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

ANSWER KEY

PAPER – 1 (CODE: 11)

MATHEMATICS

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

PHYSICS

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

CHEMISTRY

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

1. (AD)

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

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

Also, $\quad |x_1 - x_2| < 1$

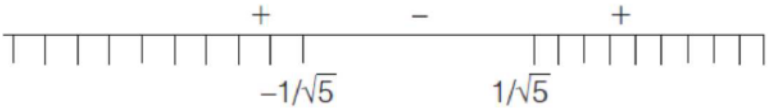
$\Rightarrow \quad |x_1 - x_2|^2 < 1$

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

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

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

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



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

Also, $\quad D > 0$

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

Or $\quad \alpha \in \left(-\frac{1}{2}, \frac{1}{2}\right) \quad \ldots \text{ (ii)}$

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

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

2. (ABCD)

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

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

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

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

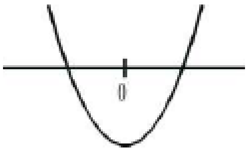
(D) $\sin\left(\frac{9\pi}{2}\right) = 1$

3. (BCD)

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

$Af(0)<0$

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



$\alpha\in(2,10)$

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

4. (A)

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

And $q=-2$

5. (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 $\cos^2\theta+\text{Cos}^2\varphi+2\cos\theta\cos\varphi=b^2$

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

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

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

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

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

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

6. (A)

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

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

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

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

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

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

7. (C)

Given equation is

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

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

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

Roots of the equation is

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

8. (0)

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

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

Have both roots common, so

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

9. (254)

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

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

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

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

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

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

10. (9)

$$L=\sum\frac{\operatorname{cosec} B\operatorname{cosec} C}{\sec A}$$

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

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

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

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

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

$M=4$

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

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

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

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

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

$L^2MN=9$

11. (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

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

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

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

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

$=-3Q_{24}$

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

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

12. (33)

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

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

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

13. (1)

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

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

14. (A)

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

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

$a = \cos\alpha \cos 2\alpha \cos 4\alpha \cos 8\alpha$

$= \frac{\sin 16\alpha}{16 \sin\alpha} = \frac{\sin\frac{16\pi}{17}}{16\sin\frac{\pi}{17}} = \frac{1}{16}$

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

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

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

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

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

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

16. (B)

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

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

(Q) maximum = 4

minimum $= 4 - 5 = -1$

(R) minimum = 0

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

17. (D)

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

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

(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.

18. (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 $y_0 = 0$

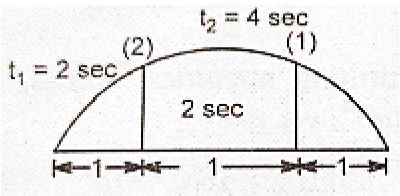
Therefore $y = \dfrac{\upsilon_0^2}{2g} = \dfrac{(4.00)^2}{2(9.80)} = 0.816\ \text{m}$

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

Time of flight $= 2 \times (0.408) = 0.816\,\text{sec}$

19. (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.

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

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

20. (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

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

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

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

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

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

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

21. (C)

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

$= \left|\int_0^2 (t-2)\, dt\right| + \left|\int_2^4 (t-2)\, dt\right|$

$= \left|\frac{t^2}{2} - 2t\right|_0^2 + \left|\frac{t^2}{2} - 2t\right|_2^4$

$= \left|\frac{2^2}{2} - 2\times 2\right| + \left|\left(\frac{4^2}{2} - 2\times 4\right) - \left(\frac{2^2}{2} - 2\times 2\right)\right|$

$= 2 + 2 = 4\,\text{m}$

22. (D)

$v = a^3$

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

$s = 6a^2$

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

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

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

23. (D)

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

$= \cos x^3 \times 3x^2$

24. (B)

$\int \frac{1}{\sin^2 x \cos 2x}\, dx = \int \frac{\sin^2 x + \cos^2 x}{\sin^2 x \cos^2 x}\, dx$

$= \int \frac{\sin^2 x}{\sin^2 x \cos^2 x}\, dx + \int \frac{\cos^2 x}{\sin^2 x \cos^2 x}\, dx$

$= \int \sec^2 x\, dx + \int \text{cosec}^2 x\, dx$

$= \tan x + (-\cot x) + C$

$= \tan x - \cot x + C$

25. (30)

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

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

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

$d = (30\cos 53^\circ)t + 6t$

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

26. (45)

Horizontal range of bullet is 30 m.

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

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

or $\quad \sin 2\theta = 0.03$

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

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

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.

27. (4)

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

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

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

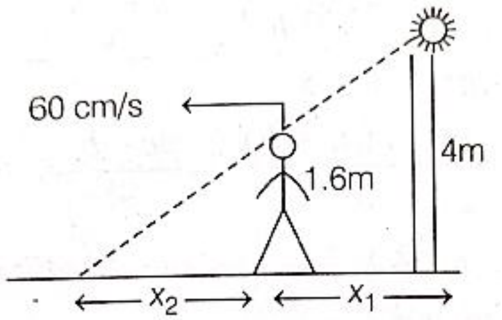
$\Rightarrow \quad 2(P^2 + Q^2 - 2PQ) = P^2 + Q^2$

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

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

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

28. (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 .

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

29. (44)

$$V=29.4-9.8t$$

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

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

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

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

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

$$=88.2-4.9\times 9$$

$$=88.2-44.1$$

$$=44.1$$

30. (83)

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

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

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

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

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

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

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

$$=111-28=83$$

31. (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) $a\cdot(b+c) = 0 \qquad ...(1)$

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

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

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

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

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

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

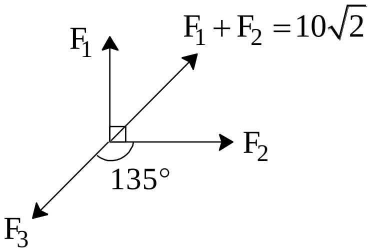
$20 = \frac{(u_y)^2}{2\times 10}$

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

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

33. (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

34. (A)

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

$S_x = u_x t$

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

$= 20\text{ m}$

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

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

$= 20 - 5$

$= 15$

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

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

$v_y = u_y + ayt$

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

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

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

$= \sqrt{20^2 + 10^2}$
$= \sqrt{500}$
$= 10\sqrt{5}\text{ m/s}$

PART (C) : CHEMISTRY

35. (A, C, D)

36. (A, B, C)

37. (A)

38. (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 × 0.3 = 14.4 g of ozone prepared

39. (C)

40. (D)

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

$198 - 150$

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

41. (D)

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

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

Density = 1 mass = volume occupied.

42. (2)

43. (50)

$SO_2Cl_2 \quad + \quad H_2O \quad \rightarrow \quad H_2SO_4 \quad + \quad 2HCl$

25 ml 0.2 M 1 2

$n = 0.2 \times \frac{25}{1000}$ $\quad n = 0.2 \times \frac{25}{1000} \quad n = 0.4 \times \frac{25}{1000}$

$Ba(OH)_2 \rightarrow 2OH^-$

$H_2SO_4 \rightarrow 2H^+$

$2HCl \rightarrow 2H^+$

$1H_2SO_4 \rightarrow 1Ba(OH)_2 \downarrow 2HCl \rightarrow Ba(OH)_2$

$n_{Ba(OH)}$ required $\rightarrow 0.2 \times \frac{25}{1000} + 0.2 \times \frac{25}{1000} \Rightarrow \frac{Volume}{1000} = \frac{\frac{0.4 \times 25}{1000}}{0.2}$

Volume = 50 ml

44. (23)

$\frac{3.011 \times 10^{22}}{6.022 \times 10^{23}} = 0.5 \times 10^{-1} mole \rightarrow 1.15\,g$

1 mole $\rightarrow$ $1.15 \times 20 = 23\,g = (23\,MW)$

45. (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 $= \frac{n(n-1)}{2} = \frac{4 \times 3}{2} = 6$

46. (500)

1 atom $= 6.643 \times 10^{-23}$ g

Weight of 1 mole $= 6.643 \times 10^{-23} \times 6.022 \times 10^{23}$
= 40 g

$\therefore$ 1 mole $\rightarrow$ 40 g

500 mole $\rightarrow$ 20000 f

47. (58)

$\Delta x = \frac{h}{4\pi\Delta p} = \frac{h}{4\pi m\Delta V} = \frac{6.63 \times 10^{-34}}{4 \times 3.14 \times 9.1 \times 10^{-31} \times 1}$

$\Delta x = 58\,\mu m.$

48. (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

49. (B)

50. (A)

51. (B)