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MOMENTUM

बेतियाहाता चौक

Also at Medical Road खजांची चौक

22/01/2026
MORNING

Memory Based
Answers & Solutions

Time : 3 hrs. *for* M.M. : 300

JEE (Main)-2026 (Online) Phase-1

(Mathematics and Physics, Chemistry)

IMPORTANT INSTRUCTIONS:

(1) The test is of **3 hours** duration.

(2) This test paper consists of 75 questions. Each subject (PCM) has 25 questions. The maximum marks are 300.

(3) This question paper contains **Three Parts**. **Part-A** is Physics, **Part-B** is Chemistry and **Part-C** is **Mathematics**. Each part has only two sections: **Section-A** and **Section-B**.

(4) **Section - A :** Attempt all questions.

(5) **Section - B :** Attempt all questions.

(6) **Section - A (01 – 20)** contains 20 multiple choice questions which have **only one correct answer**. Each question carries **+4 marks** for correct answer and **–1 mark** for wrong answer.

(7) **Section - B (21 – 25) contains** 5 **Numerical value** based questions. The answer to each question should be rounded off to the **nearest integer**. Each question carries **+4 marks** for correct answer and **–1 mark** for wrong answer.

1. The number of real solution of equation $x|x+4|+3|x+2|+10=0$ is/are :

(1) 1 (2) 2

(3) 3 (4) 4

Ans. **(1)**

Sol. Case I $x < -4$

$x(-(x+4))+3(-(x+2))+10=0$

$x^2 + 7x - 4 = 0$

$\Rightarrow x = -\frac{7+\sqrt{65}}{2}$ or $-\frac{7-\sqrt{65}}{2}$

Reject Acept

Case II $-4 \le x < -2$

$x(x+4) + 3(-(x+2)) + 10 = 0$

$x^2 + x + 4 = 0$

$D < 0$ No solution

Case III $x \ge -1$

$x(x+4) + 3(x+2) + 10 = 0$

$x^2 + 7x + 16 = 0$

$D < 0$ No solution

$\Rightarrow$ No. of solution = 1.

2. If $xdy - ydx = \left(\sqrt{x^2+y^2}\right)dx$. If $y = y(x)$ & $y(1) = 0$ then $y(3)$ is :

(1) 1 (2) 2

(3) 3 (4) 4

Ans. **(4)**

Sol. $\frac{xdy-ydx}{x^2} = \frac{\sqrt{x^2+y^2}}{x^2}dx$

$d\left(\frac{y}{x}\right) = \sqrt{1+\frac{y^2}{x^2}}.\frac{1}{x}dx$

$\int \frac{d\left(\frac{y}{x}\right)}{\sqrt{1+\left(\frac{y}{x}\right)^2}} = \int \frac{1}{x}dx$

$\Rightarrow ln\left(\frac{y}{x}+\sqrt{1+\frac{y^2}{x^2}}\right) = ln\,x + ln\,k = ln\,kx$

$\Rightarrow y + \sqrt{x^2+y^2} = kx^2$

$0 + 1 = k$

$\Rightarrow y + \sqrt{x^2+y^2} = x^2$

$y + \sqrt{9+y^2} = 9$

$y = 4$

3. If $\int (\sin x)^{-11/2}(\cos x)^{-5/2}dx$

$= \frac{p_1}{q_1}(\cot x)^{9/2} - \frac{p_2}{q_2}(\cot x)^{5/2} - \frac{p_3}{q_3}(\cot x)^{1/2} + \frac{p_4}{q_4}(\cot x)^{-3/2} + C$

where H.C.F. $\{p_i, q_i\} = 1$ & $i \in \{1, 2, 3, 4\}$.

Then value of $\sum_1^4 (p_i + q_i)$

(1) 30 (2) 25

(3) 24 (4) 34

Ans. **(4)**

Sol. $\int (\tan x)^{-11/2}.\sec^8 x\,dx$

$= \int (\tan x)^{-11/2}(1+\tan^2 x)3\sec^2 x dx$

Put $\tan x = t$

$\Rightarrow \int t^{-11/2}(1+t^2)^3 dx = \int t^{-11/2}(1+t^6+3t^2+3(4))dt$

$= \int (t^{-11/2} + t^{1/2} + 3.t^{-7/2} + 3.t^{-3/2})dt$

$= -\frac{2}{9}(\cot x)^{9/2} - \frac{6}{5}(\cot)^{5/2} - 6(\cot x)^{1/2} + \frac{2}{3}(\cot x)^{-3/2} + C$

$\Rightarrow p_1 = 2, p_2 = 6, p_3 = 6, p_4 = 2$

& $q_1 = 9, q_2 = 5, q_3 = 1, q_4 = 3$

$\Rightarrow \sum_{i=1}^4 (p_i + q_i)$

$= (2 + 9) + (6 + 5) + (6 + 1) + (2 + 3) = 34.$

4. Let M {1, 2, 3 ….., 16}, if a relation R defined on set M such that R = {(x, y) : 4y = 5x – 3, x, y ∈ M}. How many elements should be added to R to make it symmetric.

(1) 2 (2) 3

(3) 4 (4) 5

Ans. (1)

Sol. R = {(3, 3), (7, 8), (11, 13)}

to make it symmetric (8, 7), (13, 11) must be added.

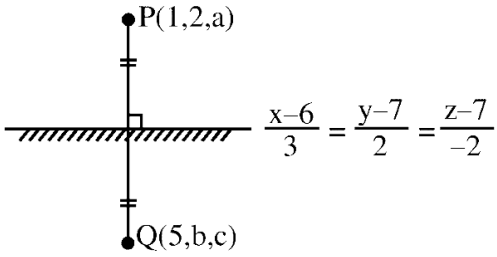
5. Image of point P (1, 2, a) with respect to line mirror $\frac{x-6}{3}=\frac{y-7}{2}=\frac{z-7}{-2}$ is point Q (5, b, c), then value of $(a^2 + b^2 + c^2)$ is :

(1) 293 (2) 298

(3) 283 (4) 264

Ans. (2)

Sol.



$\frac{x-6}{3}=\frac{y-7}{2}=\frac{z-7}{-2}$

Point $M \equiv \left(3, \frac{b}{2}+1, \frac{c+a}{2}\right)$ satisfies the line

$$\frac{3-6}{3}=\frac{\frac{b}{2}+1-7}{2}=\frac{\frac{c+a}{2}-7}{-2}$$

$$-1=\frac{b-12}{4}=\frac{c+a-14}{-4}$$

$\Rightarrow b = 8$ … (1) & $c + a = 18$ … (2)

Now $PQ \perp L$

$\Rightarrow (4i + (b–2)j + (c – a)k) \cdot (3i + 2j – 2k) = 0$

$\Rightarrow 12 + 2 (b – 2) – 2 (c – a) = 0$

$\Rightarrow 6 + (b – 2) – (c – a) = 0$

$\Rightarrow b – c + a + 4 = 0$

$\Rightarrow 8 – c + a + 4 = 0$

$\Rightarrow c + a = 12$ … (3)

From (2) & (3)

$c = 15$ & $a = 3$

So $a^2 + b^2 + c^2 = 9 + 64 + 225 = 298$

6. The no. of solution in $x \in \left(-\frac{1}{2\sqrt{6}}, \frac{1}{2\sqrt{6}}\right)$ of equation $\tan^{-1}4x + \tan^{-1}6x = \frac{\pi}{6}$ is :

(1) 0 (2) 1

(3) 2 (4) 3

Ans. (2)

Sol. $\tan^{-1}4x+\tan^{-1}6x=\frac{\pi}{6}$

$$\Rightarrow \tan^{-1}\left(\frac{4x+6x}{1+24x^2}\right)=\frac{\pi}{6}$$

$$\Rightarrow \frac{10x}{1-24x^2}=\frac{1}{\sqrt{3}}$$

$$\Rightarrow 24x^2+10\sqrt{3}x-1=0$$

$$x=\frac{-10\sqrt{3}\pm\sqrt{300+96}}{48}$$

$$x=\frac{\sqrt{396}-10\sqrt{3}}{48}$$

Only 1 solution in $\left(-\frac{1}{2\sqrt{6}}, \frac{1}{2\sqrt{6}}\right)$

7. If the value of $\frac{\cos^2 48^\circ-\sin^2 12^\circ}{\sin^2 24^\circ-\sin^2 6^\circ}$ is $\frac{\alpha+\beta\sqrt{5}}{\gamma}$ then value of $(\alpha + \beta + \gamma)$

(where $\alpha, \beta, \gamma \in N$ and are in lowest form) :

(1) 3 (2) 4

(3) 5 (4) 6

Ans. (4)

Sol. Use $\sin(A + B)\sin(A + B) = \sin^2A – \sin^2B$

$\cos(A + B)\cos(A – B) = \cos^2A – \sin^2B$

$$\frac{\cos60^\circ\cos36^\circ}{\sin30^\circ\sin18^\circ}=\frac{\sqrt{5}+1}{\sqrt{5}-1}\times\frac{\sqrt{5}+1}{\sqrt{5}+1}=\frac{(\sqrt{5}+1)^2}{4}$$

$$=\frac{3+\sqrt{5}}{2}$$

$\alpha = 3$; $\beta = 1$; $\gamma = 2$

So, $(\alpha + \beta + \gamma) = 6$

8. If a line $\alpha x + y = 1$ does not intersect the hyperbola $x^2 - 9y^2 = 9$ then a possible value of α is :

(1) 0.2 (2) 0.3

(3) 0.4 (4) 0.5

Ans. **(4)**

Sol. $y = 1-\alpha x$

Put this is equation of hyperbola

$\therefore x^2 - 9(1-\alpha x)^2 = 9$

i.e. $x^2(1-9\alpha^2) + 18\alpha x - 18 = 0$

$\because$ line does not intersect hyperbola

$\therefore D < 0$

$$\Rightarrow \alpha^2 - \frac{2}{9} > 0$$

$$\Rightarrow \alpha \in \left(-\infty, -\frac{\sqrt{2}}{3}\right) \cup \left(\frac{\sqrt{2}}{3}, \infty\right)$$

Here $\frac{\sqrt{2}}{3} \simeq 0.47$

9. If domain of

$$f(x) = \sin^{-1}\left(\frac{5-x}{2x+3}\right) + \frac{1}{\log_e(10-x)} \text{ is}$$

$(-\infty, \alpha] \cup (\beta, \gamma) - \{\delta\}$ then value of $6(\alpha + \beta + \gamma + \delta)$ is equal to :

(1) 60 (2) 70

(3) 80 (4) 90

Ans. **(2)**

Sol. $-1 \le \frac{5-x}{2x+3} \le$ & $10 - x > 0,\ 10 - x \ne 1$

$$\left|\frac{5-x}{2x+3}\right| \ge 1 \text{ \& } x < 10 \text{ \& } x \ne 9$$

$(5 - x)^2 - (2x + 3)^2 \le 0$ & $x < 10$ & $4x \ne 9$

$(x + 8)(3x - 2) \ge 0$ & $x < 10$ & $x \ne 9$

$$\Rightarrow \left(-\infty, -8\right] \cup \left(\frac{2}{3}, 10\right) - \{9\}$$

$$\Rightarrow (\alpha + \beta + \gamma + \delta) = 6\left(-8 + \frac{2}{3} + 10 + 9\right)$$

$= 70$

10. If $(9 + 7\alpha - 7\beta)^{20} + (9\alpha + 7\beta - 7)^{20} + (9\beta + 7 - 7\alpha)^{20} + (14 + 7\alpha + 7\beta)^{20}$ is m^{10} then the value of m is :

(where $\alpha = \frac{-1+i\sqrt{3}}{2}$ & $\beta = \frac{-1-i\sqrt{3}}{2}$)

(1) 50 (2) 49

(3) 46 (4) 48

Ans. **(2)**

Sol. $\left(9 + 7\omega - 7\omega^2\right) + \omega^{20}\left(9 + 7\omega - 7\omega^2\right)^{20} +$

$\omega^{40}\left(9 + 7\omega - 7\omega^2\right)^{20} + (14 + 7(\omega + \omega^2))^{20}$

$\left(9 + 7\omega - 7\omega^2\right)^{20}\left(1 + \omega + \omega^2\right) + (14 - 7)^{20} = 7^{20}$

$= (49)^{10}$

Hence, M = 49

11. If the end points of chord of parabola $y^2 = 12x$ are (x_1, y_1) and (x_2, y_2) and it subtend 90° at the vertex of parabola then $(x_1x_2 - y_1y_2)$ equals :

(1) 288 (2) 280

(3) 290 (4) not possible

Ans. **(1)**

Sol. $(x_1y_1) = \left(3t_1^2, 6t_1\right)$ & $(x_2y_2) = \left(3t_2^2, 6t_2\right)$

$t_1t_2 = -4$

$x_1x_2 = 9(t_1t_2)^2$, $y_1y_2 = 36t_1t_2$

$x_1x_2 - y_1y_2 = 9(16) - 36(-4)$

$= 144 + 144$

$= 288$

12. If probability distribution is given by

X	0	1	2	3	4	5	6	7
P(x)	0	k	2k	2k	3k	k^2	$2k^2$	$7k^2+k$

Then find $P(3 < x \le 6)$

(1) 0.33 (2) 0.22

(3) 0.11 (4) 0.44

Ans. **(1)**

Sol. $\sum P(x_i) = 1$

$\Rightarrow 9k + 10k^2 = 1$

$$\Rightarrow 10k^2 + 9k - 1 = 0 \Rightarrow k = \frac{1}{10}$$

$P(3 < x \le 6) = 3k + k^2 + 2k^2$

$$= \frac{3}{10} + \frac{3}{100} = 0.33$$

$= 0.33$

13. $f(x) = x^{2025} - x^{2000}$, $x \in [0, 1]$, then minimum value of f(x) is :

(1) $(80)^{400}.(81)^{-395}((80)^5 - (81)^5)$

(2) $(80)^{300}.(81)^{-295}((80)^5 - (81)^5)$

(3) $(80)^{-395}.(81)^{+400}((80)^4 - (81)^4)$

(4) $(80)^{-395}.(81)^{+400}((80)^3 - (81)^3)$

Ans. **(1)**

Sol. $f(x) = x^{2025} - x^{2000}$

$f'(x) = 2025x^{2024} - 2000x^{1999}$

$25x^{1999}(81x^5 - 80) = 0$

$x = \left(\frac{80}{81}\right)^{1/5}$

Minimum at $x = \left(\frac{80}{81}\right)^{1/5}$

$$f\left(\left(\frac{80}{81}\right)^{1/5}\right) = \left(\frac{80}{81}\right)^{\frac{2000}{5}}\left(\left(\frac{80}{81}\right)^{\frac{25}{5}} - 1\right)$$

$$= \left(\frac{80}{81}\right)^{400}\left(\left(\frac{80}{81}\right)^{5} - 1\right)$$

$(80)^{400}.(81)^{-395}((80)^5 - (81)^5)$

14. If the sum of first 4 terms of an AP is 6 and sum of first 6 terms is 4, then sum of first 12 terms of AP is :

(1) – 22 (2) –20

(3) 22 (4) 20

Ans. **(1)**

Sol. Sum of first 4 term $S_4 = 6$

$$\frac{4}{2}(2a+3d) = 6 \Rightarrow 2a+3d = 3 \quad \ldots\ldots (1)$$

Sum of first 6 terms $S_6 = 4$

$$\frac{6}{2}(2a+5d) = 4 \Rightarrow 2a+5d = \frac{4}{3} \quad \ldots\ldots (2)$$

eq. (2) – eq. (1)

$$(2a+5d)-(2a+3d) = \frac{4}{3} - 3$$

$$\Rightarrow d = -\frac{5}{6}$$

$$\therefore\ 2a + 3\left(-\frac{5}{6}\right) = 3 \Rightarrow a = \frac{11}{4}$$

$$S_{12} = \frac{12}{2}\left\{2\times\frac{11}{4} + (12-1)\left(-\frac{5}{6}\right)\right\}$$

$$S_{12} = 6\left(-\frac{22}{6}\right) = -22$$

15. The value of $\int_{-\pi/2}^{\pi/2} \frac{dx}{[x]+4}$ is, where $[\cdot]$ denotes greatest integer function:

(1) $\frac{7\pi}{20} - \frac{11}{30}$ (2) $\frac{\pi}{20} - \frac{11}{30}$

(3) $\frac{11\pi}{20} - \frac{7}{30}$ (4) $\frac{11\pi}{30} - \frac{7}{20}$

Ans. **(1)**

Sol. $I = \int_{-\pi/2}^{\pi/2} \frac{1}{[x]+4}dx$

$$I = \int_{-\pi/2}^{-1}\frac{dx}{2} + \int_{-1}^{0}\frac{dx}{3} + \int_{1}^{0}\frac{dx}{4} + \int_{1}^{\pi/2}\frac{dx}{5}$$

$$= \frac{1}{2}\left(-1+\frac{\pi}{2}\right) + \frac{1}{3}(1) + \frac{1}{4}(1) + \left(\frac{\pi}{2}-1\right)\frac{1}{5}$$

$$= \frac{7\pi}{20} - \frac{11}{30}$$

16. If S={1,2…..50}, two numbers α and β are selected at random find the probability that produc is divisible by 3 :

(1) $\frac{664}{1225}$ (2) $\frac{646}{1225}$

(3) $\frac{527}{1225}$ (4) $\frac{461}{1225}$

Ans. **(1)**

Sol. Req. probability = 1– (product not divisible by 3)

Multiple of 3 = 16

Not multiple of 3 = 34

$$= 1 - \frac{{}^{34}C_2}{{}^{50}C_2} = \frac{664}{1225}$$

17. The coefficient of x^{48} in

$1(1+x) + 2(1+x)^2 + 3(1+x)^3 + \ldots.. + 100(1+x)^{100}$

is :

(1) ${}^{101}C_{50} - {}^{101}C_{49}$ (2) ${}^{101}C_{49} - {}^{101}C_{50}$

(3) ${}^{101}C_{46} - 100$ (4) ${}^{101}C_{47} - {}^{101}C_{46}$

Ans. **(2)**

Sol. Let $1 + x = r$

$\therefore S = 1.r + 2.r^2 + 3.r^3 + \ldots\ldots + 100r^{100}$ ……. (1)

(AGP)

$rS = 1.r^2 + 2.r^3 + \ldots.. + 99r^{100} + 100r^{101}$ …..... (2)

(1) – (2) gives

$$S = -\frac{(1+x)^{101}}{x^2} + \frac{1}{x^2} + \frac{100(1+x)^{101}}{x}$$

$\therefore$ coefficient x^{48} in S

= – coefficient of x^{48} in $\frac{(1+x)^{101}}{x^2} + 100$.

Coefficient of x^{48} in $\frac{(1+x)^{101}}{x}$

$= -{}^{101}C_{49} - {}^{101}C_{50}$

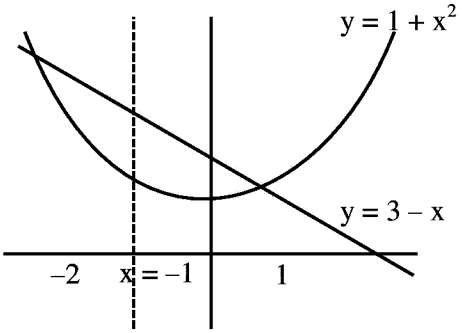
18. If a line x = – 1 divide the area of region bounded by $\{(x,y): 1+x^2 \le y \le 3-x\}$ in the ratio $\frac{m}{n}$ then (m + n) equal (where HCF of (m,n) = 1) :

(1) 25 (2) 26

(3) 27 (4) 28

Ans. (3)

Sol.



$$\frac{m}{n}=\frac{\int_{-1}^{1}\left[(3-x)-(1+x^2)\right]dx}{\int_{-2}^{1}\left[(3-x)-(1+x^2)\right]dx}=\frac{20}{7}$$

$\therefore$ m + n = 20 + 7

= 27

19. If $A=\begin{bmatrix}2 & 3\\ 3 & 5\end{bmatrix}$ then value of det $(A^{2025}-3A^{2024}+A^{2023})$:

Ans. (16)

Sol. $A=\begin{bmatrix}2 & 3\\ 3 & 5\end{bmatrix} \Rightarrow A^2=\begin{bmatrix}13 & 21\\ 21 & 34\end{bmatrix}$

$|A^{2025}-3A^{2024}+A^{2023}|$

$= \left| A^{2023}\left(A^2-3A+I\right)\right|$

$= |A|^{2023}\left|A^2-3A+I\right|$

$= 1.\begin{vmatrix}8 & 12\\ 12 & 20\end{vmatrix} = 160 - 144 = 16$

20. If $6\int_1^x f(x)dx = 3x\,f(x) + x^3 - 4,\ x \ge 1$ then value of $\left(f(2)-f(3)\right)$ is :

Ans. (3)

Sol. $6\int_1^x f(x)dx = 3x\,f(x) + x^3 - 4$

Diff. both side

$6\,f(x) = 3x\,f'(x) + 3f(x) = 3x^2$

$3f(x) = 3x\,f'(x) + 3x^2$

$x\frac{dy}{dx} - y = -x^2$

$\frac{x\frac{dy}{dx}-9}{x^2} = -1$

$\Rightarrow \frac{d}{dx}\left(\frac{y}{x}\right) = -1$

$\frac{y}{x} = -x + C$

$\Rightarrow f(x) = -x^2 + Cx$

at x = 1, y = 1 $\Rightarrow$ C = 2

$f(x) = -x^2 + 2x$

f(2) – f(3) = 3

21. If two circles

$x^2 + y^2 - 4x - 2y - 4 = 0$ & $(x+1)^2 + (y+4)^2 = r^2$ intersect at two distinct points and range of $r \in (\alpha, \beta)$, then the value of $\alpha\beta$ is :

Ans. (25)

Sol. $(x-2)^2 + (y-1)^2 = 3^2$ & $(x+1)^2 + (y+4)^2 = r^2$

$|r_1 - r_2| < c_1c_2 < r_1 + r_2$

$|r-3| < \sqrt{(2+1)^2+(1+4)^2} < r+3$

$|r-3| < \sqrt{34}$ & $r + 3 > \sqrt{34}$

$-\sqrt{34} < r-3 < \sqrt{34}$ & $r > \sqrt{34} - 3$

i.e. $r = \left(3-\sqrt{34}, 3+\sqrt{34}\right) \cap \left(\sqrt{34}-3, \infty\right)$

i.e. $r \in \left(\sqrt{34}-3, \sqrt{34}+3\right)$

$\therefore \alpha\beta = \left(\sqrt{34}-3\right)\left(\sqrt{34}+3\right)$

= 34 – 9

= 25

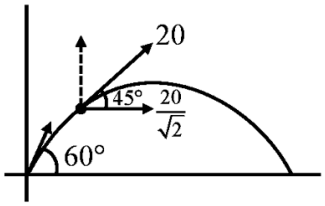
1. A particle is projected at an angle of 60° with the ground. When projectile makes an angle 45° with the horizontal, its speed becomes 20 m/s, then initial velocity is :

(1) $20\sqrt{2}$ m/s (2) $10\sqrt{2}$ m/s

(3) $5\sqrt{5}$ m/s (4) $10\sqrt{5}$ m/s

Ans. **(1)**

Sol.



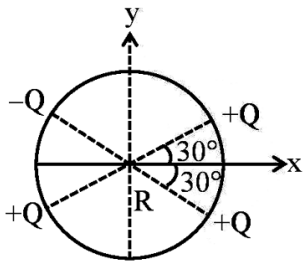
$$u\cos 60° = \frac{20}{\sqrt{2}}$$

$$\frac{u}{2} = \frac{20}{\sqrt{2}}$$

$$u = \frac{40}{\sqrt{2}}$$

$$u = 20\sqrt{2} \text{ m/s}$$

2. Find electric field intensity $\vec{E}$ at centre of circle :

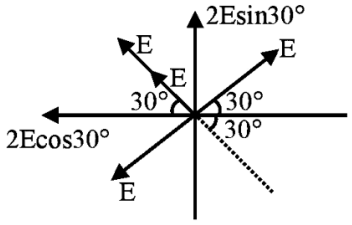


(1) $\frac{KQ}{R^2}\hat{i} + \frac{KQ}{R^2}\hat{j}$ (2) $\frac{-\sqrt{3}KQ}{R^2}\hat{i} + \frac{KQ}{R^2}\hat{j}$

(3) $\frac{KQ}{R^2}\hat{i} + \frac{\sqrt{3}KQ}{R^2}\hat{j}$ (4) $\frac{\sqrt{3}KQ}{R^2}\hat{i} + \frac{\sqrt{3}KQ}{R^2}\hat{j}$

Ans. **(2)**

Sol.

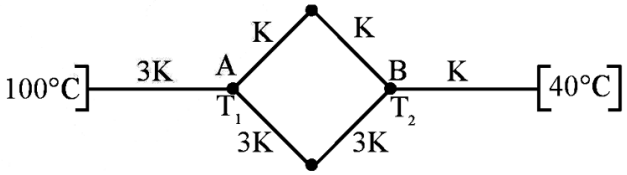


$\left[E = \frac{kQ}{R^2}\right]$

$$\vec{E}_{net} = 2E\cos 30°\left(-\hat{i}\right) + 2E\sin 30°\left(\hat{j}\right)$$

$$\frac{-\sqrt{3}kQ}{R^2}\left(\hat{i}\right) + \frac{kQ}{R^2}\left(\hat{j}\right)$$

3. As shown in the figure, six rods of same geometry are connected, and maintained at temperatures 100°C and 40°C. The temperature at points A and B are :



(1) T_A =73°C, T_B = 89°C

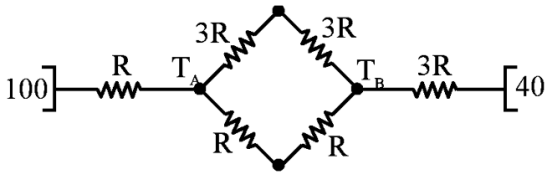
(2) T_A =85°C, T_B = 75°C

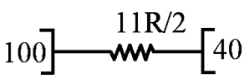
(3) T_A =89°C, T_B = 73°C

(4) T_A =74°C, T_B = 88°C

Ans. **(3)**

Sol. Let $\left[R = \frac{\ell}{3KA}\right]$





$$\left[H = \frac{100-40}{\frac{11R}{2}}\right] \ldots (1)$$

$$= \frac{100 - T_A}{R} \ldots\ldots (2)$$

$120 = 1100 - 11T_A$

using (1) and (2)

$T_A = 89°C$

$$= \frac{T_B - 40}{3R}$$

using (1) and (3)

$T_B = 73°C$

4. A convex lens of focal length 5 cm and a concave lens of focal length 4 cm are placed in contact and a point object is placed at 10 cm from system. In this arrangement magnification is m_1. Now keeping system as it is concave lens is moved 1 cm away and now magnification becomes m_2. Find m_1/m_2 :

(1) 5/6

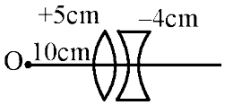
(2) 4/7

(3) 6

(4) 7

Ans. (1)

Sol. Initial configuration



$$\frac{1}{f} = \frac{1}{5} - \frac{1}{4} = -\frac{1}{20}$$

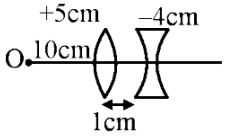
$f = -20$ cm

$u = -10$cm

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

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

New configuration



1st refraction

$u = -10$ cm, $f = +5$cm

$$v = \frac{uf}{u+f} = +10\text{cm}$$

$m = -1$

2nd refraction

$$m_1 = \frac{v}{u} = \frac{f}{u+f} \qquad u = +9\text{cm}\ f = -4\text{cm}$$

$$m' = \frac{f}{u+f} = \frac{-4}{5}$$

$$= \frac{-20}{-10-20} \qquad m_2 = mm' = (-1)\left(-\frac{4}{5}\right) = \frac{4}{5}$$

$$= +\frac{2}{3} \qquad \frac{m_1}{m_2} = \frac{2}{3} \times \frac{5}{4} = \frac{5}{6}$$

5. Escape velocity from a planet of radius R and density ρ is given as 10 km/s. Find the escape velocity from a planet of radius $\frac{R}{10}$ and density $\frac{\rho}{10}$:

(1) $10\sqrt{100}$ m/s

(2) $110\sqrt{10}$ m/s

(3) $100\sqrt{10}$ m/s

(4) $90\sqrt{10}$ m/s

Ans. (3)

Sol. $V_e = 10$ km/s $= 10^4$ m/s

$$\Rightarrow \sqrt{\frac{2GM}{R}} = 10^4$$

$$\sqrt{\frac{2G\left(\rho\frac{4}{3}\pi R^3\right)}{R}} = 10^4$$

$$\Rightarrow \sqrt{\frac{8}{3}G\rho\pi R^2} = 10^4 \qquad \ldots(i)$$

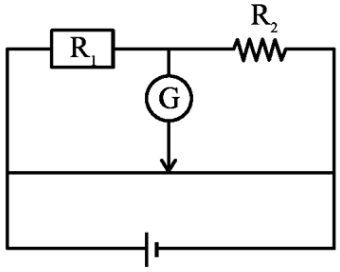
$$v_e' = \sqrt{\frac{2GM'}{R'}} = \sqrt{\frac{2G\rho\ 4\pi\left(\frac{R}{10}\right)^3}{\frac{R}{10}}}$$

$$v_e' = \sqrt{\frac{8G}{3}\frac{\rho\pi R^2}{10^3}} = \frac{v_e}{\sqrt{10^3}}$$

$$v_e' = \frac{10^4}{\sqrt{10^3}} = 10^{(4-3/2)} = 10^{5/2}$$

$$v_e' = 100\sqrt{10}\,m/s$$

6. Figure shows a meter bridge



Initially null point was achieved at a distance of 40 cm. When a resistance 16 Ω is attached in parallel with R_2, new balance point was achieved at 50 cm. Then find value of R_1 and R_2 :

(1) $R_1 = 8\Omega, R_2 = \frac{16}{3}\Omega$

(2) $R_1 = 16\Omega, R_2 = 8\Omega$

(3) $R_1 = \frac{16}{3}\Omega, R_2 = 8\Omega$

(4) $R_1 = 8\Omega, R_2 = 16\,\Omega$

Ans. (3)

Sol. Initially :

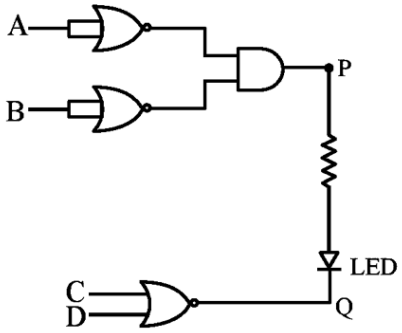
$$\frac{R_1}{R_2} = \frac{40}{60} = \frac{2}{3} \Rightarrow R_1 = \frac{2}{3}R_2$$

Again

$$\frac{R_1}{\frac{16R_2}{16+R_2}} = 1 \Rightarrow \frac{2}{3}R_2 = \frac{16R_2}{16+R_2} \Rightarrow R_2 = 8\Omega$$

$$\therefore R_1 = \frac{16}{3}\Omega$$

7. In the figure the LED will glow for input of A, B, C, D : (0 is low potential and 1 is high potential)



(1) 0 0 10 (2) 0 0 0 0

(3) 1 1 0 0 (4) 1 0 0 0

Ans. (1)

Sol. LED will glow in forward biasing :

P higher potential – 1

Q lower potential – 0

8. A closed tube filled with ideal gas is rotating with 'ω' along axis passing through end A. Find pressure at other end B (M is molar mass of the gas, ℓ is length of tube and T is the temperature of gas) :

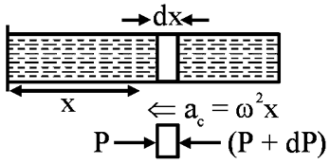
Given pressure at 'A' is P_A :

(1) $P_A e^{\frac{\omega^2\ell^2 M}{2RT}}$ (2) $P_A e^{\frac{\omega^2\ell^2 M}{RT}}$

(3) $P_A e^{\frac{\omega^2\ell^2 M}{3RT}}$ (4) $P_A e^{\frac{\omega^2\ell^2 M}{4RT}}$

Ans. (1)

Sol.



$$A[(P + dP) - P] = (dm)(\omega^2 x)$$

$$dP = \frac{(dm)}{A}\omega^2 x$$

$$dP = \frac{(\rho)(A)(dx)\omega^2 x}{A}$$

also [PM = ρRT]

$$\rho = \frac{PM}{RT}$$

$$dP = \left(\frac{PM}{RT}\right)\omega^2 x dx$$

$$\int_{P_A}^{P_B}\frac{dP}{P} = \frac{\omega^2 M}{RT}\int_0^{\ell} x dx$$

$$\ell n\left(\frac{P_B}{P_A}\right) = \frac{\omega^2 \ell^2 M}{2RT}$$

$$P_B = P_A e^{\frac{\omega^2 \ell^2 M}{2RT}}$$

9. For an ideal gas in a reversible process ($\Delta Q = 0$), volume becomes 8 times and temperature becomes $\frac{1}{4}$ times the initial value. Identify the gas :

(1) CO_2

(2) O_2

(3) NH_3

(4) He

Ans. (4)

Sol. $PV^{\gamma} = \text{constant}$

$TV^{\gamma-1} = \text{constant}$

$$TV^{\gamma-1} = \left(\frac{T}{4}\right)(8V)^{(\gamma-1)}$$

$$4 = 8^{(\gamma-1)}$$

$$2^2 = 2^{3\gamma-3}$$

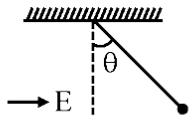
$$2 = 3(\gamma-1)$$

$$\gamma = \frac{5}{3}$$

Gas is a monoatomic gas

Answer is He.

10. A simple pendulum with bob of mass m carrying charge q is in equilibrium in presence of horizontal electric field E, then tension in the thread is :



(1) $T = \sqrt{(qE)^2 + (mg)^2}$

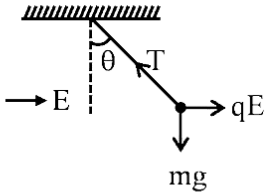
(2) $T = mg + qE\tan\theta$

(3) $T = \sqrt{(qE)^2 - (mg)^2}$

(4) $T = mg - qE\tan\theta$

Ans. (1)

Sol.



$$T = \sqrt{(qE)^2 + (mg)^2}$$

11. There is a glass sphere of refractive index 1.5, on which a parallel beam of light falls. Find distance of final converging point of final emergent ray from centre of the sphere. Radius of sphere is 50 cm :

(1) 75 cm

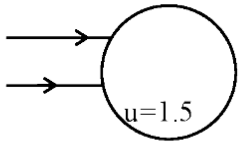
(2) 70 cm

(3) 80 cm

(4) 65 cm

Ans. (1)

Sol.



1st refraction

$$\frac{1.5}{v}-\frac{1}{\infty}=\frac{1.5-1}{+50}$$

$$\frac{1.5}{v}=\frac{1}{100}\Rightarrow v=150\text{cm}\ \text{ or}$$

= 50 cm from 2nd surface

2nd refraction

$$\frac{1}{v}-\frac{1.5}{+50}=\frac{1-1.5}{-50}$$

$$=-2$$

$$\frac{1}{v}=\frac{1}{100}+\frac{3}{100}$$

$$=\frac{4}{100}$$

v = 25 cm

$\therefore$ Distance from centre = 75 cm

12. **Statement-1 :** Liquid pressure is only exerted on solid surface in contact and is exerted in between the layers of liquid.

Statement-2 : Surface tension arises due to difference in potential energy of molecules in bulk of liquid and at surface.

(1) Both **Statement-1** and **Statement-2** are incorrect.

(2) **Statement-1** is correct but **Statement-2** is incorrect.

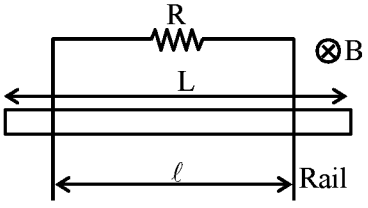
(3) **Statement-1** is incorrect but **Statement-2** is correct.

(4) Both **Statement-1** and **Statement-2** are correct.

Ans. **(4)**

Sol. Theory

13. A rod of mass 'm' and length 'L' is released on a rail placed in uniform magnetic field B. What will be the terminal velocity of rod :

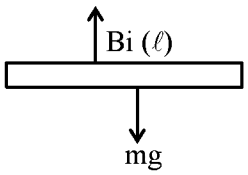


(1) $\frac{mgR}{B^2L^2}$ (2) $\frac{mgR}{B^2\ell^2}$

(3) $\frac{mgR}{B\ell^2}$ (4) $\frac{mg}{B^2\ell^2R}$

Ans. **(2)**

Sol. Terminal velocity



$$i=\frac{(B)(v)(\ell)}{R}$$

$$B(i)(\ell)=mg$$

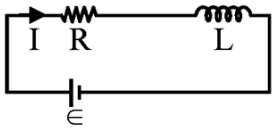
$$B\left[\frac{Bv\ell}{R}\right]\ell=mg$$

$$\frac{B^2\ell^2v}{R}=mg$$

$$v=\frac{mgR}{B^2\ell^2}$$

14. Find energy density at the instant current is $\frac{1}{e}$ times maximum value. If value is $\alpha\frac{\pi}{e^2}$. Find α.

(Given : $\in$ = 10 volt, R = 10Ω, L = 10 mH, $\frac{N}{\ell}=10000$.)



Ans. **20**

Sol. $\frac{I_0}{e}=I=I_0(1-e^{-Rt/L})$, where $I_0=\in/R$

Energy density = $\frac{1}{2}\frac{B^2}{\mu_0}=\frac{1}{2\mu_0}(\mu_0nI)^2$

$$=\frac{1}{2}\mu_0n^2I^2$$

$$=\frac{1}{2}\mu_0n^2\frac{I_0^2}{e^2}$$

$$=\frac{1}{2}(4\pi)(10^{-7})(10000)^2\left(\frac{10}{10}\right)^2\frac{1}{e^2}$$

$$=2\times10^{+1}\times\left(\frac{\pi}{e^2}\right)$$

$$\frac{\alpha\pi}{e^2}=20\left(\frac{\pi}{e^2}\right)\Rightarrow\alpha=20$$

15. The energy required to excite electron from first Bohr's orbit of Hydrogen atom to second Bohr's orbit in J is :

(1) 1.634×10^{-18} J (2) 1.2×10^{-18} J

(3) 0.2×10^{-18} J (4) 1.2×10^{-20} J

Ans. (1)

Sol. $E_n = \frac{-13.6}{n^2} eV$

$\Rightarrow n = 1; E_1 = -13.6$ eV

$\Rightarrow n = 2; E_2 = \frac{-13.6}{2^2} = -3.4eV$

$\Delta E = E_2 - E_1 = -3.4 - (-13.6)$

$= 10.2$ eV

$\Delta E = 10.2 \times 1.6 \times 10^{-19}$

$\Delta E = 1.634 \times 10^{-18}$ J

16. A photon is incident on particle having mass m = 15.356 amu. What should be the frequency of photon so that particle of mass 'm' breaks into four α-particles :

(given : $m_\alpha = 4.004$ amu ;$h = 6.6 \times 10^{-34}$ Js)

(1) 14.9×10^{19} kHz

(2) 12.9×10^{19} kHz

(3) 9.9×10^{19} kHz

(4) 10.9×10^{19} kHz

Ans. (1)

Sol. $hv = (4 \times 4.004 - 15.356)$ amu $\times c^2$

$v = \frac{0.66}{h} \times 931 \times 10^6 eV$

$v = 14.9 \times 10^{19}$ kHz

17. Match the following :

(1)	Spring constant	(i)	$ML^2T^{-2}K^{-1}$
(2)	Thermal Conductivity	(ii)	$MLT^{-3}K^{-1}$
(3)	Boltzman constant	(iii)	ML^0T^{-2}
(4)	Inductance	(iv)	$ML^2T^{-2}A^{-2}$

(1) (1) $\rightarrow$ (ii), (2) $\rightarrow$ (iii), (3) $\rightarrow$ (i), (4) $\rightarrow$ (iv)

(2) (1) $\rightarrow$ (iii), (2) $\rightarrow$ (i), (3) $\rightarrow$ (ii), (4) $\rightarrow$ (iv)

(3) (1) $\rightarrow$ (i), (2) $\rightarrow$ (ii), (3) $\rightarrow$ (iii7), (4) $\rightarrow$ (iv)

(4) (1) $\rightarrow$ (iii), (2) $\rightarrow$ (ii), (3) $\rightarrow$ (i), (4) $\rightarrow$ (iv)

Ans. (4)

Sol. $F = K.x$

$K = F/x$

$[K] = \frac{[MLT^{-2}]}{[L]} = MT^{-2}$ (iii)

(A) $\rightarrow$ (iii)

(B) Thermal conductivity : $\left[MLT^{-3}K^{-1}\right] \rightarrow$ (ii)

(C) Boltzman constant : $\left[ML^2T^{-2}K^{-1}\right] \rightarrow$ (i)

(D) Inductance : $\left[ML^2T^{-2}A^{-2}\right] \rightarrow$ (iv)

18. An α-particle is projected towards a fixed gold nucleus (Z = 79) with kinetic energy 7.9 MeV. If particle is just able to touch the nucleus boundary. Find diameter of nucleus :

(1) 57.6 fm (2) 45.6 fm

(3) 36.6 fm (4) 20.6 fm

Ans. (1)

Sol. $K_f + U_i = K_f + U_f$

$7.9 \text{ MeV} + 0 = 0 + \frac{K.Qq}{r}$

$7.9 \times 10^6 \times e = \frac{9 \times 10^9 \times 79e.2e}{r}$

$r = 9 \times 10^3 \times 10 \times 2 \times 1.6 \times 10^{-19}$

$= 28.8 \times 10^{-15} = 2.88 \times 10^{-14}$ m

$d = 2r = 5.76 \times 10^{-14}$ m

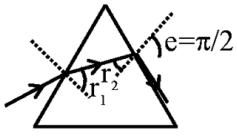
$= 57.6$ fm

19. A ray of light is incident at angle of incidence 'i' on an equilateral prism. If the ray emerges grazing the second surface, find angle of refraction (in degree) at first surface. Refraction index is $\sqrt{2}$.

Ans. (15)

Sol. Equilateral prism.

$A = 60°$



$\mu \text{Sin} r_2 = 1.\text{sine} = 1$

$\text{Sin} r_2 = \frac{1}{\mu} = \frac{1}{\sqrt{2}}$

$r_2 = 45°$

$\therefore r_1 = A - r_2 = 15°$

20. Two discs having same moment of inertia about their axis. Their thicknesses are t_1 and t_2 and they have same density. If $R_1/R_2 = 1/2$, then find t_1/t_2 :

(1) 1/16 (2) 16

(3) 1/4 (4) 4

Ans. (2)

Sol. $I_1 = I_2$

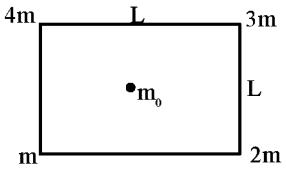
$$\frac{M_1R_1^2}{2} = \frac{M_2R_2^2}{2}$$

$$\rho\frac{\pi R_1^2 t_1 R_1^2}{2} = \rho\frac{\pi R_2^2 t_2 R_2^2}{2}$$

$$\frac{t_1}{t_2} = \frac{R_2^4}{R_1^4} = 2^4$$

$$\frac{t_1}{t_2} = 16$$

21. If initially force on $m_0 = F_0$. When position of 4m & 3m are interchanged, force become F'. If $F_0/F' = \alpha/\sqrt{5}$. Find α :

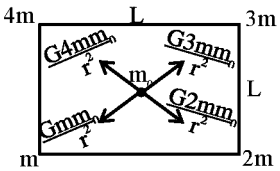


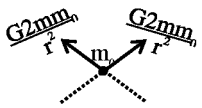
(1) 1 (2) 2

(3) 3 (4) 4

Ans. (2)

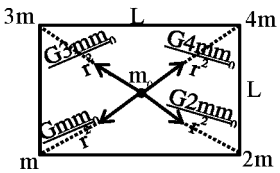
Sol. Initial configuration

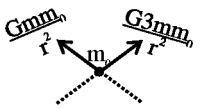




$$F = 2\sqrt{2}\frac{Gmm_0}{r^2}$$

New configuration



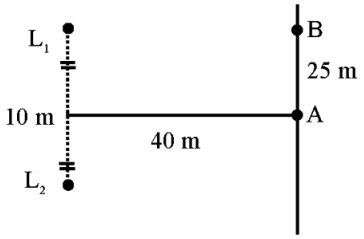


$$F' = \sqrt{10}\frac{Gmm_0}{r^2}$$

$$\Rightarrow \frac{F}{F'} = 2\sqrt{2}.\frac{1}{\sqrt{10}} = \frac{2}{\sqrt{5}}$$

$$\therefore \alpha = 2$$

22. Two coherent loudspeaker L_1 and L_2 are placed at separation of 10 m parallel to the wall at distance 40 m as shown in the figure. On width AB on the wall, 10 maximas and minimas are found. If velocity of sound is 324 m/s. find frequency of sound ($\sqrt{5} = 2.23$) :



(1) 600 Hz (2) 500 Hz

(3) 400 Hz (4) 700 Hz

Ans. (1)

Sol. $L_1B = \sqrt{20^2 + 40^2} = 20\sqrt{5}\text{m} = 44.6\text{m}$

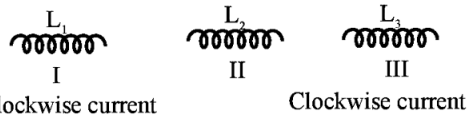
$L_2B = \sqrt{30^2 + 40^2} = 50\text{m}$

$\Delta x = 50 - 44.6 = 5.4\text{ m} = 10\lambda$ for 10 cycles

$\lambda = 0.54$ m

$$f = \frac{v}{\lambda} = \frac{324}{0.54} = 600\text{Hz}$$

23. As shown three coils are given having equal current in first and last coil, choose the correct option for the 2nd inductor to have clockwise current :



(1) Move L_1 to words L_2 & L_3 away from L_2.

(2) Move L_1 away from L_2 & L_3 away from L_2.

(3) Move L_1 to words L_2 & L_3 towards L_2.

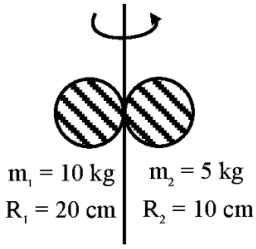
(4) Move L_1 away from L_2 & L_3 towards L_2.

Ans. (1)

Sol. Theory

24. Find the moment of inertia about given axis.

Two solid spheres



(1) 0.63 kg m^2 (2) 0.61 kg m^2

(3) 0.62 kg m^2 (4) 0.60 kg m^2

Ans. (1)

Sol. $I = \frac{2}{5}m_1R_1^2 + m_1R_1^2 + \frac{2}{5}m_2R_2^2 + m_2R_2^2$

$= \frac{7}{5}\left[m_1R_1^2 + m_1R_2^2\right]$

$= \frac{7}{5}\left[10\times(20)^2 + 5(10)^2\right]\times10^{-4}$

$= \frac{7}{5}\left[10\times4+5\right]\times10^2\times10^{-4}$

$= \frac{7}{5}\times45\times10^{-2}$

$I = 63 \times 10^{-2}$ kg m^2

$I = 0.63$ kg m^2

25. If potential is v = 500 volts at (10, 20) and electric field given $\vec{E} = 10x\hat{i} + 5y\hat{j}$ N/C. Find potential at origin.

(1) 1000 volt (2) 2000 volt

(3) 1500 volt (4) 3000 volt

Ans. (2)

Sol. $\Delta V = -\int \vec{E}.d\vec{r}$

$V_{(10,20)} - V_{(0,0)} = -\int_{(0,0)}^{(10,20)} (10xdx + 5ydy)$

$500 - V = -\left[5x^2 + \frac{5}{2}y^2\right]_{0,0}^{10,20}$

$= -\left[5(10)^2 + \frac{5}{2}(20)^2 - 0\right]$

$500 - V = -1500$

$V = 500 + 1500$

$V_{(0,0)} = 2000$ volt

SECTION-A

1. Number of unpaired e^- in low spin octahedral complex formed by ions Mn^{3+}, Cr^{3+}, Fe^{3+} & Co^{3+} follows the order :

(1) $Mn^{3+} > Cr^{3+} > Fe^{3+} > Co^{3+}$

(2) $Cr^{3+} > Mn^{3+} > Fe^{3+} > Co^{3+}$

(3) $Fe^{3+} > Cr^{3+} > Co^{3+} > Mn^{3+}$

(4) $Co^{3+} > Fe^{3+} > Cr^{3+} > Mn^{3+}$

Ans. **(2)**

Sol. $Co^{3+} \rightarrow 3d^6 \Rightarrow t_{2g}^{2,2,2}\, e_g^{0,0}$,unpaired electron = 0

$Fe^{3+} \rightarrow 3d^5 \Rightarrow t_{2g}^{2,2,1}\, e_g^{0,0}$ unpaired electron = 1

$Cr^{3+} \rightarrow 3d^3 \Rightarrow t_{2g}^{1,1,1}\, e_g^{0,0}$ unpaired electron = 3

$Mn^{3+} \rightarrow 3d^4 \Rightarrow t_{2g}^{2,1,1}\, e_g^{0,0}$ unpaired electron = 2

2. Four elements from second period Boron to Oxygen can have following IE_1 values (in kJ mol^{-1}) :

1086.5, 800.6, 1313.9, 1402.3

The value of IE_1 for "Nitrogen" is.

(1) 1086.5 (2) 800.6

(3) 1402.3 (4) 1313.9

Ans. **(3)**

Sol. IE_1 : N > O > C > B

3. An element of p-block forms a species of type EH_4^+, which when passed through a basic solution of $K_2[HgI_4]$, forms a brown ppt.

Select the correct option :

(1) Element E has maximum covalency equal to 5.

(2) Brown ppt. formed is HgO. $Hg(NH_2)I$.

(3) Element E has maximum electron affinity in its group.

(4) EH_3 is phosphine.

Ans. **(2)**

Sol. Element E is N, the species is NH_4^+

4. Match the following and choose the correct option.

List-I	List-II
(a) $[Ag(NH_3)_2]^{\oplus}$	(i) Fehling solution
(b) Zn-Hg/HCl	(ii) Clemmensen reduction
(c) NH_2–NH_2/KOH	(iii) Tollen's reagent
(d) $Cu^{+2}/OH^{\ominus}$	(iv) Wolff-Kishner reduction

(1) a → (i), b → (ii), c → (iii), d → (iv)

(2) a → (iv), b → (iii), c → (ii), d → (i)

(3) a → (iii), b → (ii), c → (iv), d → (i)

(4) a → (i), b → (ii), c → (iv), d → (iii)

Ans. **(3)**

5. **Statement-I** An element 'X' of P-block forms a hydride H–X, which has longest bond length then element 'X' will have the shortest covalent radius.

Statement-II An element 'E' of Group 15 forms hydride EH_3 that has least B.P. The Maximum covalency of E is 4.

(1) Both statements are correct

(2) Statement-I is correct ; statement-II is incorrect

(3) Statement-I is incorrect; statement-II is correct

(4) Both statements are incorrect.

Ans. **(4)**

Sol. Least B.P. is for PH_3. Maximum covalency of P is 5.

6. Two elements of p-block can form following halides XF_3 & YF_3. XF_3 can act as Lewis acid while YF_3 can act as Lewis base. Then hybridization of 'X' & 'Y' in XF_3 & YF_3 is respectively.

(1) sp^2, sp^2 (2) sp^3, sp^2

(3) sp^2, sp^3 (4) sp^3, sp^3

Ans. **(3)**

Sol. $XF_3 = BF_3$; $YF_3 = NF_3$

7. An element 'M' does not evolve H_2 gas on treatment with dilute HCl. MSO_4 (1 mol) on treatment with ex.KCN forms a compound 'P'. The amount of MS formed (in moles) when H_2S gas is passed through compound 'P' is -

(1) 0 (2) 1

(3) 2 (4) 4

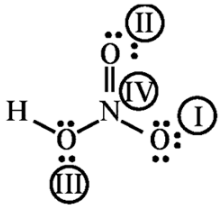
Ans. **(1)**

Sol. $Cu \xrightarrow{\text{dil.HCl}} X$

$CuSO_4 \xrightarrow{KCN} \underset{\text{perfect complex}}{[Cu(CN)_4]^{3-}} \xrightarrow{H_2S}$ no sulphide ppt

(CuS)

8. Consider the structure of HNO_3



Select the correct option having formal charge of I, II, III & IV respectively

(1) –1, 1, +1, 0 (2) 0, 0, +1, –1

(3) –1, 0, 0, +1 (4) +1, –1, 0, 0

Ans. **(3)**

Sol. Formal charge = valence e's – non bonding e's

$$-\left(\frac{\text{bonding electrons}}{2}\right)$$

9. $CH_3 - Br \xrightarrow{CH_3OH/\overset{\ominus}{Nu}:}$

Correct order of rate of this reaction for given nucleophile

$\overset{\ominus}{Nu}: \Rightarrow I^{\ominus}, F^{\ominus}, C_2H_5O^{\ominus}, PhO^{\ominus}$

(1) $F^{\ominus} > PhO^{\ominus} > C_2H_5O^{\ominus} > I^{\ominus}$

(2) $C_2H_5O^{\ominus} > PhO^{\ominus} > I^{\ominus} > F^{\ominus}$

(3) $I^{\ominus} > C_2H_5O^{\ominus} > PhO^{\ominus} > F^{\ominus}$

(4) $PhO^{\ominus} > C_2H_5O^{\ominus} > F^{\ominus} > I^{\ominus}$

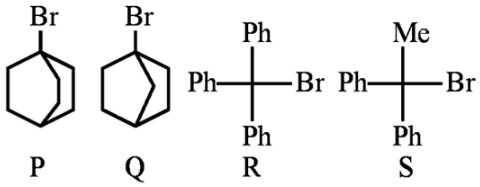
Ans. **(3)**

Sol. For the given substrate of nucleophiles :

Order of nucleophilicity :

$I^{\ominus} > C_2H_5O^{\ominus} > PhO^{\ominus} > F^{\ominus}$

10. Compare rate of S_N1



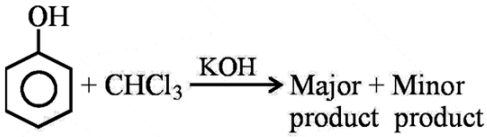
(1) P > Q > R > S (2) R > S > P > Q

(3) R > S > Q > P (4) S > R > Q > P

Ans. **(2)**

Sol. Rate of $S_N1 \propto$ Stability of $C^{\oplus}$

11. **Statement-I :**



Major product is ortho substituted product and minor product is para substituted.

Statement-II :

Ortho & Para substituted products can be separated by steam distillation.

(1) Statement-I and Statement-II both are correct.

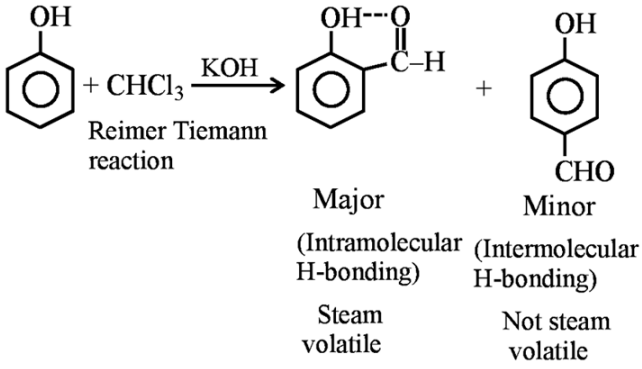
(2) Statement-I and Statement-II both are incorrect.

(3) Only Statement-I is correct.

(4) Only Statement-II is correct.

Ans. **(1)**

Sol.



Therefore can be separated by steam distillation

12. **Statement-I :** Sucrose is dextrorotatory upon by hydrolysis it becomes laevorotatory.

Statement-II : Sucrose on hydrolysis gives glucose and fructose such that the levorotation of glucose is more than dextrorotation of fructose.

(1) Statement-I is true and Statement-II is false.

(2) Statement-I is false and Statement-II is true.

(3) Only Statement-I is correct.

(4) Only Statement-II is correct.

Ans. **(1)**

Sol. $C_{12}H_{22}O + H_2O \xrightarrow{HCl} C_6H_{12}O_6 + C_6H_{12}O_6$

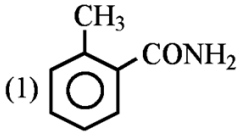
Sucrose D-glucose + D-fructose

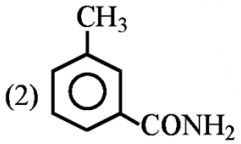
$[\alpha]_D = +66.5°$, $[\alpha]_D = +52.5°$, $[\alpha]_D = -92.4°$

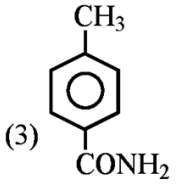
$\Rightarrow$ Sucrose is dextrorotatory and hydrolysed product is laevorotatory.

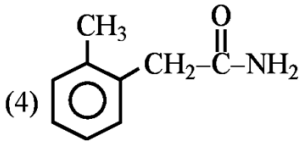
13. An organic compound with molecular formula C_8H_9NO when reacts with KOH/Br_2 forms 'P' which on diazotisation forms 'Q' followed by its reaction with CuCN forms 'R' which on hydrolysis (acidic) formed 'S' (S can also be made by hydrolysis of original compound (X) C_8H_9NO)

'S' can reaction with $KMnO_4/H^{\oplus}$ forms 'T' which has two types of hydrogen. X will be :

(1) 

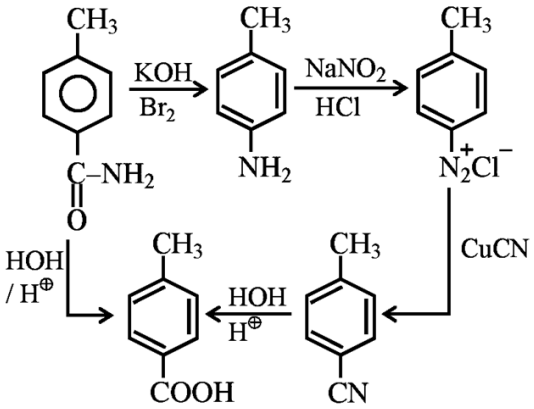
(2) 

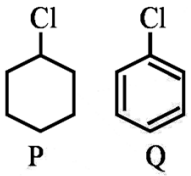
(3) 

(4) 

Ans. **(3)**

Sol.



14. 

P Q

Read the following statements :

(A) Q has more δ^- on chlorine than P.

(B) Q has more dipole moment than P.

(C) In Q, C–Cl bond has double bond character.

(D) In Q, Cl is attached to sp^2 hybridised carbon but in P, Cl is attached to sp^3.

(E) In Q, C–Cl bond length is more due to repulsion between lone pair on chlorine and π e^- in aromatic ring.

The correct option is :

(1) A, B, D, E (2) C, D

(3) B, C, D (4) B, C, D, E

Ans. **(2)**

Sol. Theory based

15. Cycloalkene (X) reacts with bromine. During reaction 1 mole of cycloalkane consumes 1 mole of Br_2 then form a product (Y). The product (Y) has C, Br ratio is 3 : 1. The % of bromine in product (Y) is :

(1) 66.11 % (2) 65.11 %

(3) 76.11 % (4) 67.11 %

Ans. (1)

Sol. $C_6H_{10} \xrightarrow{Br_2} C_6H_{10}Br_2$

Molecular mass of $C_6H_{10}Br_2$ is :

$12 \times 6 + 10 + 160$

$72 + 10 + 160 = 242$

$\%\text{ or Br} = \frac{160}{242} \times 100$

$\%\text{ of Br} = 66.11\ \%$

16. When sodium fusion extract of an organic compound was treated with $CHCl_3$ then violet colour of halogen appears. If 0.15 gm of the organic compound gives 0.12 gm of the silver halide, then find the percentage of halide in organic compound.

(1) 43.23% (2) 45.55%

(3) 42.32% (4) 44.12%

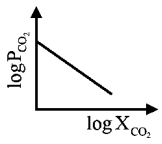
Ans. (1)

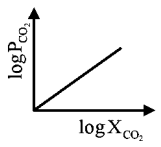
Sol. $\%\text{ of I} = \frac{\text{Atomic weight of I}}{\text{Molecular weight of AgI}} \times \frac{m}{W} \times 100$

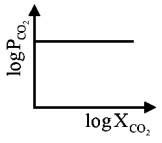
$= \frac{127}{235} \times \frac{0.12}{0.15} \times 100$

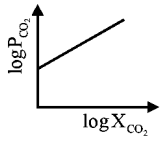
$\%\text{ of I} = 43.23\ \%$

17. Which of the following graph is a correct between $\log P_{CO_2}$ v/s $\log x_{CO_2}$? [given P_{CO_2} = Partial Pressure of CO_2, X_{CO_2} = Mole fraction of CO_2 in solution]

(1) 

(2) 

(3) 

(4) 

Ans. (4)

Sol. $P_{CO_2} = K_H X_{CO_2}$

$\log P_{CO_2} = \log K_H + \log X_{CO_2}$

$y = c + mx$

18. For the reaction

$A_{2(g)} \rightleftharpoons 2A(g)$ $\quad \Delta G^\circ_{f(A_2)} = -100 KJ/mol$

$\Delta G^\circ_{f(A)} = -50.8625 KJ/mol$

At 300K and 1 atm. pressure degree of dissociation of A_2 gas at equilibrium is $x \times 10^{-2}$. Find x.

$[R = 8.3\ Jmol^{-1}K^{-1}]$

Ans. (58)

Sol. $-1.725 \times 10^3 = -8.3 \times 300 \ln K_P$

$\ln K_P = 0.693$

$K_P = 2$

$2 = \frac{4\alpha^2 P_0}{1-\alpha^2}$

$\alpha = \frac{1}{\sqrt{3}}$

$\alpha = \frac{100}{\sqrt{3}} \times 10^{-2} = 57.736 \times 10^{-2}$

19. **Statement-I :** K_H for ideal dilute solution does not change with varying the concentration of solute.

Statement-II : K_H for solution having same gas solute is independent of nature of solvent?

(1) Both statements are correct

(2) Statement-I correct ; Statement-II incorrect

(3) Statement-II correct; Statement-I incorrect

(4) Both statements are incorrect

Ans. (2)

Sol. Statement-I is correct but statement-II is incorrect.

As K_H depends on the nature of gas & solvent.

20. Three experiments are running in separate vessel, following 1st order kinetics

Experiment-(A) 100 ml, 10 M

Experiment-(B) 200 ml, 10 M

Experiment-(C) 100 ml, 10 M + 100 ml H_2O

Select correct order of rate of reaction in above experiments

(1) A = B = C (2) A = B > C

(3) A > B > C (4) A > B > C

Ans. (2)

Sol. Rate $\propto$ [concentration of Reactant]^1

21. For an ideal gas volume is made 8 times and temperature is decreased 4 times, and heat exchanged during process is zero (q = 0), select the correct gas

(1) CH_4 (2) He

(3) CO_2 (4) NH_3

Ans. (2)

Sol. Using $TV^{\gamma-1} = K$

$T_1V_1^{\gamma-1} = T_2V_2^{\gamma-1}$

$\frac{T_1}{T_2} = \left(\frac{V_2}{V_1}\right)^{\gamma-1}$

$4 = (8)^{\gamma-1}$

$2 = 3(\gamma - 1)$

$\gamma = 5/3$

22. If E_{cell} of following reaction is $x \times 10^{-1}$. Find x

$Pt/ HSnO_2^-/ Sn(OH)_6^{2-}, OH^-/ Bi_2O_3/ Bi/ Pt$

[Reaction Quotient, $Q = 10^6$]

Given $E^\circ_{[Sn(OH)_6]^{2-}/HSnO_2^-} = -0.90V$

$E^\circ_{Bi_2O_3/Bi} = -0.44V$

Ans. (4)

Sol. $E^\circ_{cell} = -0.44 - (-0.90)$

$= +0.46\ V$

Applying Nernst equation :-

$E_{cell} = E^\circ_{cell} - \frac{0.06}{n}\log Q$

$E_{cell} = 0.46 - \frac{0.06}{6}\log 10^6$

$E_{cell} = 4 \times 10^{-1}$

$x = 4$

23. Find temperature (in kelvin) at which rate constant are equal for the following reaction ?

$A \rightarrow B,\ K = 10^4 e^{\frac{-24000}{T}}$

$P \rightarrow Q\ K = 10^6 e^{\frac{-30000}{T}}$

Ans. $T \approx 1303\ K$

Sol. $10^4 e^{\frac{-24000}{T}} = 10^6 e^{\frac{-30000}{T}}$

$e^{\frac{6000}{T}} = 100$

$\frac{6000}{T} = 2\ln 10$

$T = \frac{6000}{2 \times 2.303}$

$T = 1302.64\ K$

$T \approx 1303\ K$

24.

List-I		List-II (KJ)
(I)	Isothermal reversible (1mole ideal gas, T = 300K, $2dm^3$ to $20dm^3$) calculate |w|	(A) 8.32
(II)	Isothermal irreversible [3KPa, $1m^3$ to $3m^3$] calculate |w|	(B) 6
(III)	1 mole gas undergoes constant pressure process in which change in temperature is 400K, Cp = 5R/2, ΔH will be	(C) 4
(IV)	1 mole ideal gas having Cv=3R/2 and ΔT = 320K, calculate ΔU	(D) 5.74

Select the correct match

(1) I-A: II-B: III-D: IV-C

(2) I-D: II-B: III-A: IV-C

(3) I-B: II-A: III-C: IV-D

(4) I-A: II-B: III-C: IV-D

Ans. (2)

Sol. (I) $w = -nRT\ln\left(\frac{V_2}{V_1}\right)$

$= -1 \times \frac{8.314}{1000} \times 300 \times \ln\left(\frac{20}{2}\right) = -5.74KJ$

(II) $w = -P_{ext}(V_2 - V_1)$

$= -3 \times 10^3\ Pa \times (3 - 1)$

$= -6KJ$

(III) $\Delta H = \frac{1 \times 5 \times 8.314}{2 \times 1000} \times 400 = 8.32KJ$

(IV) $\Delta U = nC_v\Delta T = \frac{1 \times 3 \times 8.314}{2 \times 1000} \times 320 = 3.99 \simeq 4KJ$

25. For Balanced chemical reaction

$2Al_{(s)} + 6HCl_{aq.} \rightarrow 2AlCl_3 + 3H_{2(g)}$ which of the following is correct.

(1) With excess of Al, volume of H_2 gas produced per mole of HCl reacted will be 33.6 L at 1 atm & 273K.

(2) With excess of Al, volume of H_2 gas produced per mole of HCl reacted will be 11.2 L at 1 atm & 273K.

(3) With excess of HCl, moles of $AlCl_3$ produced per mole of Al reacted are 2.

(4) At given P and T, 12 L HCl produce 6 L H_2 gas.

Ans. (2)

Sol. 6 moles HCl $\rightarrow$ 3 mol H_2

$1 \rightarrow \frac{3}{6}$ mole H_2 = 11.2 L at (1atm and 273K)

4^{th} option is incorrect since, HCl is in aqueous medium.