23/01/2026
EVEINING

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. If $\sum_{k=1}^{n} a_k = \alpha n^2 + \beta n$ & $a_{10} = 59$, $a_6 = 7a_1$, then find $\alpha + \beta$:

(1) 5 (2) 10

(3) 8 (4) 3

Ans. **(1)**

Sol. $\because S_n = \alpha n^2 + \beta n$

$\therefore a_n = S_n - S_{n-1} = \alpha(n^2 - (n-1)^2) + \beta(1)$

$= (2n - 1)\alpha + \beta$

$\because a_{10} = 59 \Rightarrow 19\alpha + \beta = 59 \quad \ldots(1)$

$a_1 = \alpha + \beta$

$a_6 = 11\alpha + \beta$

$\because a_6 = 7a_1$

$11\alpha + \beta = 7\alpha + 7\beta$

$4\alpha = 6\beta$

$2\alpha = 3\beta \quad \ldots(2)$

From (1) & (2)

$19\alpha + \frac{2\alpha}{3} = 59$

$\boxed{\alpha = 3 \Rightarrow \beta = 2}$

$\therefore \boxed{\alpha + \beta = 5}$

2. The minimum value of

$\cos^2\theta + 6\sin\theta\cos\theta + 3\sin^2\theta + 3$ is :

(1) –1 (2) 1

(3) $5+\sqrt{10}$ (4) $5-\sqrt{10}$

Ans. **(4)**

Sol. $3(2\sin\theta\cos\theta) + 2\sin^2\theta + (\cos^2\theta+\sin^2\theta) + 3$

$= 3\sin 2\theta + (1 - \cos 2\theta) + 4$

$= 5 + (3\sin 2\theta - \cos 2\theta)$

So, minimum value $= 5-\sqrt{9+1}$

$= 5-\sqrt{10}$

3. If matrices A & B are such that $A = \begin{bmatrix} 0 & -2 & 3 \\ -2 & 0 & 1 \\ -1 & 1 & 0 \end{bmatrix}$

B (I – A) = (I + A), then find B.

(1) $B = \begin{bmatrix} -1 & 2/3 & 2/3 \\ -2 & 5/3 & -10/3 \\ -2 & 2 & -3 \end{bmatrix}$

(2) $B = \begin{bmatrix} -1 & 1/3 & 1/3 \\ -2 & 5/3 & -10/3 \\ -2 & 2 & -3 \end{bmatrix}$

(3) $B = \begin{bmatrix} -1 & 0 & 2/3 \\ 0 & 5/3 & -10/3 \\ 2 & 2 & -3 \end{bmatrix}$

(4) $B = \begin{bmatrix} -1 & 2/3 & 2/3 \\ -2/3 & 1 & 5/3 \\ -2 & 2 & -3 \end{bmatrix}$

Ans. **(1)**

Sol. $I - A = \begin{bmatrix} 1 & 2 & -3 \\ 2 & 1 & -1 \\ 1 & -1 & 1 \end{bmatrix}, I + A = \begin{bmatrix} 1 & -2 & 3 \\ -2 & 1 & 1 \\ -1 & 1 & 1 \end{bmatrix}$

$|(I - A)| = 1(0) - 2(3) - 3(-3)$

$= -6 + 9 = 3$

$(I - A)^{-1} = \frac{1}{3}\begin{bmatrix} 0 & 1 & 1 \\ -3 & 4 & -5 \\ -3 & 3 & -3 \end{bmatrix}$

$B = (I + A)(I - A)^{-1}$

$B = \frac{1}{3}\begin{bmatrix} 1 & -2 & 3 \\ -2 & 1 & 1 \\ -1 & 1 & 1 \end{bmatrix}\begin{bmatrix} 0 & 1 & 1 \\ -3 & 4 & -5 \\ -3 & 3 & -3 \end{bmatrix}$

$B = \frac{1}{3}\begin{bmatrix} -3 & 2 & 2 \\ -6 & 5 & -10 \\ -6 & 6 & -9 \end{bmatrix}$

$$B=\begin{bmatrix}-1 & 2/3 & 2/3\\ -2 & 5/3 & -10/3\\ -2 & 2 & -3\end{bmatrix}$$

4. If $\cot\theta=-\frac{1}{2\sqrt{2}}$ where $\theta\in\left(\frac{3\pi}{2},2\pi\right)$ then value of

$\sin\left(\frac{15\theta}{2}\right)(\sin 8\theta+\cos 8\theta)+\cos\left(\frac{15\theta}{2}\right)(\cos 8\theta-\sin 8\theta)$

is :

(1) $\frac{\sqrt{2}+1}{\sqrt{3}}$ (2) $-\left(\frac{\sqrt{2}+1}{\sqrt{3}}\right)$

(3) $\frac{\sqrt{2}-1}{\sqrt{3}}$ (4) $-\left(\frac{\sqrt{2}-1}{\sqrt{3}}\right)$

Ans. (2)

Sol. $\cos\left(8\theta-\frac{15\theta}{2}\right)+\sin\left(\frac{15\theta}{2}-8\theta\right)$

$\cos\frac{\theta}{2}-\sin\frac{\theta}{2}=-\sqrt{1-\sin\theta}$

$=-\sqrt{1+\frac{2\sqrt{2}}{3}}$

$=-\sqrt{\frac{3+2\sqrt{2}}{3}}=-\left(\frac{\sqrt{2}+1}{\sqrt{3}}\right)$

5. Sum of solutions of the equation

$\log_{x+3}(6x^2+28x+30)=5-2\log_{6x+10}(x^2+6x+9)$, are :

(1) 0 (2) 1

(3) 2 (4) 3

Ans. (1)

Sol. $\log_{x+3}[(x+3)(6x+10)]=5-2\log_{6x+10}(x+3)^2$

$1+\log_{x+3}(6x+10)=5-4\log_{6x+10}(x+3)$

Let $\log_{6x+10}(x+3)=t$

$1+\frac{1}{t}=5-4t$

$t+1=5t-4t^2\Rightarrow 4t^2-4t+1=0$

$\Rightarrow(2t-1)^2=0\Rightarrow t=\frac{1}{2}$

$\therefore \log_{6x+10}(x+3)=\frac{1}{2}\Rightarrow x+3=(6x+10)^{1/2}$

$\Rightarrow x^2+6x+9=6x+10$

$\Rightarrow x=1,-1$

So, sum of solution = 0

6. If PQ is a chord perpendicular to the transverse axis of $\frac{x^2}{4}-\frac{y^2}{b^2}=1$ of eccentricity $\sqrt{3}$ such that ΔOPQ is equilateral Δ(where O is the origin), then area of ΔOPQ is :

(1) $\frac{4}{5}\sqrt{3}$ (2) $\frac{2}{5}\sqrt{3}$

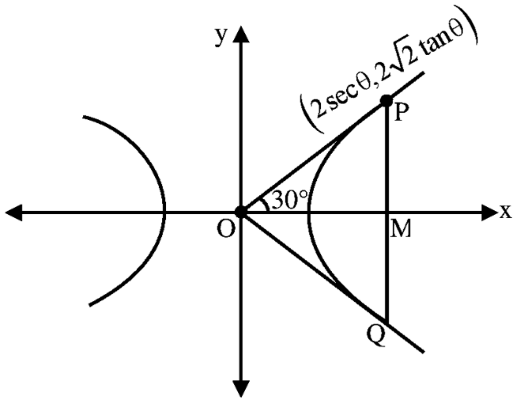
(3) $\frac{8}{5}\sqrt{3}$ (4) $\frac{16\sqrt{3}}{5}$

Ans. (3)

Sol. $e=\sqrt{1+\frac{b}{4}}=\sqrt{3}$

$\Rightarrow b=8$

$\therefore$ Hyperbola $\frac{x^2}{4}-\frac{y^2}{8}=1$



$\frac{PM}{OM}=\tan 30°$

$\Rightarrow\frac{2\sqrt{2}\tan\theta}{2\sec\theta}=\frac{1}{\sqrt{3}}\Rightarrow\sin\theta=\frac{1}{\sqrt{6}}$

Area $=2\times\frac{1}{2}\times OM\times MP$

$=2\sec\theta\times 2\sqrt{2}\tan\theta$

$$= 4\sqrt{2}\frac{\sin\theta}{\cos^2\theta} = 4\sqrt{2}\times\frac{1}{\sqrt{6}\times\left(1-\frac{1}{6}\right)} = \frac{8\sqrt{3}}{5}$$

7. If $\vec{a}, \vec{b}, \vec{c}$ are three vectors such that $\vec{a}\times\vec{b} = 2(\vec{a}\times\vec{c})$, $|\vec{a}|=1, |\vec{b}|=4, |\vec{c}|=2$ and angle between $\vec{b}\,\&\,\vec{c}$ is 60°, then find $|\vec{a}\cdot\vec{c}|$:

(1) 4 (2) 1

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

Ans. **(2)**

Sol. $\vec{a}\times\vec{b} - 2(\vec{a}\times\vec{c}) = 0$

$\vec{a}\times(\vec{b}-2\vec{c}) = 0 \Rightarrow \vec{b}-2\vec{c} = \lambda\vec{a}$ ...(1)

$|\lambda a|^2 = |\vec{b}-2\vec{c}|^2 \Rightarrow \lambda^2|\vec{a}|^2 = b^2 + 4c^2 - 4\vec{b}.\vec{c}$

$\lambda^2 = 16 + 16 - 4.4.2\cdot\frac{1}{2}$

$\lambda^2 = 16$

$\lambda = \pm 4$

$\because\ \vec{b} - 2\vec{c} = \pm 4\vec{a}$

Dot with $\vec{c} \Rightarrow \vec{b}.\vec{c} - 2|\vec{c}|^2 = \pm 4(\vec{a}.\vec{c})$

$4.2.\frac{1}{2} - 2.4 = \pm 4(\vec{a}.\vec{c})$

$|\vec{a}.\vec{c}| = 1$

8. The system of linear equations

$x + y + z = 6$

$2x + 5y + az = 36$

$x + 2y + 3z = b$

(1) Infinitely many solutions for a = 8 & b = 16

(2) Unique solution for a = 8 & b = 16

(3) Unique solution for a = 8 & b = 14

(4) Infinitely many solutions for a = 8 & b = 14

Ans. **(4)**

Sol. If $D = \begin{vmatrix} 1 & 1 & 1 \\ 2 & 5 & a \\ 1 & 2 & 3 \end{vmatrix} = 0 \Rightarrow a = 8$

If $D_1 = \begin{vmatrix} 6 & 1 & 1 \\ 36 & 5 & a \\ b & 2 & 3 \end{vmatrix} = 0 \Rightarrow ab - 5b - 12a + 54 = 0$

If $D_2 = \begin{vmatrix} 1 & 6 & 1 \\ 2 & 36 & a \\ 1 & b & 3 \end{vmatrix} = 0 \Rightarrow ab - 6a - 2b - 36 = 0$

If $D_3 = \begin{vmatrix} 1 & 1 & 6 \\ 2 & 5 & 36 \\ 1 & 2 & b \end{vmatrix} = 0 \Rightarrow b = 14$

For a = 8 & b= 14 ⇒ D_1 & D_2 are also zero

For a = 8 & b = 14 ⇒ $D = D_1 = D_2 = D_3 = 0$

⇒ infinitely many solutions.

9. Number of ways of distributing 16 identical oranges among 4 persons such that each one gets atleast one oranges is

(1) 435 (2) 455

(3) 470 (4) 489

Ans. **(2)**

Sol. $x_1 + x_2 + x_3 + x_4 = 16$

Number of positive integral solution

$= {}^{15}C_3 = 455$

10. $\int_0^x t^2\sin(x-t)\,dt = x^2$, then sum of values of x where $x \in [0, 100]$

(1) 300π (2) 272π

(3) 200π (4) 240π

Ans. **(4)**

Sol. $\int_0^x (x-t)^2\sin t\,dt = x^2$

$\int_0^x (x^2 - 2xt + t^2)\sin t\,dt = x^2$

$x^2\left(-\cos t\right)_0^x - 2x\int_0^x t\sin t\,dt + \int_0^x t^2\sin t\,dt = x^2$

$-x^2(\cos x - 1) - 2x\left(-t\cos t + \sin t\right)_0^x + \left(t^2(-\cos t)\right)_0^x + \int_0^x 2t\cos t\,dt = x^2$

$-x^2\cos x + x^2 - 2x(-x\cos x + \sin x) - x^2\cos x + 2(t\sin t + \cos t)_0^x = x^2$

$-x^2\cos x + x^2 + 2x^2\cos x - 2x\sin x - x^2\cos x + 2(x\sin x + \cos x - 1) = x^2$

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

$\cos x = 1$

$x = 2m\pi,\ m \in I$

$0 + 2\pi + 4\pi + \ldots + 30\pi$

$= 2\pi(1 + 2 + \ldots + 15)$

$= 2\pi.\dfrac{15.16}{2} = 240\pi$

11. If y = f(x) satisfies the differential equation $(x^2 - 4)y' - 2xy + 2x(4 - x^2)^2 = 0$ and f(3) = 15, then find local maximum value of f(x)

(1) 16 (2) 20

(3) 25 (4) 30

Ans. **(1)**

Sol. $\dfrac{(x^2-4)\dfrac{dy}{dx} - 2xy}{(4-x^2)^2} = -2x$

$\dfrac{d}{dx}\left(\dfrac{y}{x^2-4}\right) = -2x$

$\therefore \dfrac{y}{x^2-4} = -x^2 + C$

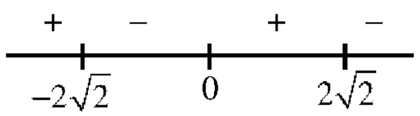
$\{(3, 15) \Rightarrow \dfrac{15}{5} = -9 + C \Rightarrow C = 12\}$

$\Rightarrow \dfrac{y}{x^2-4} = 12 - x^2$

$\Rightarrow y = (x^2 - 4)(12 - x^2)$

$y' = (x^2 - 4)(-2x) + (12 - x^2).2x$

$= -4x\left(x - 2\sqrt{2}\right)\left(x + 2\sqrt{2}\right)$



Local maximum value of

$f(x) = f\left(\pm 2\sqrt{2}\right)$

$= (8 - 4)(12 - 8) = 16$

12. Let A = {1, 2, 3, …, 9} : x R y, if $|(x - y)|$ is multiple of 3.

S_1 : Number of elements in R is 36

S_2 : R is equivalence relation.

(1) S_1 & S_2 both correct

(2) S_1 & S_2 is correct, but S_2 not correct

(3) S_2 is correct, but S_1 is not correct

(4) S_1 & S_2 both incorrect

Ans. **(3)**

Sol. Number of numbers of form $3n \Rightarrow 3$

Number of numbers of form $3n + 1 \Rightarrow 3$

Number of numbers of form $3n + 2 \Rightarrow 3$

Number of ordered pairs (x, y) = 3(3 × 3) = 27

S_1 false

$\Rightarrow x\,R\,y \Leftrightarrow y\,R\,x$

$\Rightarrow (x - y) = 3\lambda,\ (y - z) = 3\mu$

$\Rightarrow (x - z) = 3(\lambda + \mu)$

R is reflexive, symmetric & transitive

S_2 is true

Ans. S_1 is false but S_2 is true

13. $f(x) = \begin{cases} \dfrac{a|x| + 2x^2 - 2\sin|x|\cos|x|}{x} & ;\ x \neq 0 \\ b & ;\ x = 0 \end{cases}$

If f(x) is continuous then value of a + b is equal to

(1) 2 (2) 3

(3) 4 (4) 5

Ans. **(1)**

Sol. $\lim\limits_{x\to 0}\left(\dfrac{a|x| + 2x^2 - 2\sin|x|\cos|x|}{x}\right)$

$f(0^+) = a - 2$

$f(0^-) = -a + 2$

for continuity

$a - 2 = -a + 2 = b \Rightarrow a = 2\ \&\ b = 0$

so $a + b = 2$

14. Let sets A : {x : ||x – 3| – 3| ≤ 1}, x ∈ z.

set B : $\left\{x : x \in R\ (x \neq 1,2)\ \frac{(x-2)(x-4)}{(x-1)}\log_e|x-2| = 0\right\}$

then number of onto functions from A → B.

(1) 61 (2) 62

(3) 63 (4) 64

Ans. (2)

Sol. A : ||x – 3| – 3| ≤ 1

$\Rightarrow -1 \le |x-3| - 3 \le 1$

$2 \le |x-3| \le 4$

$2 \le (x-3) \le 4$ or $-4 \le (x-3) \le -2$

$5 \le x \le 7$ or $-1 \le x \le 1$

A = {–1, 0, 1, 5, 6, 7}

B ⇒ x = 4, |x – 2| = 1 ⇒ x = 3 or 1(reject) +

B = {4, 3}

Number of onto functions from A to B = $2^6 - 2 = 62$

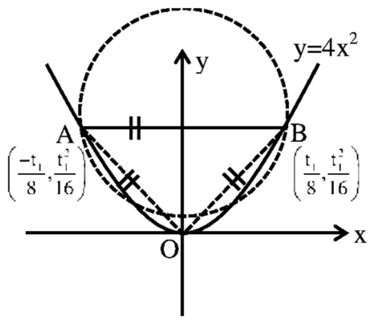
15. An equilateral triangle OAB is inscribed in the parabola $y = 4x^2$ whose vertex is O. Find the least distance of the circle described on AB as diameter from the origin.

(1) $\frac{6-\sqrt{3}}{2}$ (2) $\frac{3-\sqrt{3}}{4}$

(3) $\frac{6+\sqrt{3}}{2}$ (4) $\frac{3+\sqrt{3}}{2}$

Ans. (2)

Sol.



$OB^2 = AB^2$

$\Rightarrow \frac{t_1^2}{64} + \frac{t_1^4}{256} = \frac{t_1^2}{16}$

$\Rightarrow 4t_1^2 + t_1^4 = 16t_1^2$

$\Rightarrow t_1 = 2\sqrt{3}$

$\therefore A\left(\frac{-\sqrt{3}}{4},\frac{3}{4}\right)$ & $B\left(\frac{\sqrt{3}}{4},\frac{3}{4}\right)$

Midpoint of AB i.e. centre of circle is $\left(0,\frac{3}{4}\right)$ and

radius = $\frac{\sqrt{3}}{4}$

$\therefore OP = OM - r = \frac{3}{4} - \frac{\sqrt{3}}{4} = \frac{3-\sqrt{3}}{4}$

16. If the point of intersection of ellipses $x^2 + 2y^2 - 6x - 12y + 23 = 0$ and $4x^2 + 2y^2 - 20x - 12y + 35 = 0$ lie on a circle of radius r and centre (a, b), then the value of $ab + 18r^2$ is

(1) 90 (2) 95 (3) 85 (4) 100

Ans. (2)

Sol. $4x^2 + 2y^2 - 20x - 12y + 35 = 0$

$\underline{2(x^2 + 2y^2 - 6x - 12y + 23) = 0}$

$6x^2 + 6y^2 - 32x - 36y + 81 = 0$

$x^2 + y^2 - \frac{16}{3}x - 6y + \frac{27}{2} = 0$

$(a,b) \equiv \left(\frac{8}{3},3\right)$

$r = \sqrt{\frac{64}{9} + 9 - \frac{27}{2}} = \sqrt{\frac{87}{18}}$

$r^2 = \frac{87}{18} \Rightarrow 18r^2 = 87$

Now, $ab + 18r^2 = 8 + 87 = 95$

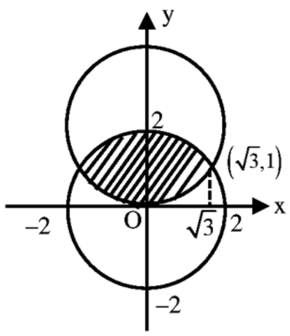
17. Find the area bounded by the curves $x^2 + y^2 = 4$ & $x^2 + (y-2)^2 = 4$

(1) $\frac{8\pi}{3} - 2\sqrt{3}$ Sq. units (2) $\frac{8\pi}{3} + \sqrt{3}$ Sq. units

(3) $\frac{4\pi}{3} - 2\sqrt{3}$ Sq. units (4) $\frac{4\pi}{3} + 2\sqrt{3}$ Sq. units

Ans. (1)

Sol.



$$A = 2\int_0^{\sqrt{3}}\left[\sqrt{4-x^2} - \left(2-\sqrt{4-x^2}\right)\right]dx$$

$$= 2\int_0^{\sqrt{3}}\left(2\sqrt{4-x^2} - 2\right)dx$$

$$= 4\int_0^{\sqrt{3}}\left(\sqrt{4-x^2} - 1\right)dx$$

$$= \left[4\left[\frac{1}{2}\left(x\sqrt{4-x^2} + 4\sin^{-1}\frac{x}{2}\right) - x\right]\right]_0^{\sqrt{3}}$$

$$= 4\left[\frac{1}{2}\left(\sqrt{3} + 4\times\frac{\pi}{3}\right) - \sqrt{3}\right] = 4\left[\frac{2\pi}{3} - \frac{\sqrt{3}}{2}\right]$$

$$= \frac{8\pi}{3} - 2\sqrt{3} \text{ (Sq. units)}$$

18. If $z = \frac{\sqrt{3}}{2} + \frac{i}{2}$, then $\left(z^{201} - i\right)^8$ is -

(1) 0 (2) 256

(3) 1 (4) –1

Ans. (2)

Sol. $z = \cos\frac{\pi}{6} + i\sin\frac{\pi}{6}$

$$z^{201} = \cos\left(201\frac{\pi}{6}\right) + i\sin\left(201\frac{\pi}{6}\right) = -i$$

$$(z^{201} - i)^8 = (-2i)^8 = 256$$

19. If $I(x) = 3\int\frac{dx}{(4x+6)\sqrt{4x^2+8x+3}}$, $I(0) = \frac{\sqrt{3}}{4}$, then $I(1) =$

(1) $\frac{3\sqrt{15}}{20}$ (2) $\frac{3\sqrt{15}}{10}$

(3) $\frac{\sqrt{15}}{10}$ (4) $\frac{\sqrt{15}}{20}$

Ans. (1)

Sol. Let $4x + 6 = \frac{1}{t}$

$$dx = \frac{-dt}{4t^2}$$

$$I = \frac{-3}{4}\int\frac{dt}{t^2 \times \frac{1}{t} \times \sqrt{4\left(\frac{\frac{1}{t}-6}{4}\right)^2 + 2\left(\frac{1}{t}-6\right) + 3}}$$

$$= \frac{-3}{4}\int\frac{dt}{t\sqrt{\frac{1}{4}\left(\frac{1-6t}{t}\right)^2 + \frac{2}{t} - 9}}$$

$$= \frac{-3}{2}\int\frac{dt}{\sqrt{1-4t}}$$

$$= \frac{-3}{2}\times\frac{-1}{4}\times\frac{(1-4t)^{\frac{1}{2}}}{\frac{1}{2}} + C$$

$$= \frac{3}{4}\sqrt{1-4t} + C = \frac{3}{4}\sqrt{1-\frac{4}{4x+6}} + C$$

$$I(0) = \frac{3}{4}\sqrt{1-\frac{2}{3}} + C = \frac{\sqrt{3}}{4} \Rightarrow C = 0$$

$$I(x) = \frac{3}{4}\sqrt{1-\frac{4}{4x+6}}$$

$$\therefore I(1) = \frac{3}{4}\times\sqrt{\frac{6}{10}} = \frac{3\sqrt{6}}{4\sqrt{10}} = \frac{3\sqrt{60}}{40} = \frac{3\sqrt{15}}{20}$$

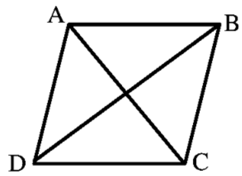
20. Rhombus ABCD is given with vertices A(1,2), C(–3,–6) and sides AD & BC are parallel to the line 7x – y = 14. If coordinates of B & C are (α,β) & (γ, δ) respectively, then find $\alpha + \beta + \gamma + \delta = ?$

(1) –4 (2) 5

(3) –6 (4) –7

Ans. **(3)**

Sol. Mid points of BD & AC are same



As $\frac{\alpha+\gamma}{2}=\frac{1+(-3)}{2}, \frac{\beta+\delta}{2}=\frac{2+(-6)}{2}$

$\alpha + \gamma = -2, \quad \beta + \delta = -4$

$\alpha + \beta + \gamma + \delta = -6$

21.

Class	4-8	8-12	12-16	16-20
Freq.(f_i)	3	λ	4	7

The mean and variance of following data is μ & 19 respectively & μ is an integer. The value of $(\lambda+\mu)$ is

(1)19 (2) 20

(3) 13 (4) 17

Ans. **(1)**

Sol. $\mu = \frac{\sum f_i x_i}{\sum f_i} = \frac{18+10\lambda+56+126}{14+\lambda}$

$= \frac{200+10\lambda}{\lambda+14} = 10 + \left(\frac{60}{\lambda+14}\right)$

$\lambda + 14$ is multiply of 60 $\Rightarrow \lambda = 1$ or 6 or 16.

$\sigma^2 = \frac{\sum x_1^2}{\lambda+14} - (\mu)^2$

$\sigma^2 = \frac{6^2(3)+10^2(\lambda)+14^2(4)+(18)^2(7)}{\pi+14} - \mu^2$

for $\lambda = 6$, $\mu = 10 + 3 = 13$

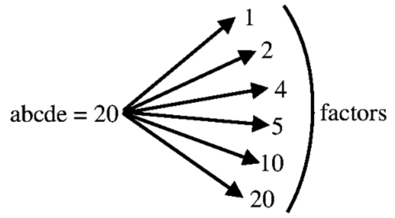
$\lambda + \mu = 19$

22. Let S = number of 4 digit numbers abcd, where a > b > c > d & P = number of 5 digit numbers abcde, where product of digits is 20, then S + P =

Ans. **(260)**

Sol. $S = {}^{10}C_4 = 210$

For P $\therefore$



$\therefore$ Case -(1) 5 4 1 1 1 $\Rightarrow \frac{5!}{3!} = 20$

Case -(2) 5 2 2 1 1 $\Rightarrow \frac{5!}{2!2!} = 30$

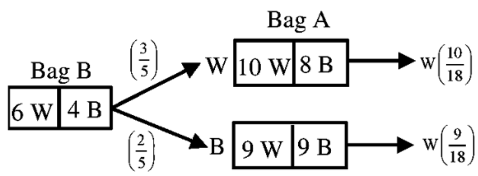
$\therefore$ P = 20 + 30 = 50

$\therefore$ S + P = 260

23. Bag A contains 9 White & 8 Black balls and bag B contains 6 White & 4 Black balls. A ball is randomly transferred from bag B to bag A then a ball is drawn from bag A. If probability that drawn ball is White, is $\frac{p}{q}$ (Where p & q are coprime), then (p + q) is

Ans. **(23)**

Sol.

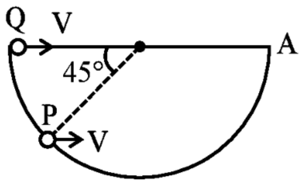


$\therefore$ P(Drawn ball is white) $= \frac{3}{5}\times\frac{10}{18}+\frac{2}{5}\times\frac{9}{18}$

$= \frac{48}{90} = \frac{8}{15} = \frac{p}{q}$

$\therefore$ p + q = 23

1. Two beads P & Q move along two wires straight and semi circle. At some instant both are shown in figure having same horizontal component of velocity V. Find relation of time taken to reach A by beads :

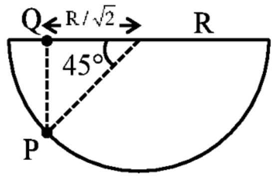


(1) $t_P > t_Q$ (2) $t_p < t_Q$

(3) $t_P = t_Q$ (4) None of these

Ans. **(2)**

Sol.



X-displacements :

$X_P < X_Q$

and average velocity in X-direction of P is > average velocity in X-direction of Q

hence

$t_P < t_Q$

2. When an object is kept at distance 8 cm and 24 cm from a convex lens, magnitude of magnification is same in both cases. Find focal length (in cm) of the lens :

(1) 18 cm (2) 16 cm

(3) 20 cm (4) 8 cm

Ans. **(2)**

Sol. $m = \frac{f}{f+u}$

$m_1 = -m_2$

$\frac{f}{f-8} = -\frac{f}{f-24}$

$f - 8 = 24 - f$

$2f = 32$

$f = 16$ cm

3. Time taken to achieve terminal velocity by a body depends on density of material (ρ), density of liquid (σ), radius of material (r) and viscosity of liquid (η) as $t = k\rho^a r^b \eta^c \sigma^d$. Find $\frac{b+c}{a+d}$?

(1) 1 (2) $\frac{1}{2}$

(3) 3 (4) 2

Ans. **(1)**

Sol. $T = (ML^{-3})^a L^b (ML^{-1}T^{-1})^c (ML^{-3})^d$

$T = M^{a+c+d} L^{-3a-c-3d+b} T^{-c}$

on comparing

$c = -1$; $a + c + d = 0$; $-3a - c - 3d + b = 0$

$b = 2$; $a + d = 1$

4. Speed of sound at $T_1 = 0°C$ is V_0 and at $T_2 = \alpha°C$ speed becomes $2V_0$. Find α :

(1) 819°C (2) 918°C

(3) 546°C (4) 1092°C

Ans. **(1)**

Sol. $V = \sqrt{\frac{\gamma RT}{M}}$

$\frac{V_1}{V_2} = \frac{\sqrt{T_1}}{\sqrt{T_2}}$

$\frac{V_0}{2V_0} = \sqrt{\frac{273}{T_2}}$

$\frac{1}{4} = \frac{273}{T_2}$

$T_2 = 4 \times 273$

$\alpha + 273$

$\alpha = 3 \times 273$

$\alpha = 819°C$

5. An air bubble inside water at depth h = 5 m rises to surface. At bottom temperature is T_1 and volume is V_1 and at surface the temperature is T_2. Find final volume (Given that number of moles remains same and $P_0 = 10^5$ Pa) :

(1) 6 cm^3 (2) 8 cm^3
(3) 2 cm^3 (4) 1 cm^3

Ans. (3)

Sol. $T_1 = 17°C, V_1 = 2.9\ cm^3$

$T_2 = 27°C$

$$\frac{10^5 \times 2.9}{290} = \frac{1.5 \times 10^5 \times V_2}{300}$$

$V_2 = 2\ cm^3$

6. A metallic sphere of diameter 2mm and density 10.5 g/cc is dropped in glycerine having viscosity 10 poise and density 1.5 g/cc. The terminal velocity attained by sphere is _____ cm/s. $\left[\pi = \frac{22}{7}, g = 10\ m/s^2\right]$

(1) 2.0 (2) 1.0
(3) 1.5 (4) 3.0

Ans. (1)

Sol. $V = \frac{2}{9}\frac{r^2 g}{\eta}(\rho_m - \rho_l)$

$$= \frac{2}{9} \times \frac{(0.1)^2 \times 1000}{10}(10.5 - 1.5)$$

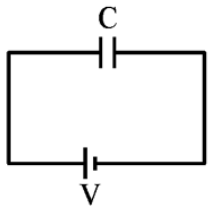
$= 2$ cm/s

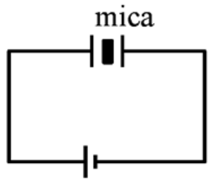
7. A parallel plate capacitor with plate separation 5 mm is charged by a battery. On introducing a mica sheet of 2 mm while battery is connected, it is found that it draws 25% more charge. The dielectric constant of mica is :

(1) 2 (2) 1.5
(3) 1 (4) 4

Ans. (1)

Sol.





$$C = \frac{\varepsilon_0 A}{5}$$

$Q_i = CV$

$Q_f = C_{eq}V = 1.25\ CV$

$$C_{eq} = \frac{\frac{\varepsilon_0 A}{3} \times \frac{K\varepsilon_0 A}{2}}{\frac{\varepsilon_0 A}{3} + \frac{K\varepsilon_0 A}{2}}$$

$$= \frac{\varepsilon_0 A 5K}{5(3K+2)}$$

$$= \frac{5CK}{3K+2}$$

$C_{eq} = 1.25\ C$

$$\frac{5K}{3K+2} = 1.25 = \frac{5}{4}$$

$4K = 3K + 2$

$K = 2$

8. Two point charges $7\mu C(-9,0,0)$ and $-2\mu C(9,0,0)$ are placed in external electric field $\vec{E} = \frac{A}{r^2}\hat{r}$ where $A = 10^3$ SI unit. Find potential energy of system ?

(1) $-\frac{58}{9} \times 10^{-3}$ J (2) $\frac{50}{3} \times 10^{-6}$ J
(3) 40×10^{-4} J (4) 2×10^{-5} J

Ans. (1)

Sol. $U = U_{self} + U_{interaction}$

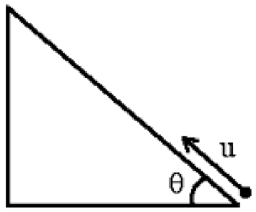
$$= q_1V_1 + q_2V_2 + \frac{kq_1q_2}{r}$$

Here $V = \int_{\infty}^{r} Edr = -A\left(-\frac{1}{r}\right)_{\infty}^{r} = \frac{A}{r}$

So $U = -7 \times 10^{-3} + \frac{7 \times 10^{-6} A}{9} - \frac{2 \times 10^{-6} A}{9}$

$$= \left(\frac{5}{9} - 7\right) \times 10^{-3} = -\frac{58}{9} \times 10^{-3}\ J$$

9. A particle is projected from bottom of inclined plane with speed u find distance covered along plane before coming to rest :

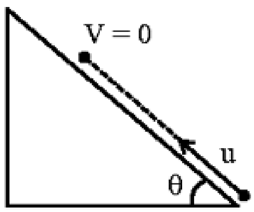


(1) $\frac{u^2}{2g\sin\theta}$ (2) $\frac{u^2}{g\sin\theta}$

(3) $\frac{u^2}{g\cos\theta}$ (4) $\frac{u^2}{2g\cos\theta}$

Ans. **(1)**

Sol.



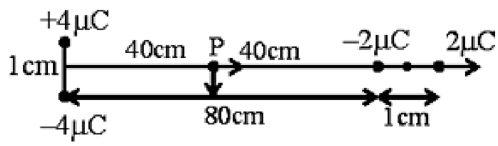
$a = -g\sin\theta$

$V^2 = U^2 + 2as$

$0 = u^2 - 2g\sin\theta \, . \, s$

$s = \frac{u^2}{2g\sin\theta}$

10. Four charges are kept as shown in the figure. Find magnitude of electric field at point P. P is mid point of line AB.



(1) $625\sqrt{2}$ (2) $5625\sqrt{2}$

(3) $3625\sqrt{2}$ (4) $4525\sqrt{2}$

Ans. **(2)**

Sol. $E_p = -\frac{KP_1}{r^3}\hat{j} + \frac{2KP_2}{r^3}(\hat{i})$

$|\vec{E}_{net}| = \frac{\sqrt{2}\times 2\times 9\times 10^9\times 2\times 10^{-6}\times 10^{-2}}{(0.4)^3}$

$= 5625\sqrt{2}$

11. Dielectric constant of a medium is 3 and its magnetic permeability $\mu = 2\mu_0$. Find ratio of velocity of light in vacuum to velocity of light in medium :

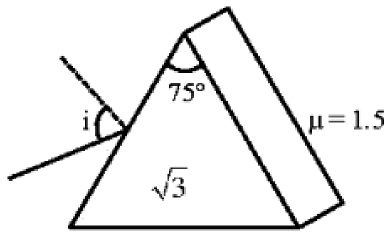
(1) $\sqrt{5}$ (2) $\sqrt{6}$

(3) 2 (4) 3

Ans. **(1)**

Sol. $\frac{c}{v} = \mu = \sqrt{\varepsilon_r\mu_r} = \sqrt{3\times 2} = \sqrt{6}$

12. A prism with angle of prism 75° and having refractive index $\sqrt{3}$ has a slab of refractive index 1.5 kept on one side of the prism as shown. Find angle of incidence such that TIR occurs at slab prism interface. (Given sin 15° = 0.25 and sin 25° = 0.43) :



(1) $10° < \theta < 20°$ (2) $\theta < 25°$

(3) $\theta < 15°$ (4) $15° < \theta < 25°$

Ans. **(2)**

Sol. For TIR at prism-slab interface,

$r_2 = \sin^{-1}\left(\frac{1.5}{\sqrt{3}}\right) = 60°$

$\therefore r_1 = 15°$

$\therefore 1 \sin i = \sqrt{3}\sin 15° = 0.433 \Rightarrow i = 25°$

$\therefore \theta < 25°$

13. When an unpolarized light falls at a particular angle on a glass plate (placed in air). It is observed that reflected beam is completely polarized the angle of refracted beam with respect to the normal is :

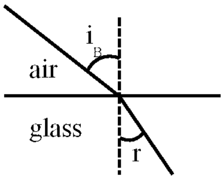
(Given : $\tan^{-1}(1.52) = 57.3°$, $\mu_{air} = 1$, $\mu_{glass} = 1.52$)

(1) 57.3 (2) 36.7

(3) 28.65 (4) 61.35

Ans. **(2)**

Sol.



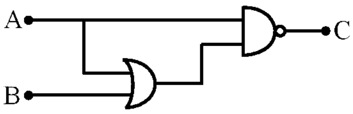
$\tan i_B = \frac{n_2}{n_1} = \frac{n_g}{n_a}$

$\tan i_B = 1.52$

$i_B = 57.6°$

$r = 90 - i_B = 36.7°$

14. For given logic gate circuit choose correct truth table.



(1)

A	B	C
0	0	1
1	0	1
0	1	1
1	1	0

(2)

A	B	C
0	0	1
1	0	0
0	1	1
1	1	0

(3)

A	B	C
0	0	0
1	0	0
0	1	0
1	1	1

(4)

A	B	C
0	0	0
1	0	1
0	1	0
1	1	1

Ans. **(2)**

Sol. $C = \overline{(A+B)\cdot A}$

$C = \overline{A\cdot A + A\cdot B} = \overline{A\cdot(1+B)} = \overline{A}$

A	B	C
0	0	1
1	0	1
0	1	1
1	1	0

15. Energy released per fission of U-235 is 190 MeV, then total energy released by 47 g of U-235 is $x \times 10^{23}$ MeV. Find the value of x.

Ans. **(228)**

Sol. Total numbers of U-235 atom is

$47\text{ g} = \frac{47}{235}\text{ moles} = \frac{1}{5}\text{ moles}$

$\therefore$ Total energy released $= \frac{1}{5}\times 6\times 10^{23}\times 190$ MeV

16. A parachutist jumps from a helicopter. It falls freely for 2 sec. Then he opens parachute which produces retardation of 3 m/s^2. When his height from ground is 10 m his velocity is 5 m/s. Find his initial height from ground.

(1) 90 m (2) 82 m

(3) 92.5 m (4) 100 m

Ans. **(3)**

Sol. $S_1 = \frac{1}{2}\times 10\times 2^2 = 20\text{m}$

$v_1 = 0 + g \times 2 = 20$ m/s

For 2nd part of journey :

$5^2 = 20^2 + 2(-3)S_2$

$S_2 = 62.5$ m

So, total distance $S = S_1 + S_2 + S_3$

$= 20 + 62.5 + 10 = 92.5$ m

17. One mole of diatomic gas is expanding isothermally from V to 2V at 27°C. If the magnitude of work done by gas in this case is same as the work done in adiabatic process where initial temperature is 27°C and final temperature is T°C. Find T.

(1) –37°C (2) –57°C

(3) –35°C (4) –55°C

Ans. **(2)**

Sol. $W_{isothermal} = 1 \times R \times (300) \ln(2)$

$W_{adiabatic} = \frac{nR(300-T)}{\left(\frac{7}{5}-1\right)} = \frac{5}{2}\times 1\times R\times(300-T)$

$W_{isothermal} = W_{adiabatic}$

$300\ell n2 = \frac{5}{2}(300 - T)$

$\frac{5}{2}T = 750 - 300\ell n2$

$T = 216.82$ K

$T = -56.17$ °C

18. A bomb at rest explodes into three pieces in the ratio of masses 2 : 2 : 3. The identical masses fly off perpendicular to each other with 18 m/s. Find speed of the third piece.

(1) $12\sqrt{2}$ m/s (2) $12/\sqrt{2}$ m/s

(3) 12 m/s (4) 18 m/s

Ans. **(2)**

Sol. $7m \times 0 = 2m \times 18\hat{i} + 2m \times 18\hat{j} + 3m \times \vec{v}$

$\vec{v} = -12\hat{i} - 12\hat{j}$

$|\vec{v}| = 12\sqrt{2}$ m / s

19. Choose correct option :

(A) Number of photons required for a light beam of 2000 pm wavelength and 1 Joule energy is 1.01×10^{16}.

(B) Light with wavelength 300 nm has energy E_1 and for wavelength 900 nm has energy E_2, then $\frac{E_1}{E_2} = \frac{1}{3}$.

(C) Frequency of light is 4.5×10^{16} then its wavelength is 6.7×10^{-9} m.

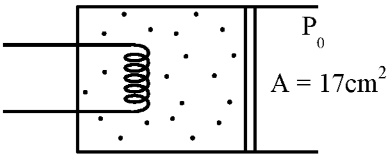
(D) If electrons and protons are accelerated by same potential diffenrece, then their de-Broglie wavelength are equal.

(1) A only (2) A & B only

(3) A & C only (4) A, B, C & D

Ans. (3)

20. Internal energy of gas is given as U = 3nRT. 1mole He gas takes 126 J heat and its temperature rise by 4°C. Atmospheric pressure is $P_0 = 10^5$ Pa and area of piston is 17 cm^2. Find distance moved by piston.



(1) 18.5 cm (2) 21.3 cm

(3) 12.3 cm (4) 10.2 cm

Ans. (1)

Sol. Piston is free to move hence

For isobaric process

$\Delta Q = \Delta U + W = 3nR\Delta T + nR\Delta T$

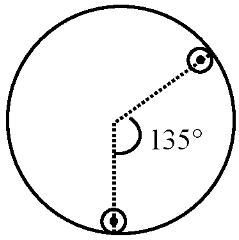
$\Delta Q = 4P\Delta V$

$126 = 4 \times 10^5 \times A(\Delta x)$

$$\Delta x = \frac{126}{4 \times 10^5 \times 17 \times 10^{-4}}$$

= 0.185 m = 18.5 cm

21. A disc of mass (M, R) is given. Two discs of radius $\frac{R}{4}$ are cut from this, whose center are at 135° angle. Their peripheries touch larger disc a shown. If moment of inertia of remaining disc about center is $\frac{\alpha}{256}MR^2$ find α:



Ans. (α = 109)

Sol. $M = \sigma\pi R^2$

$\sigma\pi R^2 = 16$ m

$$m = \frac{\sigma\pi R^2}{16}$$

$$I_{system} = \frac{MR^2}{2} - 2\left(\frac{mR^2}{2 \times 16} + \frac{9mR^2}{16}\right)$$

$$= \frac{MR^2}{2} - 2 \times \frac{19mR^2}{32}$$

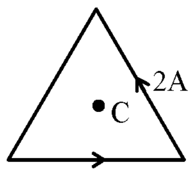
$$= \frac{MR^2}{2} - \frac{19}{16}mR^2$$

$$= \frac{MR^2}{2} - \frac{19}{256}MR^2 \quad \text{becoz} \quad m = \frac{M}{16}$$

$$= \frac{(128 - 19)(MR^2)}{256}$$

$$= \frac{109MR^2}{256}$$

22. The equilateral triangular frame has current 2A. The side of frame is $4\sqrt{3}$ cm. Magnetic field at center C is:

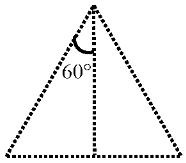


(1) $30\sqrt{3}\,\mu T$ (2) $10\sqrt{3}\,\mu T$

(3) $3\sqrt{10}\,\mu T$ (4) $10\sqrt{10}\,\mu T$

Ans. (1)

Sol.



$$B = 3\left[\frac{\mu_0 i}{4\pi\left(\frac{a}{2\sqrt{3}}\right)}(\sin 60 + \sin 60)\right]$$

$$= \frac{9\mu_0 i}{2\pi a}$$

$$= \frac{9 \times 4\pi \times 10^{-7} \times 2}{2\pi \times (4\sqrt{3}/100)}$$

$$= 3\sqrt{3} \times 10^{-5} = 30\sqrt{3}\,\mu T$$

23. An experiment is performed for comparing EMF of two cells using a potentiometer. For 1st cell, balancing length was achieved at 200 cm and for 2nd cell it was 150 cm. If least count of measurement of length of potentiometer wire is 1cm, the percentage error in the ratio of εmf of two cells is :

(1) $\frac{8}{7}$ (2) $\frac{7}{6}$

(3) $\frac{5}{6}$ (4) $\frac{3}{2}$

Ans. **(2)**

Sol. At balancing length $\varepsilon = \lambda\ell$ [λ is potential gradient]

$\therefore \varepsilon_1 = \lambda \times 200$

$\varepsilon_2 = \lambda \times 150$

Let $y = \frac{\varepsilon_1}{\varepsilon_2}$

$$\therefore \frac{\Delta y}{y} = \frac{\Delta\varepsilon_1}{\varepsilon_1} + \frac{\Delta\varepsilon_2}{\varepsilon_2} = \frac{\Delta\ell_1}{\ell_1} + \frac{\Delta\ell_2}{\ell_2} = \frac{1}{200} + \frac{1}{150} = \frac{7}{600}$$

$\therefore$ % error = $\frac{7}{6}$

24. A small ring is given some velocity along the axis of a solenoid and it remains coaxial with solenoid. Current in solenoid $i = 10 \sin\omega t$; $\omega = 1000$ rad/s. Number of turns per unit length is 500/m. Radius of ring is 1 cm and its resistances is 10Ω. Find RMS value of induced current in the ring :

(1) $\sqrt{2} \times 10^{-5}$A (2) 3×10^{-4}A

(3) $\sqrt{2} \times 10^{-4}$A (4) 5×10^{-6}A

Ans. **(3)**

Sol. EMF induced $\varepsilon = A\frac{dB}{dt} = A\mu_0 n\frac{di}{dt}$

$\varepsilon = A\mu_0 n\, i_0 \omega \cos\omega t$

current induced $i = \frac{\varepsilon}{R} = \frac{\pi r^2 \mu_0 n i_0 \omega}{R}\cos\omega t$

So $i = \frac{\pi r^2 \mu_0 n i_0 \omega}{\sqrt{2}R}$

$$= \frac{\pi \times 10^{-4} \times 4\pi \times 10^{-7} \times 500 \times 10 \times 10^{3}}{\sqrt{2} \times 10}$$

$$= \frac{20\pi^2}{\sqrt{2}} \times 10^{-6}$$

$$= \sqrt{2} \times 10^{-4}\,A$$

25. Which of the following is isobaric pairs :

(1) ${}^{3}_{1}C$ & ${}^{13}_{6}C$

(2) ${}^{3}_{1}H$ & ${}^{3}_{2}He$

(3) ${}^{14}_{7}N$ & ${}^{13}_{6}He$

(4) ${}^{16}_{8}O$ & ${}^{15}_{7}N$

Ans. **(2)**

Sol. Isobars are atoms having same number of nucleons

SECTION-A

1. 3 moles of liquid A and 1 mole of liquid B are mixed to form an ideal solution. The vapour pressure of solution becomes 500 mm Hg. If 1 mole of A is further added then vapour pressure of solution increases by 20 mm Hg.

Find vapour pressure of pure B ($P°_B$) in mm Hg ?

Ans. (200)

Sol. $X_A = \frac{3}{4}, X_B = \frac{1}{4}$

$P_S = P_A^o X_A + P_B^o X_B$

$500 = P_A^o \times \frac{3}{4} + P_B^o \times \frac{1}{4}$

$3P_A^o + P_B^o = 2000$ ..... (1)

Now 1 moles of A is further added so $n_A = 4$ mole, $n_B = 1$ mole

$X'_A = \frac{4}{5}, X'_B = \frac{1}{5}$

$P_s = 520 = P_A^o \times \frac{4}{5} + P_B^o \times \frac{1}{5}$

$4P_A^o + P_B^o = 2600$ ..... (2)

By equation (2) – equation (1)

$P_A^o = 600$ mm Hg

$P_B^o = 200$ mm Hg

2. If $K_2Cr_2O_7$ (200 cm^3, $x \times 10^{-3}$ M) reacts with 0.6 M, 750 cm^3 Mohr's salt then find value of x ?

Ans. (375)

Sol. $K_2Cr_2O_7 + Fe^{2+} \rightarrow Cr^{3+} + Fe^{3+}$

$n_f = 6$ $n_f = 1$

V=200 cm^3 V=750 cm^3

$x \times 10^{-3}$ M 0.6 M

milli eq. of $K_2Cr_2O_7$ = milli eq. of $FeSO_4$

$6 \times x \times 10^{-3} \times 200 = 1 \times 0.6 \times 750$

$x = 375$

3. On two metal surfaces, a monochromatic light of 6 eV was incident. They have ratio of their work function and maximum KE as

$$\frac{\phi_1}{\phi_2} = \frac{1}{2}, \frac{(KE_{max})_1}{(KE_{max})_2} = \frac{2.62}{1}$$

Then ϕ_1 and ϕ_2 values are respectively (in eV).

(1) 2.292, 4.584 (2) 4.584, 2.292

(3) 4.584, 9.168 (4) 1.146, 2.292

Ans. (1)

Sol. $KE_{max} = E - \phi$

$(KE_{max})_1 = 6 - \phi_1$ ...... (1)

$(KE_{max})_2 = 6 - \phi_2$ ...... (2)

By eq. (1) divide eq. (2)

$\frac{(KE_{max})_1}{(KE_{max})_2} = \frac{2.62}{1} = \frac{6-\phi_1}{6-\phi_2}$

$\frac{2.62}{1} = \frac{6-\phi_1}{6-2\phi_1}$

$15.72 - 5.24\ \phi_1 = 6 - \phi_1$

$9.72 = 4.24\ \phi_1$

$\phi_1 = \frac{9.72}{4.24}$

$\phi_1 = 2.292$ eV, $\phi_2 = 4.584$ eV.

4. A cell is given as

$M(s) \mid M^{n+}(aq) \parallel M^{+n}(aq) \mid M(s)$

For which of the following condition, E_{cell} is positive:

(1) $C_1 < C_2$ (If C_1 is concentration at cathode)

(2) $C_2 < C_1$ (If C_1 is concentration at anode)

(3) $C_1 < C_2$ (If C_2 is concentration at anode)

(4) $C_1 > C_2$ (If C_1 is concentration at cathode)

Ans. (4)

Sol. $M(s) + M^{n+}(aq) \rightarrow M(s) + M^{n+}(aq.)$
(cathode) (anode)

$$E_{cell} = E^\circ_{cell} - \frac{0.059}{n}\log\frac{[M^{n+}]_{anode}}{[M^{n+}]_{cathode}}$$

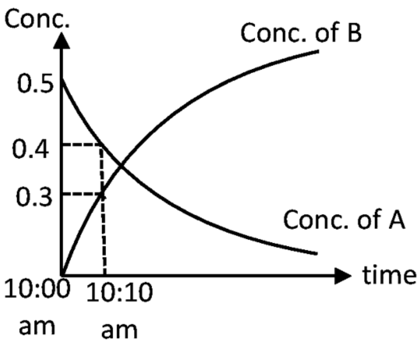
For concentration cell : $E^\circ_{cell} = 0$

$$E_{cell} = -\frac{0.059}{n}\log\frac{[M^{n+}]_{anode}}{[M^{n+}]_{cathode}}$$

For E_{cell} = +ve

$[M^{n+}]_{anode} < [M^{n+}]_{cathode}$

5. For a given reaction A → nB, a graph is given between concentration and time. Find value of n for above reaction, based on the information given in graph for 10 min.



Ans. **(3)**

Sol.

	A	→ nB
at 10:00 am	0.5	–
at 10:10 am	0.5–x = 0.4	nx

x = 0.1

nx = 0.3

$$n = \frac{0.3}{x} = 3$$

6. Given at 10 AM, reaction is started

(i) $A \xrightarrow{k}$ Product (1^{st} order reaction)

(ii) $BrO_3^- + 5Br^- \rightarrow 3Br_2$

At 10:10 AM, rate of disappearance of Br^- was 2×10^{-3} M/min. and concentration of A was 0.1 M, if both reactions were proceed with same rate at this time then value of k will be ?

(1) $10^{-3}\ min^{-1}$ (2) $2 \times 10^{-3}\ min^{-1}$
(3) $4 \times 10^{-3}\ min^{-1}$ (4) $8 \times 10^{-3}\ min^{-1}$

Ans. **(3)**

Sol. Rate of reaction $= \frac{2\times10^{-3}}{5} = k[0.1]$

$k = 4 \times 10^{-3}\ min^{-1}$

7. For given reaction

$X_2(g) + Y_2(g) \rightleftharpoons 2Z\ (g)$

Moles of X_2, Y_2 & Z are at equilibrium are 3 mole, 3 mole & 9 mole respectively. If 10 moles of Z are added at constant T then find moles of Z at restablished equilibrium.

Ans. **(15)**

$X_2(g) + Y_2(g) \rightleftharpoons 2Z\ (g)$

$$K_C = \frac{(9)^2}{3\times3} = 9$$

Now 10 moles of Z are added then reaction will move in backward direction.

$X_2(g) + Y_2(g) \rightleftharpoons 2Z\ (g)$

3 + X 3 + X 19–2X

$$K_C = \frac{(19-2X)^2}{(3+X)(3+X)} = 9$$

$$\frac{19-2X}{3+X} = 3$$

19 – 2X = 9 + 3X

10 = 5X

X = 2

At equilibrium ⇒ moles of Z = 19 – 2 × 2

= 15 moles

8. For XeO_2F_2, select the correct statements :

(A) It has see-saw shape

(B) ∠FXeF ≈ 180°

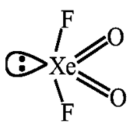
(C) ∠OXeO ≈ 180°

(D) Number of valence electron on Xe = 5

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

Ans. **(2)**

Sol.



See-saw

9. How many of the following complexes have unpaired electrons $[Ni(CO)_4]$, $[NiCl_4]^{2-}$, $[PtCl_4]^{2-}$, $[Pt(CN)_4]^{2-}$, $[Pt(NH_3)_2Cl_2]$

Ans. (1)

Sol. In $[Ni(CO)_4]$, Ni^0 : $3d^{10}\ 4s^0\ 4p^0$
Hybridisation state : sp^3, n = 0
In $[NiCl_4]^{2-}$, Ni^{2+} : $3d^8\ e^{2,2}\ t_2^{2,1,1}$
Hybridisation state : sp^3, n = 2
In $[PtCl_4]^{2-}$, Pt^{2+} : $5d^8$ square planar
Hybridisation state : dsp^2, n = 0
In $[Pt(CN)_4]^{2-}$ $5d^8$ square planar
Hybridisation state : dsp^2, n = 0
In $[Pt(NH_3)_2Cl_2]$ Pt^{2+} : $5d^8$ square planar
Hybridisation state : dsp^2, n = 0

10. From the following :

(A) $[Co(NH_3)_6]^{3+}$: Inner orbital complex, d^2sp^3 hybridization

(B) $[MnCl_6]^{3-}$: Outer orbital complex, sp^3d^2 hybridization

(C) $[CoF_6]^{3-}$: Outer orbital complex, d^2sp^3 hybridization

(D) $[FeF_6]^{3-}$: Outer orbital complex, sp^3d^2 hybridization

(E) $[Ni(CN)_4]^{2-}$: Inner orbital complex, sp^3 hybridization

Choose the correct answer from the given options.

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

Ans. (3)

Sol. (A) $Co^{3+}\ 3d^6\ t_{2g}^{2,2,2}\ e_g^{0,0}$ d^2sp^3 Inner orbital complex

(B) $Mn^{3+}\ 3d^4\ t_{2g}^{1,1,1}\ e_g^{1,0}$ sp^3d^2 Outer orbital complex

(C) $Co^{3+}\ 3d^6\ t_{2g}^{2,1,1}\ e_g^{1,1}$ sp^3d^2 Outer orbital complex

(D) $Fe^{3+}\ 3d^5$, $t_{2g}^{1,1,1}\ e_g^{1,1}$ sp^3d^2 Outer orbital complex

(E) Ni^{2+} $3d^8$ Square planar dsp^2 Inner orbital complex

11. The oxidation state of 'Cr' in the final product formed by reaction between KI and acidified $K_2Cr_2O_7$ is :

(1) +2 (2) +6
(3) +4 (4) +3

Ans. (4)

Sol. $K_2Cr_2O_7 + KI \xrightarrow{H^+} I_2 + Cr^{3+}$

12. Statement-I : Size of O^{2-} is smaller than F^-.

Statement-II : Second ionization energy of Na is greater than second ionization energy of Mg.

(1) Both statements are correct.

(2) Both statements are incorrect.

(3) Statement I is correct while Statement II is incorrect.

(4) Statement I is incorrect while statement II is correct.

Ans. (4)

Sol. Size of $O^{2-} > F^-$
IE_2 of Na > IE_2 of Mg

13. Which of the following are isobars?

(1) $^{232}_{92}U$ and $^{238}_{92}U$

(2) $^{3}_{1}H$ and $^{2}_{1}H$

(3) $^{3}_{1}H$ and $^{3}_{2}He$

(4) $^{14}_{7}N$ and $^{15}_{7}N$

Ans. (3)

Sol. Isobars have same mass number.

14. Consider the following changes :

$SnO_2 \rightarrow SnO \quad \Delta G_1^0$

$PbO_2 \rightarrow PbO \quad \Delta G_2^0$

Select the correct option

(1) $\Delta G_1^0 > 0$, $\Delta G_2^0 > 0$ (2) $\Delta G_1^0 > 0$, $\Delta G_2^0 < 0$

(3) $\Delta G_1^0 < 0$, $\Delta G_2^0 < 0$ (4) $\Delta G_1^0 < 0$, $\Delta G_2^0 > 0$

Ans. (2)

Sol. $\rightarrow$ Pb^{2+} is more stable than Pb^{4+} (inert pair effect)
$\Rightarrow \Delta G_2^0 < 0$

$\Rightarrow \Delta G_1^0 > 0$. As Sn^{4+} is more stable than Sn^{2+}

15. Electronegativity difference between a group 15 element and P is less than electronegativity difference between another group 15 element and P. Those group 15 elements respectively are :

(1) Bi, N (2) Sb, As
(3) Sb, Bi (4) N, As

Ans. (1)

Sol.

	EN
N	3.0
P	2.1
As	2.0
Sb	1.9
Bi	1.9

16. Iodoform test can differentiate :
(1) Anisole and Acetone
(2) Acetic acid and Aniline
(3) Ethanol and Acetone
(4) Methanol and benzoic acid

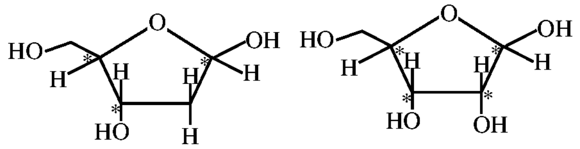
Ans. (1)

Sol. Acetone Me–CO–Me will show Iodoform due to methylketo group Me–CO–Me

17. Both DNA and RNA are chiral molecules. The chirality in DNA and RNA arises due to the presence of :
(1) D-sugar component
(2) Phosphodiester linkage
(3) L-sugar component
(4) Nitrogenous bases

Ans. (1)

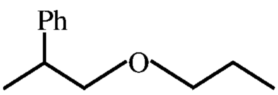
Sol.

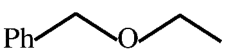


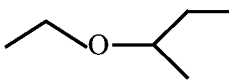
2-Deoxyribose D-ribose

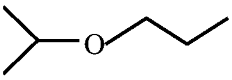
18. Organic compound (P) $\xrightarrow[\text{(ii) Aq.NaOH}]{\text{(i) excess of HI}}$ Q + R

Q and R both gives Iodoform test,
Which among the following is (P) from the given organic compound?

(1) 

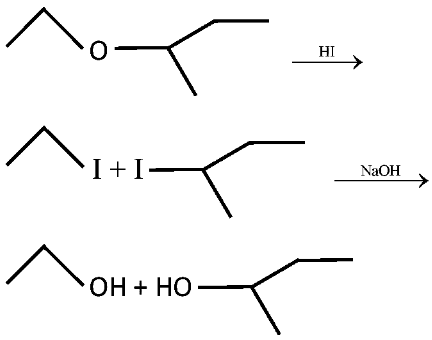
(2) 

(3) 

(4) 

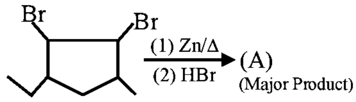
Ans. (3)

Sol.

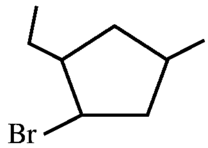


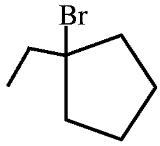
Both products Q & R gives idoform test.

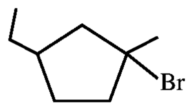
19.

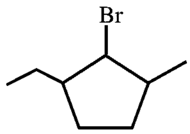


Identify (A) ?

(1) 

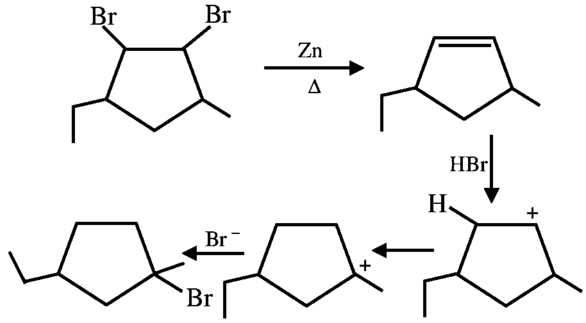
(2) 

(3) 

(4) 

Ans. (3)

Sol.

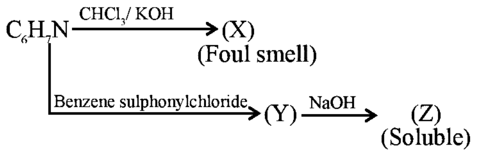


20. 0.245 gm of an unknown organic compound gave 0.5453 gm of AgCl through Carious method. Calculate % of Cl in unknown compound.

Ans. (55.06)

Sol. $\% \text{ Cl} = \dfrac{\left(\dfrac{.5453}{143.5}\right) \times 35.5}{.245} \times 100$

% of Cl = 55.06

21. 

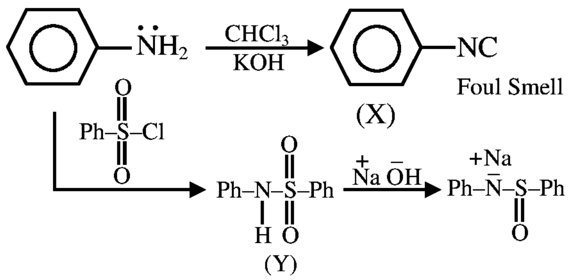
Number of different H-atoms in (Y)

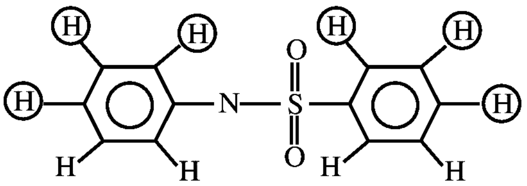
(1) 4 (2) 7

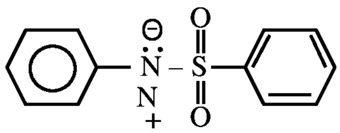
(3) 12 (4) 13

Ans. (2)

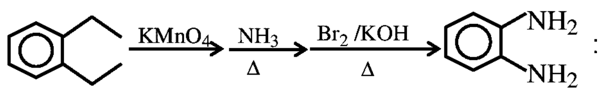
Sol.



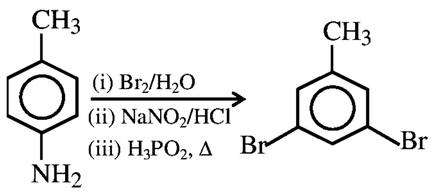




22. Statement-I :



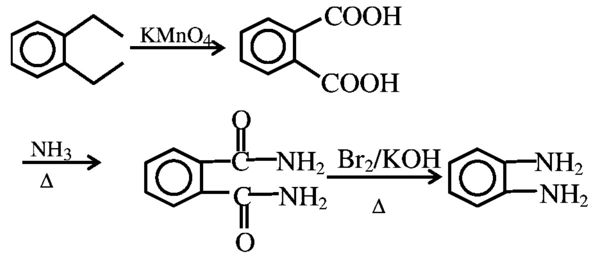
Statement-II :



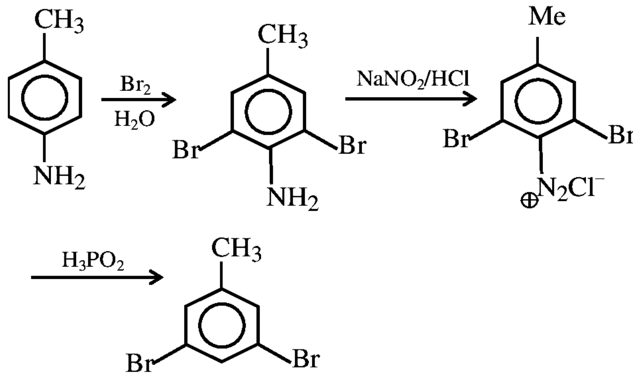
(1) Statement-I and Statement-II both are correct
(2) Statement-I is incorrect Statement-II is correct
(3) Statement-I is correct Statement-II is incorrect
(4) Statement-I and Statement-II both incorrect

Ans. (1)

Sol. Statement-I

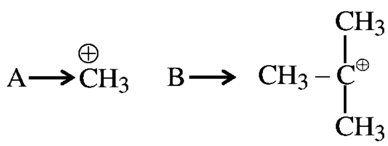


Statement-II



OC

23. Consider the following



Statement-I : B is more stable due to 9αH

Statement-II : A is less stable due to 3αH

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

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

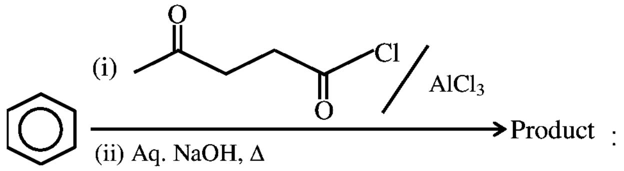
(3) Statement-I is correct Statement-II is incorrect

(4) Statement-I and Statement-II both incorrect

Ans. (3)

Sol. Tertiary butyl carbocation has 9 αH

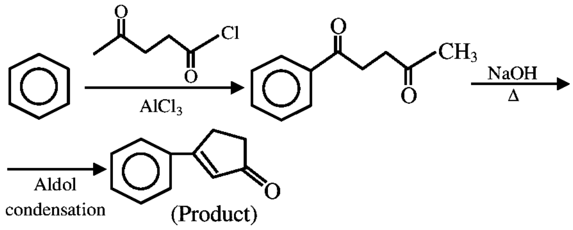
Methylcarbocation has zero αH

24. 

Calculate total number of mass percentage of oxygen in the product

Ans. **(10.13)**

Sol.



Molecular mass of product = 158

Mass % of oxygen = $\frac{16}{158}\times 100 = 10.13\%$

25. Correct statement is :

(A) NaOCl when reacted with KI gives KOI

(B) KOI is best reducing agent

(C) Methanoic acid gives iodoform test

(D) Isopropyl alcohol gives iodoform test

(E) $H_3C-CH=CH-\overset{O}{\overset{\|}{C}}-CH_3$ gives iodoform test

(1) A,B, C only

(2) B, D only

(3) D, E only

(4) B, C, D only

Ans. **(3)**

Sol. Isopropyl alcohol and $H_3C-CH=CH-\overset{O}{\overset{\|}{C}}-CH_3$ gives positive Iodoform test.