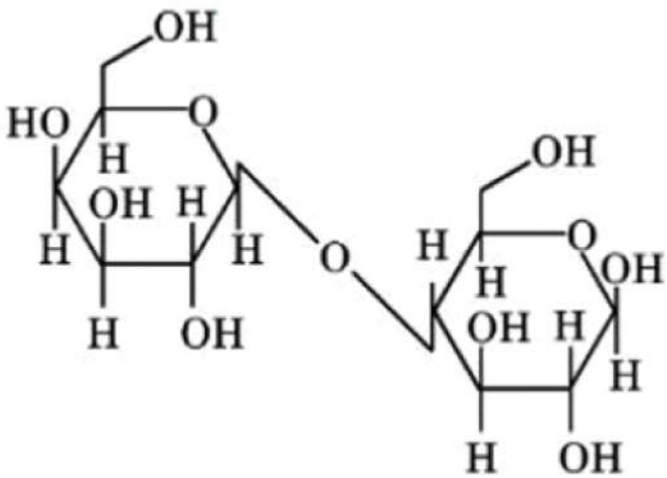
68. Given below are two statements:

Statement I: The structure of Maltose is given below:



Maltose is a non-reducing sugar

Statement-II: The structure of Lactose is given below:



Lactose is a reducing sugar

In the light of the above statements, choose the correct answer from the options given below

1) Both Statement I and Statement II are true
2) Both Statement I and Statement II are false
3) Statement I is true but Statement II is false
4) Statement I is false but Statement II is true

Key: 4

Sol: Both Maltose and Lactose are reducing sugars.

69. Match the List-I with List-II

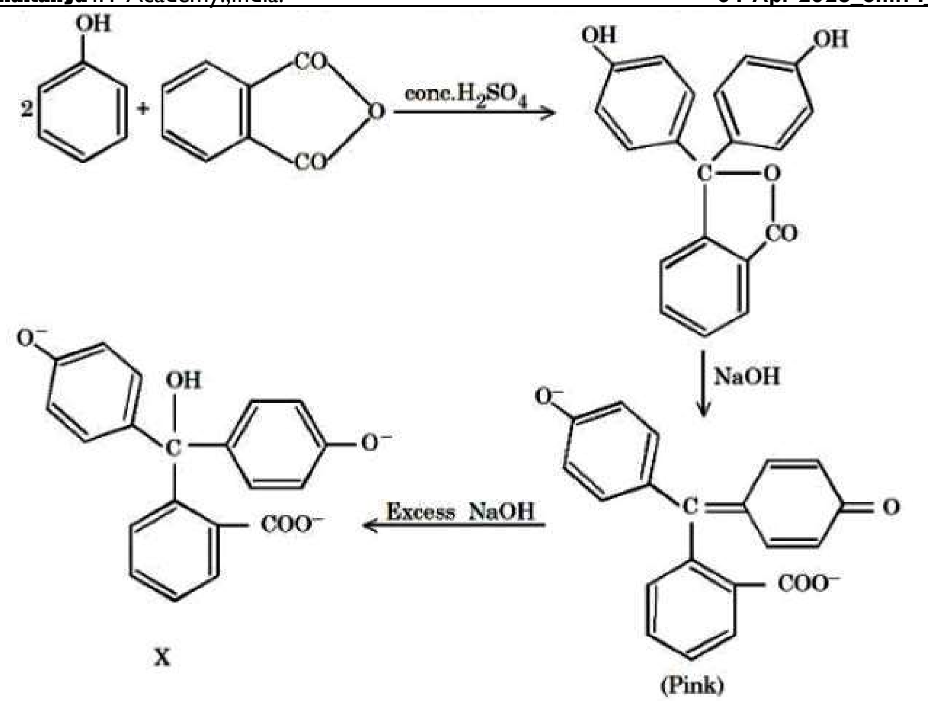
List-I (Name of amino acid)		List-II (One letter symbol/type)	
A	Arginine	I	D/Non-essential
B	Aspartic acid	II	R/Essential
C	Lysine	III	E/Non-essential
D	Glutamic acid	IV	K/Essential

1) $A-II, B-I, C-IV, D-III$
2) $A-IV, B-III, C-II, D-I$
3) $A-III, B-IV, C-I, D-II$
4) $A-II, B-IV, C-I, D-III$

Key: 1

Sol: Arginine – R – Essential
Aspartic acid – D – Non essential
Lysine – K – Essential
Glutamic acid – E – Non essential

70. Identify the colour of compound 'X' in the sequence of the reaction.



1) Violet 2) Green 3) Red 4) Colourless

Key: 4

Sol: Excess of $NaOH$ increases the pH beyond 10. At this pH (11 to 14) the Quinonoid structure converts into a trianionic form which is colourless

SECTION-II
(NUMERICAL VALUE TYPE

This section contains **5 Numerical Value Type Questions.** The Answer should be within **0 to 9999.** If the Answer is in **Decimal** then round off to the **Nearest Integer** value (Example i,e. If answer is above **10** and less than **10.5** round off is **10** and If answer is from **10.5** and less than **11** round off is **11).**

Marking scheme: +4 for correct answer, 0 if not attempt and -1 in all other cases

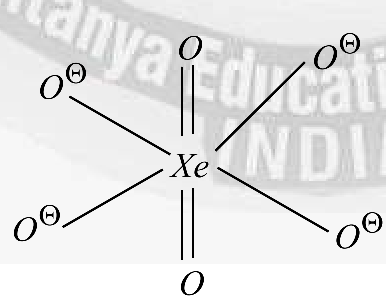
71. According to Lewis theory, the total number of σ bond-pairs and lone pair of electrons around the central atom of XeO_6^{4-} ion is ___.

Key: 6

Sol: XeO_6^{-4}

$x+6(-2)=-4$

$x=+8$

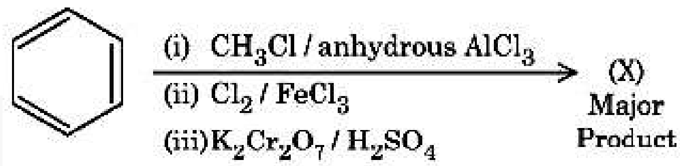


Total count: (σ bonds-pairs) + (lone pair)

$=6+0$

$=6$

72. Consider the following sequence of reactions to give the major product (X)

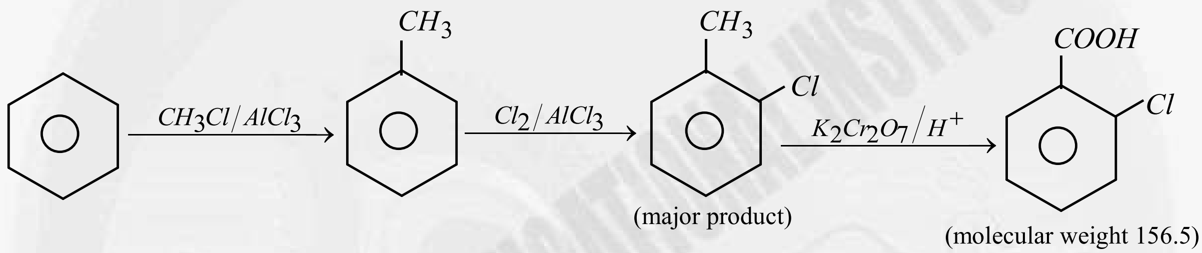


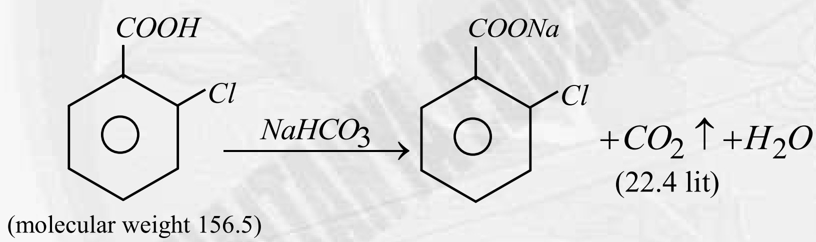
$P\,g$ of the major product (X) formed is reacted with $NaHCO_3$ solutions to liberate a gas which occupied $11.2\,dm^3$ at STP. $P=$ ____ g.

(Given molar mass in $g\,mol^{-1}$ $H:1, C:12, O:16, Cl:35.5$)

Key: 78

Sol:





Volume of CO_2		Mass of organic compound
22.4 lit	-	156.5 gm
11.2 lit	-	78.25

$=78$

73. $2.0\,g$ of a bromo hydrocarbon (X) was subjected to Carius analysis, gave $3.36\,g$ of $AgBr$. The percentage of carbon in the compound (X) is 26.7%. Total number of carbon atoms in the empirical formula for compound (X) is ____.

(Given molar mass in $g\,mol^{-1}$ $H:1, C:12, Br:80, Ag:108$)

Key: 5

Sol: $\%Br=\dfrac{Atomic\,mass\ of\ Br}{Molar\,mass\ AgBr}\times\dfrac{Mass\ of\ AgBr}{Mass\ of\ compound}\times 100$

$=\dfrac{80}{188}\times\dfrac{3.36}{2.0}\times 100=71.50\%$

$\%C=26.7\%$

$H\%=100-(\%C+\%Br)$

$=100-(26.7+71.50)=1.81\%$

E.F	%	Atomic Mass	Atomic ratio	Simple ratio
C	26.7	12	2.22	$2.5\times2=5$
H	1.81	1	1.81	$2\times2=4$
Br	71.50	80	0.89	$1\times2=2$

$\left(E.F=C_5H_4Br_2\right)$

74. The pH of a solution obtained by mixing $5mL$ of $0.1M\ NH_4OH$ solution with $250mL$ of $0.1M\ NH_4Cl$ solution is ___$\times10^{-2}$. (Nearest integer)

Given: $pK_b\left(NH_4OH\right)=4.74$

$\log2=0.30$

$\log3=0.48$

$\log5=0.70$

Key: 756

Sol: No. of millimoles $=M\times V$ in M

i) $NH_4OH_{(mm)}=0.1\times5=0.5\ m\,mol$

ii) $NH_4Cl_{(mm)}=0.1\times250=25\ m\,mol$

Basic Buffer solution,

$$pOH=pK_b+\log\frac{(Salt)}{(Base)}$$

$$pOH=4.74+\log\left(\frac{25}{0.5}\right)$$

$$=4.74+\log(50)$$

$$=4.74+\log5+\log10$$

$$=4.74+0.70+1$$

$$=6.44$$

$\left(pH+pOH=14\right)$

$$pH=14-pOH$$

$$=14-6.44$$

$$=7.56$$

$$=756\times10^{-2}$$

75. A non-volatile, non-electrolyte solid solute when dissolved in $40\,g$ of a solvent, the vapour pressure of the solvent decreases from $760\,mm\,Hg$ to $750\,mm\,Hg$. If the same solution boils at $320\,K$, then the number of moles of the solvent present in the solution is ____. (nearest integer)
[Given: boiling point of the pure solvent $=319.5\,k$, K_b of the solvent $=0.3\,K\,kg\,mol^{-1}$]

Key: 5

Sol: $\Delta T_b = \left(Tb - Tb^{\circ}\right)$ BP solvent

BP of solution

$$\Delta Tb = 320K - 319.5K = 0.5K$$

$$\Delta Tb = kb \times m$$

$$0.5 = 0.3 \times m$$

$$m = \frac{0.5}{0.3} = \frac{5}{3} mol/kg$$

$$\Rightarrow m = \frac{n\ solute}{mass\ of\ \ solvent\ in\ kg}$$

$$\frac{5}{3} = \frac{n\ solute}{0.04} \Rightarrow n\ solute = \frac{5 \times 0.04}{3}$$

$$= \frac{0.2}{3} = \frac{1}{15}\ moles$$

$$RLVP \Rightarrow \frac{Po - Ps}{Po} = \frac{n\,solute}{n\ solvent}$$

$$= \frac{760 - 750}{750} = \frac{n\ solute}{n\ solvent}$$

$$n\ solvent = 75 \times n\ solute$$

$$= 75 \times \frac{1}{15} = 5$$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30 RANK OM PRAKASH BEHERA
32 RANK SUNKARA SAI RISHANTH REDDY
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