PACE-IIT & MEDICAL

MUMBAI / DELHI-NCR / PUNE / HYDERABAD / AKOLA / GOA / JALGOAN / BOKARO / AMRAVATI / PATNA / BARAMATI

IIT – JEE: 2027 **MAJOR TEST - 1** **DATE: 27/07/25**

ANSWER KEY

PAPER – 1 (CODE: 12)

MATHEMATICS

Q. No.	1	2	3	4	5	6	7	8	9	10
Ans.	BCD	AD	ABCD	A	C	A	B	5	33	1
Q. No.	11	12	13	14	15	16	17			
Ans.	0	254	9	B	D	A	C			

PHYSICS

Q. No.	18	19	20	21	22	23	24	25	26	27
Ans.	AB	ACD	ABD	D	B	C	D	40	44	83
Q. No.	28	29	30	31	32	33	34			
Ans.	30	45	4	B	A	A	D			

CHEMISTRY

Q. No.	35	36	37	38	39	40	41	42	43	44
Ans.	ABC	A	ACD	D	D	A	C	6	500	58
Q. No.	45	46	47	48	49	50	51			
Ans.	2	50	23	B	B	C	A			

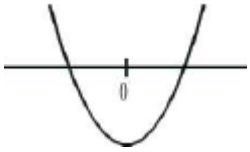
PART (A) : MATHEMATICS

1. (BCD)

$(a-2)x^2+4x+a-10=0$

A$f(0)<0$

$(a-2)(a-10)<0$



$\alpha\in(2,10)$

$3+4+5+6+7+8+9=42$

2. (AD)

Given, x_1 and x_2 are roots of $\alpha x^2-x+\alpha=0$

$\therefore \quad x_1+x_2=\dfrac{1}{\alpha}$ and $x_1x_2=1$

Also, $|x_1-x_2|<1$

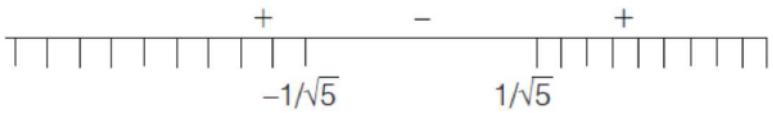
$\Rightarrow \quad |x_1-x_2|^2<1$

$\Rightarrow \quad (x_1-x_2)^2<1$

Or $(x_1+x_2)^2-4x_1x_2<1$

$\Rightarrow \quad \dfrac{1}{\alpha^2}-4<1$ or $\dfrac{1}{\alpha^2}<5$

$\Rightarrow \quad 5\alpha^2-1>0$ or $\left(\sqrt{5}\alpha-1\right)\left(\sqrt{5}\alpha+1\right)>0$



$\therefore \quad \alpha\in\left(-\infty,-\dfrac{1}{\sqrt{5}}\right)\cup\left(\dfrac{1}{\sqrt{5}},\infty\right)$ … (i)

Also, $D>0$

$\Rightarrow \quad 1-4\alpha^2>0$

Or $\alpha\in\left(-\dfrac{1}{2},\dfrac{1}{2}\right)$ … (ii)

From Eqs. (i) and (ii), we get

$\alpha\in\left(-\dfrac{1}{2},\dfrac{-1}{\sqrt{5}}\right)\cup\left(\dfrac{1}{\sqrt{5}},\dfrac{1}{2}\right)$

3. (ABCD)

$\dfrac{\sin 30\alpha+\sin 6\alpha}{\sin 20\alpha-\sin 4\alpha}=\dfrac{2\sin(18\alpha)\cos(12\alpha)}{2\sin(8\alpha)\cos(12\alpha)}$

$=\dfrac{\sin(18\alpha)}{\sin(8\alpha)}=\dfrac{\sin(26\alpha-8\alpha)}{\sin(8\alpha)}=\dfrac{\sin(\pi-8\alpha)}{\sin(8\alpha)}=1$

(A) $\cot 15^\circ\cdot\cot 75^\circ=\left(2+\sqrt{3}\right)\left(2-\sqrt{3}\right)=1$

(A) $\cos(88\pi)=1$

(C) $4\cos 72^{\circ}\cdot\sin 54^{\circ}$

$4\dfrac{\sqrt{5}-1}{4}\times\dfrac{\sqrt{5}+1}{4}=\dfrac{4}{4}=1$

(D) $\sin\left(\dfrac{9\pi}{2}\right)=1$

4. (A)

Let $\dfrac{\tan x}{2}=\dfrac{\tan y}{3}=\dfrac{\tan z}{5}=k$

If $x+y+z=\pi$, then

$\tan x+\tan y+\tan z=\tan x\tan y\tan z$

$2k+3k+5k=2k3k5k$

$k^2=\dfrac{1}{3}$

$\tan^2 x+\tan^2 y+\tan^2 z=38k^2=\dfrac{38}{3}$

5. (C)

Given equation is

$a\left(\dfrac{2x+1}{x-1}\right)^2+b\left(\dfrac{2x+1}{x-1}\right)+c=0$

Then $\dfrac{2x+1}{x-1}=\alpha$

$\Rightarrow \quad x=\dfrac{\alpha+1}{\alpha-2}$

Roots of the equation is

$\dfrac{\alpha+1}{\alpha-2},\dfrac{\beta+1}{\beta-2}$

6. (A)

Obviously $p+q=-p$ and $pq=q\Rightarrow p=1$

And $q=-2$

7. (B)

Given that $\sin\theta+\sin\varphi=a$ .....(i)

And $\cos\theta+\cos\varphi=b$ .....(ii)

Squaring, $\sin^2\theta+\sin^2\varphi+2\sin\theta\sin\varphi=a^2$

And $\cos^2\theta+\mathrm{Cos}^2\varphi+2\cos\theta\cos\varphi=b^2$

Adding, $2+2(\sin\varphi+\cos\theta\cos\varphi)=a^2+b^2$

$\Rightarrow \quad 2\cos(\theta-\varphi)=a^2+b^2-2\Rightarrow\cos(\theta-\varphi)=\dfrac{a^2+b^2-2}{2}$

$\Rightarrow \quad \dfrac{1-\tan^2\dfrac{\theta-\varphi}{2}}{1+\tan^2\dfrac{\theta-\varphi}{2}}=\dfrac{a^2+b^2-2}{2}$

$$\Rightarrow \quad \left(a^2+b^2\right)+\left(a^2+b^2\right)\tan^2\frac{\theta-\varphi}{2}-2-2\tan^2\frac{\theta-\varphi}{2}$$

$$=2-2\tan^2\frac{\theta-\varphi}{2}$$

$$\Rightarrow \quad \frac{4-a^2-b^2}{a^2+b^2}=\tan^2\frac{\theta-\varphi}{2}\Rightarrow \tan\frac{(\theta-\varphi)}{2}=\sqrt{\frac{4-a^2-b^2}{a^2+b^2}}$$

8. (5)

$$x^2+\sqrt{3}x-16=0<\beta$$

$$P_n+\sqrt{3}P_{n-1}-16P_{n-2}=0$$

$$P_{25}+\sqrt{3}P_{24}-16P_{23}=0$$

$$\therefore \ \frac{P_{25}+\sqrt{3}P_{24}}{2P_{23}}=8$$

Similarly

$$x^2+3x-1=0<\sum_{\delta}^{\gamma} \quad Q_n=\gamma^n+\delta^n$$

$$Q_{25}-Q_{23}=\gamma^{25}+\delta^{25}-\gamma^{23}-\delta^{23}$$

$$=\gamma^{23}(-3\gamma)+\delta^{23}(-3\gamma)$$

$$=-3\left[\gamma^{24}+\delta^{24}\right]$$

$$=-3Q_{24}$$

$$\therefore \ \frac{Q_{25}-Q_{23}}{Q_{24}}=-3$$

$$\frac{P_{25}+\sqrt{3}P_{24}}{2P_{23}}+\frac{Q_{25}-Q_{23}}{Q_{24}}=8-3=5$$

9. (33)

$$\sin^8\frac{\pi}{8}+\sin^8\frac{3\pi}{8}+\sin^8\frac{5\pi}{8}+\sin^8\frac{7\pi}{8}=\frac{m}{n}$$

$$\Rightarrow 2\left[\sin^8\frac{\pi}{8}+\cos^8\frac{\pi}{8}\right]$$

$$\Rightarrow 2\left[\left(\frac{1-\cos\frac{\pi}{4}}{2}\right)^4+\left(\frac{1+\cos\frac{\pi}{4}}{2}\right)^4\right]=17/16$$

10. (1)

Given, $x=\frac{1}{2}\left(\sqrt{3}+\frac{1}{\sqrt{3}}\right)$

$$\therefore \quad x^2=\frac{1}{4}\left(3+\frac{1}{3}+2\right)=\frac{4}{3}$$

11. (0)

$$(6k+2)x^2+rx+3k-1=0$$

$$(12k+4)x^2+px+6k-2=0$$

Have both roots common, so

$$\frac{6k+2}{12k+4}=\frac{r}{p}=\frac{3k-1}{6k-2}\Rightarrow\frac{r}{p}=\frac{1}{2}\Rightarrow 2r-p=0$$

12. (254)

$\because \quad x=8+3\sqrt{7}$

$\therefore \quad y=\dfrac{1}{8+3\sqrt{7}}=8-3\sqrt{7}$

Now, $\dfrac{1}{x^2}+\dfrac{1}{y^2}=\dfrac{x^2+y^2}{(xy)^2}$

$=(x+y)^2-2 \qquad [\because xy=1]$

$=\left(8+3\sqrt{7}+8-3\sqrt{7}\right)^2-2$

$=(16)^2-2=254$

13. (9)

$$L=\sum\frac{\cos ec\,B\cos ec\,C}{\sec A}$$

$$=\frac{\cos A\cdot\sin A+\cos B\sin B+\cos C\sin C}{\sin A\sin B\sin C}$$

Now if $A+B+C=\pi$

$\Rightarrow \sin 2A+\sin 2B+\sin 2C=4\sin A\sin B\sin C$

$\Rightarrow \quad 2k=4 \Rightarrow k=2$

$$M=\frac{\sin 130^\circ+\sin 70^\circ+\sin 160^\circ}{\sin 65^\circ\sin 35^\circ\sin 80^\circ}\text{ using }\sin 2A+\sin 2B+\sin 2C=4\sin A\sin B\sin C$$

$M=4$

$$N=\left(1-\cos\frac{2\pi}{9}\right)\left(1-\cos\frac{4\pi}{9}\right)\left(1-\cos\frac{6\pi}{9}\right)\left(1-\cos\frac{8\pi}{9}\right)$$

$$=\left(2\sin^2\frac{\pi}{9}\right)\left(2\sin^2\frac{2\pi}{9}\right)\left(2\sin^2\frac{3\pi}{9}\right)\left(2\sin^2\frac{4\pi}{9}\right)$$

$$=8\times\frac{3}{2}\times\left[\sin 20^\circ\sin 40^\circ\sin 80^\circ\right]^2$$

$$=12\left[\cos 10^\circ\cos\left(60^\circ-10^\circ\right)\cos\left(60^\circ+10^\circ\right)\right]^2$$

$$12\left(\frac{1}{4}\cos 30^\circ\right)^2=\frac{12}{16}\times\frac{3}{4}=\frac{9}{16}$$

$L^2MN=9$

14. (B)

(P) $0\le 3\sin^2 2\theta\le 3$

$\Rightarrow \quad -1\le\sin^2 2\theta-1\le 2$

(Q) maximum = 4

minimum $=4-5=-1$

(R) minimum = 0

(S) maximum $=-2ab=-2\times 2\times 1=-4$

15. (D)

(P) Coefficient x^2 is $^+$ve $\min\left(f(x)\right)=\dfrac{4ac-b^2}{4a}=7$

(Q) Coefficient x^2 is $^-$ve $\max\left(f(x)\right)=\dfrac{4ac-b^2}{4a}=3$

(R) Roots are $(-5,-1)$

(S) $x^3-6x^2+11x-6=(x-1)(x-2)(x-3)$ the roots are 1,2,3 only positive roots.

16. (A)

$85x^2-22\pi x+\pi^2=0$

$\beta=\dfrac{\pi}{5},\alpha=\dfrac{\pi}{17}$

$a=\cos\alpha\cos2\alpha\cos4\alpha\cos8\alpha$

$=\dfrac{\sin16\alpha}{16\sin\alpha}=\dfrac{\sin\dfrac{16\pi}{17}}{16\sin\dfrac{\pi}{17}}=\dfrac{1}{16}$

$b=\sin\alpha+\sin(\alpha+\beta)+....+\sin(\alpha+9\beta)$

$=\dfrac{\sin5\beta\sin\left(\dfrac{2\alpha+9\beta}{2}\right)}{\sin\left(\dfrac{\beta}{2}\right)}=\dfrac{\sin\pi\sin\left(\dfrac{2\pi}{17}+\dfrac{9\pi}{5}/2\right)}{\sin\left(\dfrac{\pi}{10}\right)}=0$

$c=\dfrac{\cos\beta\cdot\cos\left(\dfrac{\pi}{3}-\beta\right)\cos\left(\dfrac{\pi}{3}+\beta\right)}{\sin\dfrac{\beta}{6}\cdot\sin\left(\dfrac{\pi}{3}-\dfrac{\beta}{6}\right)\sin\left(\dfrac{\pi}{3}+\dfrac{\beta}{6}\right)}=\dfrac{\cos3\beta}{\sin\left(\dfrac{\beta}{2}\right)}=\dfrac{\cos\dfrac{3\pi}{5}}{\sin\dfrac{\pi}{10}}=-1$

17. (C)

(P) $x^4-8x^2-9=0$

$(x^2-9)(x^2+1)=0 \quad \Rightarrow x=3,-3$

(Q) $x^{2/3}+x^{1/3}-2=0$

$(x^{1/3}+2)(x^{1/3}-1)=0 \quad \Rightarrow x=-8,1$

(R) $\left(\sqrt{3x+1}\right)^2=\left(\sqrt{x}-1\right)^2$

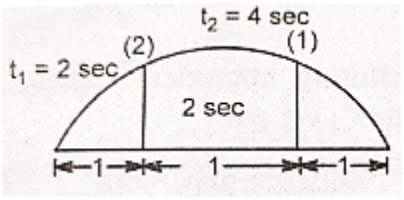
$\Rightarrow \quad 3x+1=x+1-2\sqrt{x} \quad \Rightarrow 2x=-2\sqrt{x}$ (not possible)

(S) $(3^x-9)(3^x-1)=0 \quad \Rightarrow x=0,2$

PART (B) : PHYSICS

18. (A, B)

Distance travelled by 2nd



Particle in 2 sec $= 0.5 \times 2 = 1\text{m}$

Horizontal range = 1 + 1 + 1 = 3 m

Flight time = 4 + 2 = 6 sec.

$$6 = \frac{2u\sin\theta}{g},\ u\sin\theta = 30$$

$$H = \frac{u^2\sin^2\theta}{2g} = \frac{900}{2\times 10} = 45$$

19. (ACD)

$\mathbf{u} = 4\hat{\mathbf{i}}$

$\mathbf{v} = u\,\hat{\mathbf{i}} + gt\,\hat{\mathbf{j}}$

$= 4\,\hat{\mathbf{i}} + 10t\,\hat{\mathbf{j}}$

When it hits the ground at t = 0.4 s,

$\mathbf{v} = 4\hat{\mathbf{i}} + 10(0.4)\hat{\mathbf{j}} = 4\hat{\mathbf{i}} + 4\hat{\mathbf{j}}$

Vertical component of velocity when it hits ground = 4 m/s

Angle at which it hits the ground

$$= \tan^{-1}\left(\frac{4}{4}\right) = \tan^{-1}(1) = 45°$$

$$s_y = u_y t + \frac{1}{2}a_y t^2$$

$$\Rightarrow \quad +H = 0 + \frac{1}{2}(+10)(0.4)^2$$

$$\Rightarrow \quad H = 0.8\,\text{m}$$

$$s_x = u_x t + \frac{1}{2}a_x t^2$$

$$\Rightarrow \quad R = 4\times 0.4 = 1.6\,\text{m}$$

20. (A, B, D)

$y_0 = 0,\ \upsilon_0 = 0,\ a_y = +20.0\ \text{m/s}^2$, taking y-axis as positive upward

$$\upsilon^2 = \upsilon_0^2 + 2a_y(y - y_0)$$

$$= 0 + 2(20.0)(0.400 - 0)$$

$$= 16.0\ \text{m}^2/\text{s}^2$$

or $\upsilon = 4.00\ \text{m/s}$

Part 2: From the instant his feet leave the floor until the maximum height is reached, the body experiences a constant downward acceleration g. Initial velocity for this part of motion is same as the final velocity obtained in part 1.

$\upsilon_0 = 4.00\ \text{m/s}$

$\upsilon^2 = \upsilon_0^2 - 2g(y - y_0)$, take $y_0 = 0$

Therefore $y = \dfrac{\upsilon_0^2}{2g} = \dfrac{(4.00)^2}{2(9.80)} = 0.816$ m

time at $H = \dfrac{4}{9.8} = 0.408$ sec

Time of flight $= 2 \times (0.408) = 0.816$ sec

21. (D)

$$\frac{d}{dx}\sin x^3 = \frac{d}{dx^3}\sin x^3 \cdot \frac{dx^3}{dx}$$
$$= \cos x^3 \times 3x^2$$

22. (B)

$$\int \frac{1}{\sin^2 x \cos 2x}\,dx = \int \frac{\sin^2 x + \cos^2 x}{\sin^2 x \cos^2 x}\,dx$$
$$= \int \frac{\sin^2 x}{\sin^2 x \cos^2 x}\,dx + \int \frac{\cos^2 x}{\sin^2 x \cos^2 x}\,dx$$
$$= \int \sec^2 x\,dx + \int \operatorname{cosec}^2 x\,dx$$
$$= \tan x + (-\cot x) + C$$
$$= \tan x - \cot x + C$$

23. (C)

Distance $s = \left|\int_0^2 \upsilon\,dt\right| + \left|\int_2^4 \upsilon\,dt\right|$

$$= \left|\int_0^2 (t-2)\,dt\right| + \left|\int_2^4 (t-2)\,dt\right|$$
$$= \left|\frac{t^2}{2} - 2t\right|_0^2 + \left|\frac{t^2}{2} - 2t\right|_2^4$$
$$= \left|\frac{2^2}{2} - 2\times 2\right| + \left|\left(\frac{4^2}{2} - 2\times 4\right) - \left(\frac{2^2}{2} - 2\times 2\right)\right|$$
$$= 2 + 2 = 4 \text{ m}$$

24. (D)

$v = a^3$

$$\frac{dv}{dt} = 3a^2\frac{da}{dt} \qquad .....(1)$$

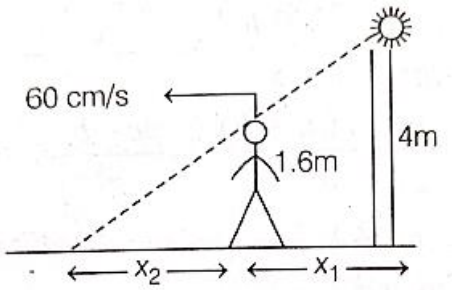
$s = 6a^2$

$$\frac{ds}{dt} = 12a\frac{da}{dt} \qquad .....(2)$$

$$\frac{ds}{dt} = 12a\left(\frac{dv}{dt}\right)\frac{1}{3a^2}$$

$$\frac{ds}{dt} = \frac{4}{a}\left(\frac{dv}{dt}\right) = \frac{4}{25}\times 3 = 0.48 \text{ cm}^2/\text{s}$$

25. (40)



$$\frac{x_1+x_2}{x_2}=\frac{4}{1.6}=\frac{5}{2} \Rightarrow x_2=\frac{2}{3}x_1$$

$$\frac{dx_2}{dt}=\frac{2}{3}\frac{dx_1}{dt}$$

Where, $\frac{dx_1}{dt}=60$ cm/s .

$$\frac{dx_2}{dt}=\left(\frac{2}{3}\right)(60)=40 \text{ cm/s}.$$

26. (44)

$$V=29.4-9.8t$$

$$V=\frac{ds}{dt}=29.4-9.8t=0 \Rightarrow 29.4=9.8t \Rightarrow t=3$$

$$\frac{dS}{dt}=29.4-9.8t$$

$$\int dS=29.4\int dt-9.8\int tdt$$

$$=29.4\left[\frac{t^0+1}{0+1}\right]_0^3-9.8\left[\frac{t^2}{2}\right]_0^3$$

$$=29.4[3-0]=4.9\left[(3)^2-(0)^2\right]$$

$$=88.2-4.9\times 9$$

$$=88.2-44.1$$

$$=44.1$$

27. (83)

$$V=9t^2-8t$$

$$\frac{ds}{dt}=9t^2-8t \Rightarrow ds=9\int t^2dt-8\int t\,dt$$

$$S=\cancel{9}^{3}\left[\frac{t^3}{\cancel{3}}\right]-\cancel{8}^{4}\left[\frac{t^2}{\cancel{2}}\right]$$

$S=[3t^3]_3^4-[4t^2]_3^4$ 4^{th} second means 3 to 4

$$=3\left[(4)^3-(3)^3\right]-4\left[(4)^2-(3)^2\right]$$

$$=3[64-27]-4[16-9]$$

$$=3(37)-4(7)$$

$$=111-28=83$$

28. (30)

$$\left((30\sin 53°)t - \frac{1}{2}gt^2\right) + \left(\frac{1}{2}gt^2\right) = 30$$

$$\Rightarrow \quad 30 \times \frac{4}{5}t = 30$$

$$\Rightarrow \quad t = \frac{5}{4}\text{s}$$

$$d = (30\cos 53°)t + 6t$$

$$\Rightarrow \quad d = 24t = 24\left(\frac{5}{4}\right) = 30 \text{ m}$$

29. (45)

Horizontal range of bullet is 30 m.

$$\frac{u^2 \sin 2\theta}{g} = 30$$

or $\sin 2\theta = \dfrac{30 \times 10}{(100)^2}$

or $\sin 2\theta = 0.03$

For small θ, $\sin\theta \approx \theta$

i.e., $2\theta = 0.03$

Therefore $\theta = 0.015$

The rifle must be aimed at an angle $\theta = 0.015$ above horizontal.

Height to be aimed $= 30\tan\theta \approx 30(\theta)$

$= 30 \times 0.015$

= 45 cm.

30. (4)

$$R^2 = P^2 + Q^2 \qquad \ldots \text{(i)}$$

$$\frac{R}{\sqrt{2}} = P - Q \qquad \ldots \text{(ii)}$$

$$\Rightarrow \quad [\sqrt{2}(P-Q)]^2 = P^2 + Q^2$$

$$\Rightarrow \quad 2(P^2 + Q^2 - 2PQ) = P^2 + Q^2$$

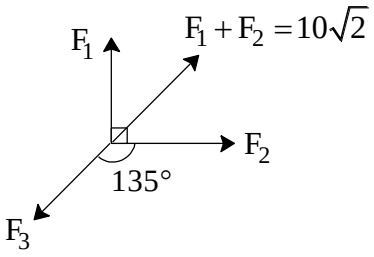
$$\Rightarrow \quad P^2 + Q^2 - 4PQ = 0$$

$$\Rightarrow \quad P^2 + Q^2 = 4PQ$$

$$\Rightarrow \quad \frac{P}{Q} + \frac{Q}{P} = 4$$

31. (B)

(P) $F_1 + F_2 + F_3 = 0$



(Q) $\left(\vec{F}_1+\vec{F}_2\right)+\left(-\vec{F}_3\right)$

$=10\sqrt{2}+10\sqrt{2}$

$=20\sqrt{2}$

(R) $\vec{F}_2=10\hat{i},\ \vec{F}_1=10\hat{j},\ \vec{F}_3=-10\hat{i}-10\hat{j}$

$\vec{F}_1\times\vec{F}_2=100\left(-\hat{k}\right)$

$$\left(\vec{F}_1\times\vec{F}_2\right)\times\vec{F}_3=\begin{vmatrix}\hat{i} & \hat{j} & \hat{k}\\ 0 & 0 & -100\\ -10 & -10 & 0\end{vmatrix}$$

$\hat{i}(-1000)-\hat{j}(-1000)+\hat{k}(0)$

$\left|\left(\vec{F}_1\times\vec{F}_2\right)\times\vec{F}_3\right|=\sqrt{1000^2+1000^2}$

$=1000\sqrt{2}$.

(S) $\vec{F}_3\cdot\left(\vec{F}_1+\vec{F}_2\right)$

$=\left|\vec{F}_3\right|\left|\vec{F}_1+\vec{F}_2\right|\cos 80°$

$=\left(10\sqrt{2}\right)\left(10\sqrt{2}\right)(-1)$

$=-200$

$\Rightarrow$ Magnitude = 200

32. (A)

(P) Average velocity $=\dfrac{\text{Total displacement}}{\text{time}}$

$S_x=u_xt$

$=20\sqrt{2}\cos 45\times 1$

$=20\text{ m}$

$S_y=u_yt+\dfrac{1}{2}a_yt^2$

$=20\sqrt{2}\cos 45\times 1-\dfrac{1}{2}\times 10\times 1^2$

$=20-5$

$=15$

Total displacement $=\sqrt{S_x^2+S_y^2}$

$=\sqrt{20^2+15^2}$

$=\sqrt{625}$

$=25\text{ m}$

$\therefore$ Average velocity = 25 m/s

(Q) $\Delta v_x=20-20=0$

$\Delta v_y = v_y - u_y = 10 - 20 = -10$ m/s

$v_y = u_y + ayt$

$= 20\sqrt{2}\sin 45 - 10$

$= 20 - 10$

$= 10$

$\therefore$ Change in velocity = –10 m/s

(R) Instantaneous velocity $= \sqrt{v_x^2 + v_y^2}$

$= \sqrt{20^2 + 10^2}$

$= \sqrt{500}$

$= 10\sqrt{5}$ m/s

33. (A)

(P) $(a+b)\cdot(2a-b) = \frac{1}{2}$

$2a^2 - b^2 + \vec{a}\cdot\vec{b} = 0$

$(a+b) + (2a-b) = 3\hat{i} + \frac{3}{2}\hat{j}$

$a = \hat{i} + \frac{\hat{j}}{2}$

$b = -\hat{i} + \frac{\hat{j}}{2} \Rightarrow \cos\theta = \frac{\bar{a}\cdot\bar{b}}{|a||b|} = \frac{-1+\frac{1}{4}}{\sqrt{5/4}\sqrt{5/4}} = \frac{3}{4}\times\frac{4}{5} = \frac{3}{5}$

(Q) $|a+b+c|^2 = 6$

$|a| = 1$

(R) Area of parallelogram

$= \frac{1}{2}\left|\left(3\hat{i} + \hat{j} - 2\hat{k}\right)\times\left(\hat{i} - 3\hat{j} + 4\hat{k}\right)\right|$

$= 5\sqrt{3}$

(S) $a\cdot(b+c) = 0 \quad ...(1)$

$b\cdot(c+a) = 0 \quad ...(2)$

$c\cdot(a+b) = 0 \quad ...(3)$

$2(a\cdot b + b\cdot c + c\cdot a) = 0$

$|a+b+c|^2 = a^2 + b^2 + c^2 + 2a\cdot c + 2b\cdot c + 2c\cdot a$

$|a+b+c| = \sqrt{2^2 + 3^2 + 6^2} = 7$

34. (D)

(A) $y = x - \frac{x^2}{80}$

$\frac{dy}{dx} = 1 - \frac{2x}{40}$

At $x = 0$

$\frac{dy}{dx} = 1 = \tan\theta$

$\theta = 45°$

(C) $\frac{dy}{dt} = \frac{dx}{dt} - \frac{2x}{80}\frac{dx}{dt}$

$v_y = v_x - \frac{x}{40}v_x$

$0 = v_x - \frac{x}{40}v_x$

$1 - \frac{x}{40} = 0$

$x = 40\,\text{m}$

At $x = 40$, $y = 40 - \frac{40\times 40}{80} = 20\,\text{m}$

$y = \text{hence} = 20\,\text{m}$

(D) Range $= 40\times 2 = 80\,\text{m}$

(B) $h_{\max} = \frac{(u_y)^2}{2g}$

$20 = \frac{(u_y)^2}{2\times 10}$

$u_y = 20\,\text{m/s}$

$\tan\theta = \frac{v_y}{v_x}$ $\quad \theta = 45°$

PART (C) : CHEMISTRY

35. (A, B, C)

36. (A)

37. (A, C, D)

38. (D)

$X_2Y_3 = 75\times 2 + 16\times 3 = 150 + 48 = 198$

$198 - 150$
$100 \quad ?$ $= \frac{150\times 100}{198} = 75.8\%$

39. (D)

6.022×10^{23} molecule $(H_2O) \rightarrow 18\,\text{g}$

1 molecule $\rightarrow \frac{18}{6.022\times 10^{23}} = 2.88\times 10^{-23}\text{g}$

Density = 1 mass = volume occupied.

40. (A)

$3O_2 \rightarrow 2O_3 \rightarrow 15\%$ convert

67.2 L

STP $\rightarrow$ 3 mole $\rightarrow$ 2 mole $\rightarrow$ 100%

0.3 mole 15%

$48 \times 0.3 = 14.4$ g of ozone prepared

41. (C)

42. (6)
If no paschen series line is observed that means n = 3 energy level is not involved.
So no. of energy levels involved (n) = 4
(n = 2, n = 4, n = 5, n = 6)
Total possible lines $= \frac{n(n-1)}{2} = \frac{4\times 3}{2} = 6$

43. (500)
1 atom $= 6.643\times10^{-23}$ g
Weight of 1 mole $= 6.643\times10^{-23}\times6.022\times10^{23}$
= 40 g
$\therefore$ 1 mole $\rightarrow$ 40 g
500 mole $\rightarrow$ 20000 f

44. (58)
$$\Delta x = \frac{h}{4\pi\Delta p} = \frac{h}{4\pi m\Delta V} = \frac{6.63\times10^{-34}}{4\times3.14\times9.1\times10^{-31}\times1}$$
$\Delta x = 58\,\mu m.$

45. (2)

46. (50)

SO_2Cl_2	+	H_2O	$\rightarrow$	H_2SO_4	+	2HCl
25 ml		0.2 M		1		2
$n = 0.2\times\frac{25}{1000}$				$n = 0.2\times\frac{25}{1000}$		$n = 0.4\times\frac{25}{1000}$

$Ba(OH)_2 \rightarrow 2OH^-$
$H_2SO_4 \rightarrow 2H^+$
$2HCl \rightarrow 2H^+$
$1H_2SO_4 \rightarrow 1Ba(OH)_2 \downarrow 2HCl \rightarrow Ba(OH)_2$
$n_{Ba(OH)}$ required $\rightarrow 0.2\times\frac{25}{1000} + 0.2\times\frac{25}{1000} \Rightarrow \frac{Volume}{1000} = \frac{0.4\times25}{\frac{1000}{0.2}}$
Volume = 50 ml

47. (23)
$\frac{3.011\times10^{22}}{6.022\times10^{23}} = 0.5\times10^{-1}$ mole $\rightarrow 1.15$ g
1 mole $\rightarrow 1.15\times20 = 23\,g = (23\,MW)$

48. (B)

49. (B)

50. (C)
(P) 0.5 moles $\Rightarrow$ 11.2 L at STP.

$SO_2 \rightarrow 64\,g \Rightarrow 32\,g$

3 atoms per $SO_2 \rightarrow 0.5 \times 3 = 1.5$ Na

(Q) $1\,g\ H_2 \rightarrow 0.5$ mole $\rightarrow 11.2$ L at STP.

$2 \times 0.5 = 1 \times$ Na atoms

(R) 0.5 mole of $O_3 \rightarrow 1.5$ Na.

24 g wt. 11.2 L

(S) $\frac{1}{32}$ moles, $\frac{1}{16} \times$ Na atoms

1 gm molar mass $O_2 = 32$ g

51. (A)