

PART-1 : PHYSICS

SECTION-I (i)	Q.	1	2	3	4	
	A.	C	C	C	B	
SECTION-I (ii)	Q.	5	6	7		
	A.	B,C	A,C,D	B,D		
SECTION-II (i)	Q.	1	2	3	4	
	A.	7.00 to 7.08	1.20	2.50	375.00	
SECTION-II (ii)	Q.	5	6	7	8	9 10
	A.	6	1	5	2	384 750

PART-2 : CHEMISTRY

SECTION-I (i)	Q.	1	2	3	4	
	A.	C	D	C	D	
SECTION-I (ii)	Q.	5	6	7		
	A.	A,B	A,C	B,C		
SECTION-II (i)	Q.	1	2	3	4	
	A.	0.16	12.50	1.20	9.00	
SECTION-II (ii)	Q.	5	6	7	8	9 10
	A.	1380	6	5	4	3 4

PART-3 : MATHEMATICS

SECTION-I (i)	Q.	1	2	3	4	
	A.	C	C	B	B	
SECTION-I (ii)	Q.	5	6	7		
	A.	A,B,C,D	C,D	B,C,D		
SECTION-II (i)	Q.	1	2	3	4	
	A.	0.24	0.19 to 0.20	2.00	100.00	
SECTION-II (ii)	Q.	5	6	7	8	9 10
	A.	100	7	5	2	5 7

HINT – SHEET

PART-1 : PHYSICS

SECTION-I (i)

1. Ans (C)

$$V \text{ at gen "y" from bottom} = \sqrt{\frac{\lambda gy}{\lambda}} = \sqrt{gy}$$

$$\Rightarrow V^2 = O^2 + 2 \frac{g}{2} y$$

$$\Rightarrow a = \frac{g}{2} (\text{constant})$$

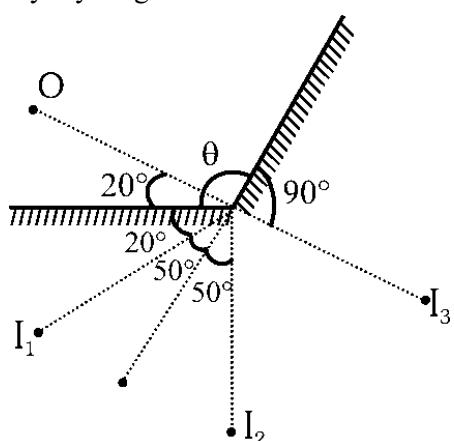
2. Ans (C)

$$\frac{hc}{\lambda} = W + \frac{1}{2} mv_m^2$$

$$v_m = \sqrt{\frac{2(hc - W\lambda)}{\lambda_m}}$$

4. Ans (B)

By ray diagram



PART-1 : PHYSICS

SECTION-I (ii)

6. Ans (A,C,D)

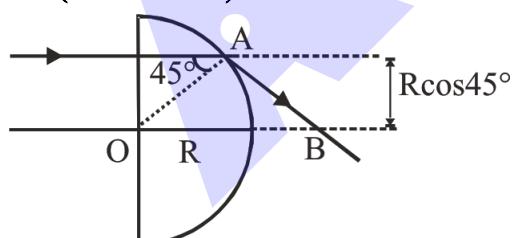
Because of charge Q at centre there will be induced charge $-Q$ at inner surface of sphere.

Hence charge density $\frac{2Q}{4\pi r^2} \Rightarrow \frac{Q}{2\pi r^2}$
because of $2Q$ charge outside the electric field is double that of inside at any point inside S, the E.F. is inversely proportional to the square of its distance from C.

PART-1 : PHYSICS

SECTION-II (i)

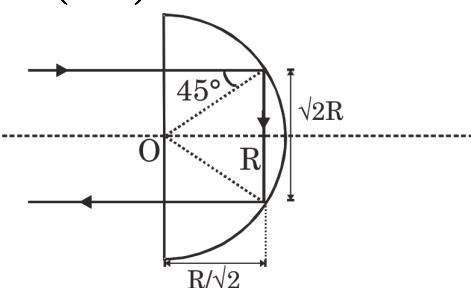
1. Ans (7.00 to 7.08)



$$\sin \theta_C = \frac{1}{\sqrt{2}} \Rightarrow \theta_C = 45^\circ \Rightarrow d = \frac{R}{\sqrt{2}}$$

$$= 5\sqrt{2}\text{cm} = 7.07\text{cm}$$

2. Ans (1.20)



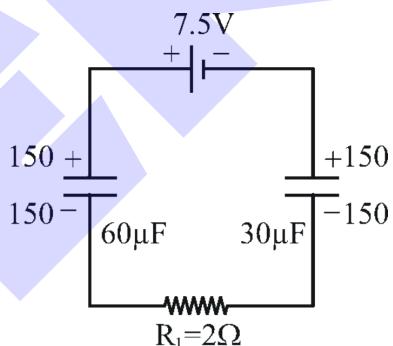
$$\text{Total distance travel in the semi cylinder} = 2\sqrt{2}R$$

$$\text{optical path travel} = (2\sqrt{2}R) \times \sqrt{2},$$

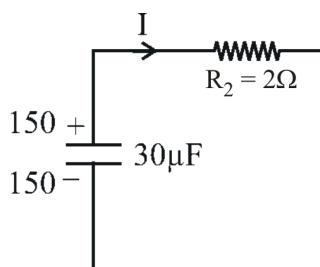
$$\text{time} = \frac{4R}{c} = \frac{4 \times 9 \times 10^{-2}}{3 \times 10^8} = 12 \times 10^{-10}\text{s} = 1.20 \times 10^{-9}\text{s}$$

3. Ans (2.50)

Long time after closing the switch S_1



Just after closing the switch S_2



$$-I \times 2 + \frac{150}{30} = 0$$

4. Ans (375.00)

$$H = \frac{Q^2}{2C}$$

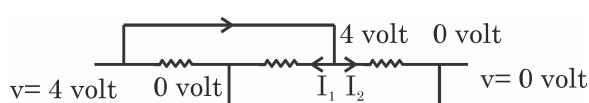
$$Q = 150 \mu\text{C}$$

$$C = 30 \mu\text{F}$$

PART-1 : PHYSICS

SECTION-II (ii)

5. **Ans (6)**



$$I = I_1 + I_2 = \frac{4-0}{R} + \frac{4-0}{2R}$$

6. **Ans (1)**

$$\frac{M\Delta X_1 + M_2\Delta X_2}{M_1 + M_2} = 0$$

$$\frac{M - \left(\frac{L}{4}\right) + 3MX}{4M}$$

$$X = \frac{L}{12}$$

7. **Ans (5)**

$$K\varepsilon_a = \frac{Q \times m_y}{m_a + m_y}$$

$$48 = \frac{50m_y}{4 + m_y}$$

$$m_y = 96$$

$$\therefore \text{mass of parent nuclei} = m_a + m_y = 100$$

8. **Ans (2)**

$$\text{K.E.} = 2E_0 - E_0 = E_0 \quad (\text{for } 0 \leq x \leq 1)$$

$$\lambda_1 = \frac{h}{\sqrt{2mE_0}} ; \text{KE} = 2E_0 \quad (\text{for } x > 1);$$

$$\lambda_2 = \frac{h}{\sqrt{4mE_0}} ; \frac{\lambda_1}{\lambda_2} = \sqrt{2}$$

9. **Ans (384)**

$$v = 2f(l_2 - l_1)$$

$$v = 2 \times 480 \times (70 - 30) \times 10^{-2}$$

$$v = 960 \times 40 \times 10^{-2}$$

$$v = 38400 \times 10^{-2} \text{ m/s}$$

$$v = 384 \text{ m/s}$$

10. **Ans (750)**

The length of the screen used portion for 15 fringes, and also for ten fringes

$$15 \times 500 \times \frac{D}{\lambda} = 10 \times \frac{\lambda D}{\lambda}$$

$$15 \times 50 = \lambda$$

$$\lambda = 750 \text{ nm}$$

\therefore Correct answer 750

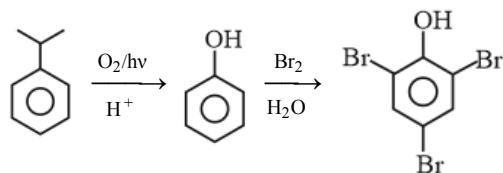
PART-2 : CHEMISTRY

SECTION-I (i)

1. **Ans (C)**

Colligative properties depend upon number of solute particles present in solution.

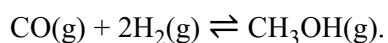
3. **Ans (C)**



PART-2 : CHEMISTRY

SECTION-II (i)

1. **Ans (0.16)**



Let x mol of H_2 used

0.2

$$0.2 - n \quad x \quad n$$

$$PV = n_{\text{Total}} RT$$

$$n_{\text{Total}} = \frac{7.5 \times 2.463}{0.0821 \times 750} = 0.3$$

$$n_{\text{CH}_3\text{OH}} = 0.1$$

$$n_{\text{CO}} = 0.1$$

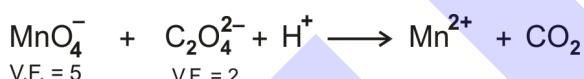
$$n_{\text{H}_2} = 0.3 - 0.1 - 0.1 = 0.1$$

$$K_p = \frac{2.5}{2.5 \times (2.5)^2} = 0.16$$

2. **Ans (12.50)**

$$\frac{P_1}{n_1} = \frac{P_2}{n_2} \Rightarrow \frac{7.5}{0.3} = \frac{P_2}{0.5} \Rightarrow P_2 = 12.5$$

3. **Ans (1.20)**



$$\frac{n(\text{MnO}_4^-)}{2} = \frac{n(\text{C}_2\text{O}_4^{2-})}{5}$$

$$n(\text{MnO}_4^-) = \frac{2}{5} \times 3 = 1.2$$

$$\text{Ans.} = 1.2$$

4. **Ans (9.00)**

X = KIO_3 Atomicity = 5

Y = MnO_2 Oxidation state of Mn = +4

$$X + Y = 5 + 4 = 9$$

PART-2 : CHEMISTRY

SECTION-II (ii)

5. **Ans (1380)**

$$PK_w = 15.2$$

$$[\text{OT}^-] = \frac{3 - 2}{25} = 4 \times 10^{-2} \Rightarrow p\text{OT} = 1.4$$

$$\therefore pT = 13.8$$

8. **Ans (4)**

i, ii, iv, v

9. **Ans (3)**

i, ii, iv

10. **Ans (4)**

i, ii, iii, iv

PART-3 : MATHEMATICS

SECTION-I (i)

1. **Ans (C)**

$$|z_1| = 2, |z_2| = 3, |z_3| = 4$$

$$z_1 \bar{z}_1 = 4, z_2 \bar{z}_2 = 9, z_3 \bar{z}_3 = 16$$

$$|4z_2z_3 + 9z_3z_1 + 16z_1z_2|$$

$$= |z_1 \bar{z}_1 z_2 z_3 + z_2 \bar{z}_2 z_3 z_1 + z_3 \bar{z}_3 z_1 z_2|$$

$$= |z_1 z_2 z_3| |\bar{z}_1 + \bar{z}_2 + \bar{z}_3| = |z_1 z_2 z_3| |z_1 + z_2 + z_3|$$

$$= 2.3.4.5 = 120$$

2. **Ans (C)**

Put $z = x + iy$

$$(x + iy) + i(|z|) = i(x - iy) + 1$$

$$\Rightarrow x = y + 1 \text{ & } y + |z| = x$$

$$\Rightarrow x - y = 1 \text{ & } x - y = |z|$$

$$\Rightarrow |z| = 1$$

3. **Ans (B)**

Required plane

$$(1 + 2\lambda)x + (2 - 3\lambda)y + (3 + 7\lambda)z + 5 + \lambda = 0$$

it is parallel to given line $\Rightarrow \sin\theta = 0$

$$8(1+2\lambda) - 7(2-3\lambda) - 4(3+7\lambda) = 0$$

$$\Rightarrow \lambda = 2$$

$$x \text{ intercept} = \frac{-5-\lambda}{1+2\lambda} = -\frac{7}{5}$$

4. **Ans (B)**

Plane passing through line of intersection of given planes : $P_1 + \lambda P_2 = 0$

$$(2 + \lambda)x + (2\lambda - 4)y + (\lambda + 3)z - (4\lambda + 5) = 0$$

\therefore Perpendicular to $2x - y + z = 4$

$$\Rightarrow 2(2 + \lambda) - (2\lambda - 4) + \lambda + 3 = 0$$

$$\Rightarrow \lambda = -11$$

$$\text{At } \lambda = -11 : 9x + 26y + 8z - 39 = 0$$

PART-3 : MATHEMATICS

SECTION-I (ii)

5. **Ans (A,B,C,D)**

$$A = \begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix}$$

$$A^2 = \begin{bmatrix} 5 & 4 \\ 4 & 5 \end{bmatrix}$$

$$A^3 = \begin{bmatrix} 13 & 14 \\ 14 & 13 \end{bmatrix}$$

:

$$A^n = \begin{bmatrix} \alpha & \alpha + 1 \\ \alpha + 1 & \alpha \end{bmatrix} \text{ OR } \begin{bmatrix} \beta & \beta - 1 \\ \beta - 1 & \beta \end{bmatrix}$$

according as n is odd or even respectively.

6. **Ans (C,D)**

Given limit

$$\begin{aligned} &= \lim_{n \rightarrow \infty} \frac{1}{n} \sum_{i=1}^n \frac{i/n}{1 + \left(\frac{i}{n}\right)^2} = \int_0^1 \frac{x}{1+x^2} dx = \frac{1}{2} (\ln(1+x^2))_0^1 \\ &= \frac{1}{2} \ln 2 = \ln \sqrt{2} \end{aligned}$$

7. **Ans (B,C,D)**

$$D = \begin{vmatrix} 1 & 1 & a \\ 2 & 3 & 0 \\ 3 & 4 & a^2 \end{vmatrix} = a(a-1)$$

$$\text{for } a = 0 : D = 0, D_x = 0, D_y = 0, D_z = 2 - b$$

so for a = 0, b = 2 \Rightarrow Infinite Solutions.

for a = 0, b = 1 \Rightarrow No solution.

$$\text{for } a = 1, D = 0, D_x = 0, D_y = 0, D_z = 0$$

\Rightarrow Infinite solutions.

If a \neq 0 but a = 1 does't have unique solutions.

PART-3 : MATHEMATICS

SECTION-II (i)

1. **Ans (0.24)**

$$(2R)(1R,1G) \text{ or } (1R,1G)(2R)$$

$$P = \frac{^2C_2 \cdot ^3C_1 \cdot ^2C_1}{^5C_2 \cdot ^5C_2} + \frac{^2C_1 \cdot ^3C_1 \cdot ^3C_2}{^5C_2 \cdot ^5C_2} = \frac{24}{100}$$

2. Ans (0.19 to 0.20)

$$P = \frac{\frac{^3C_2 \cdot ^3C_2}{^5C_2 \cdot ^5C_2}}{\frac{^2C_2 \cdot ^2C_2}{^5C_2 \cdot ^5C_2} + \frac{^3C_2 \cdot ^3C_2}{^5C_2 \cdot ^5C_2} + \frac{^2C_1 \cdot ^3C_1 \cdot ^3C_1 \cdot ^2C_1}{^5C_2 \cdot ^5C_2}}$$

$$P = \frac{9}{46}$$

3. Ans (2.00)

$$B_1 B_2 B_3 B_4 B_5 \quad G_1 G_2 G_3 G_4 G_5$$

number of ways = $(5!5!)2$

4. Ans (100.00)

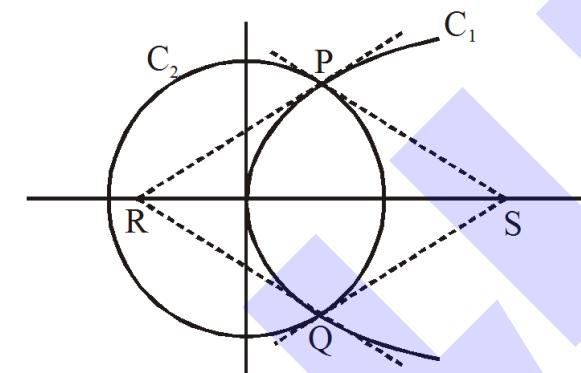
$$\frac{5!}{3!2!} \times \frac{5!}{3!2!} = 100$$

PART-3 : MATHEMATICS

SECTION-II (ii)

5. Ans (100)

Put $z = x + iy$



$$C_1 : y^2 = 8x$$

$$C_2 : x^2 + y^2 = 9$$

On solving C_1 & C_2

$$\text{Tangent to } C_1 \text{ at } P : y(2\sqrt{2}) = 8 \frac{(x+1)}{2}$$

$$\text{at } y=0 : x=-1 \Rightarrow R(-1, 0)$$

$$\text{Tangent to } C_2 \text{ at } P : x(1) + y(2\sqrt{2}) = 9$$

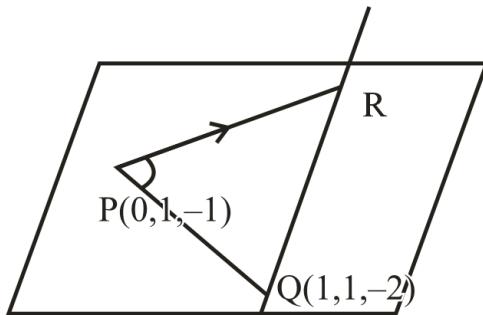
$$\text{at } y=0 : x=9 \Rightarrow S(9, 0).$$

$$\therefore \text{Area } \Delta PRS : \frac{1}{2} \times (9 - (-1)) \times 2\sqrt{2} = 10\sqrt{2}$$

$$\therefore \lambda = 10 \Rightarrow \lambda^2 = 100$$

6. Ans (7)

$$\frac{x-1}{2} = \frac{y-1}{3} = \frac{z+2}{1} = \lambda$$



$$\therefore R(2\lambda + 1, 3\lambda + 1, \lambda - 2)$$

$$\overrightarrow{PR} \cdot \overrightarrow{PQ} = 0$$

$$((2\lambda + 1)\hat{i} + 3\lambda\hat{j} + (\lambda - 1)\hat{k}) \cdot (\hat{i} - \hat{k}) = 0$$

$$2\lambda + 1 - \lambda + 1 = 0 \Rightarrow \lambda = -2$$

$$\therefore R \text{ is } (-3, -5, -4)$$

$$PR = \sqrt{9 + 36 + 9} = \sqrt{54}$$

$$\therefore [PR] = 7$$

7. Ans (5)

In the expansion of $(x+y)^n$ $\frac{T_2}{T_3}$ &

In the expansion of $(x+y)^{n+3}$ $\frac{T_3}{T_4}$ are equal

$$\Rightarrow \frac{^nC_1 x^{n-1} y}{^nC_2 x^{n-2} y^2} = \frac{^{n+3}C_2 x^{n+1} y^2}{^{n+3}C_3 x^n y^3}$$

$$\frac{2}{n-1} \frac{x}{y} = \frac{3}{n+1} \frac{x}{y} \Rightarrow 2n+2 = 3n-3$$

$$\Rightarrow n = 5$$

8. Ans (2)

$$f'(x) = 3\sin^2 x \cdot \cos x + 2m \sin x \cos x \\ = \sin x \cos x (3\sin x + 2m)$$

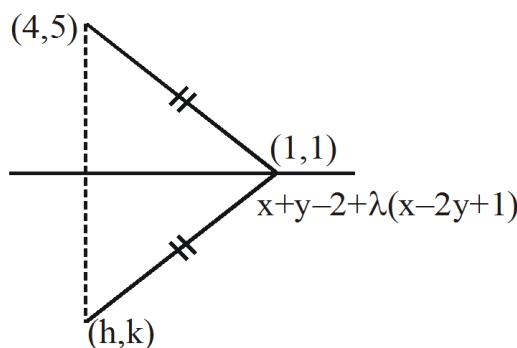
for maximum & minimum $f'(x) = 0$

$$\Rightarrow \cos x = 0 \text{ and } \frac{2m}{3} \in [-1, 1]$$

$$\Rightarrow m \in \left[-\frac{3}{2}, \frac{3}{2}\right] - \{0\} \quad (\because \sin x \neq 0)$$

9. Ans (5)

Centre of circle is (4, 5)



Let image of centre in variable line be (h, k)

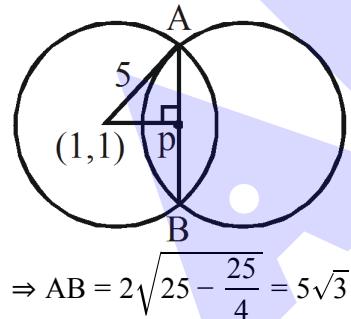
$$\Rightarrow (h - 1)^2 + (k - 1)^2 = 25$$

\Rightarrow equation of locus of (h, k) is

$x^2 + y^2 - 2x - 2y - 23 = 0$ which is also a circle.

Now, AB is common chord of two circles.

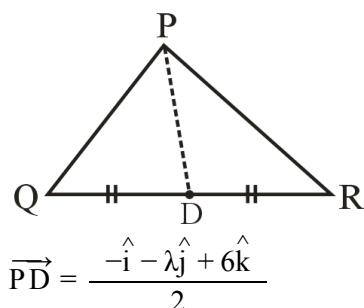
$$\text{i.e. } 6x + 8y = 39 \Rightarrow p = \left| \frac{6+8-39}{10} \right| = \frac{5}{2}$$



$$\Rightarrow AB = 2\sqrt{25 - \frac{25}{4}} = 5\sqrt{3}$$

10. Ans (7)

$$\overrightarrow{PD} = \frac{\overrightarrow{PQ} + \overrightarrow{PR}}{2}$$



$$|\overrightarrow{PD}| = \sqrt{\frac{1}{4} + \frac{\lambda^2}{4} + 9} = \sqrt{24}$$

$$\frac{1}{4} + \lambda^2 + 9 = 24$$

$$\lambda = \sqrt{59}$$

$$\therefore \overrightarrow{PD} = \frac{-\hat{i} - \sqrt{59}\hat{j} + 6\hat{k}}{2}$$

$$\therefore \overrightarrow{QD} = \overrightarrow{QP} + \overrightarrow{PD}$$

$$= 4\hat{i} - 5\hat{k} + \left(-\frac{\hat{i}}{2} - \frac{\sqrt{59}}{2}\hat{j} + \frac{6\hat{k}}{2} \right) = \frac{7\hat{i}}{2} - \frac{\sqrt{59}}{2}\hat{j} - 2\hat{k}$$

$$|\overrightarrow{QD}| = \sqrt{\frac{49 + 59}{4} + 4} = \sqrt{31}, \quad |\overrightarrow{QR}| = \sqrt{124}$$