

ONLINE TEST SERIES CONTACT PROGRAMME

(Academic Session : 2024 - 2025)

Test Pattern

JEE (Main)

SEMI MAJOR

17-11-2024

ANSWER KEY

JEE (Main) : ENTHUSE + LEADER COURSE (PHASE : 3)

PART 1 : PHYSICS

SECTION-I	Q.	1	2	3	4	5	6	7	8	9	10
	A.	C	D	C	A	B	B	C	A	D	A
	Q.	11	12	13	14	15	16	17	18	19	20
	A.	C	A	B	D	A	A	C	D	C	D
SECTION-II	Q.	5	2	3	4	2					
	A.		1	4	8						

PART 2 : CHEMISTRY

SECTION-I	Q.	1	2	3	4	5	6	7	8	9	10
	A.	B	B	B	B	D	A	C	D	D	D
	Q.	11	12	13	14	15	16	17	18	19	20
	A.	B	C	C	B	C	D	C	C	A	C
SECTION-II	Q.	1	2	3	4	1					
	A.	3	2	2	4						

PART 3 : MATHEMATICS

SECTION-I	Q.	1	2	3	4	5	6	7	8	9	10
	A.	C	C	A	C	D	D	A	D	C	D
	Q.	11	12	13	14	15	16	17	18	19	20
	A.	C	D	C	A	A	B	C	B	A	C
SECTION-II	Q.	1	2	3	4	84					
	A.	1	8	4	5						

H I N T - S H E E T

PART 1 : PHYSICS

SECTION-I

1. Ans (C)

Max potential energy of deformation = max.

K.E. loss

$$= \frac{1}{2} \times 22 + \frac{1}{2} \times 2 \times 32 = 15 \text{ J}$$

2. Ans (D)

In the presence of non-zero external force for the system, we cannot conserve the mechanical energy.

3. Ans (C)

$$\frac{\lambda}{2} = 1 \Rightarrow \lambda = 2 \Rightarrow v = \omega \Rightarrow \lambda = \frac{2}{2} \Rightarrow 1 \text{ cm/sec}$$

$$v_p = \omega \sqrt{A-x} = 2 = \frac{2\pi}{T} \sqrt{42 - 232} = \frac{2\pi}{T} \sqrt{16 - 12}$$

$$\frac{2\pi}{2} \times 2 = 2\pi \text{ cm/sec}$$

4. Ans (A)

Distance between two position of bridge is $\lambda/2$

(Distance between two nodes)

$$\frac{\lambda}{2} = 25 \text{ cm}$$

$$\lambda = 50 \text{ cm}$$

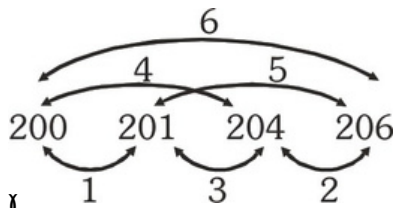
$$v = n\lambda \Rightarrow \sqrt{\frac{T}{\mu}} = n\lambda$$

$$n = 400; T = 20 \text{ N}$$

$$\mu = 0.5 \text{ gm/m}$$

5. Ans (B)

Now divide 1 second into number of beats between two frequencies



$$\begin{aligned}
 & \left(\frac{1}{1} \right) (2) 2 \\
 & \left(\frac{1}{3} \right) (3) 3 \\
 & \left(\frac{1}{4} \right) (4) 4 \\
 & \left(\frac{1}{5} \right) (5) 5 \\
 & \left(\frac{1}{6} \right) (6) 6
 \end{aligned}$$

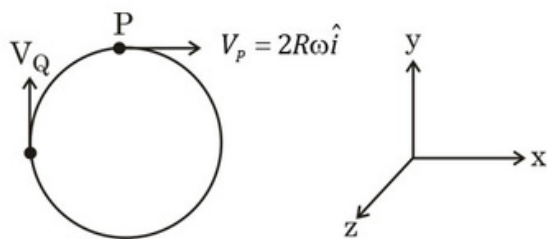
6. Ans (B)

$$f = f_0 \left(\frac{v}{v - v_s} \right) = 1000 \left(\frac{330}{330 - 220} \right) = 3000 \text{ Hz}$$

7. Ans (C)

$$\begin{aligned}
 \frac{3\cancel{x}}{4l_1} &= \frac{2\cancel{x}}{2l_2} \\
 \frac{l_1}{l_2} &= \frac{3}{4}
 \end{aligned}$$

8. Ans (A)



$$\begin{aligned}
 V_Q &= R\omega \hat{j} + R\omega \hat{i} \\
 \therefore \frac{|V_P|}{|V_Q|} &= \frac{2}{\sqrt{2}} = \frac{\sqrt{2}}{1}
 \end{aligned}$$

9. Ans (D)

$$T_1 + T_2 = mg \text{ (Force balance)}$$

$$\text{Torque about one end of rod} \\ T_2 l \cos 30^\circ - mg \frac{l}{2} \cos 30^\circ = 0$$

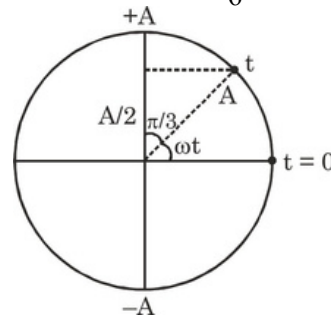
$$\text{So } T_1 = T_2 = \frac{mg}{2}$$

10. Ans (A)

$$\begin{aligned}
 Mgh &= \frac{1}{2} Mv^2 + \frac{1}{2} (MR^2) \left(\frac{v}{R} \right)^2 \\
 v &= \sqrt{gh} \\
 \text{Angular momentum } L &= I\omega \\
 &= MR^2 \frac{\sqrt{gh}}{R} = MR\sqrt{gh}
 \end{aligned}$$

11. Ans (C)

Corresponding to equilibrium positions to A/2, phase angle will be $\frac{\pi}{6}$.



$$\therefore \text{Time required} = \frac{T}{12}$$

12. Ans (A)

$$\begin{aligned}
 \text{Time period} &\Rightarrow T = 2\pi \sqrt{\frac{m_{\text{total}}}{k_{\text{eq}}}} \\
 T &= 2\pi \sqrt{\frac{3m}{3k}} = 2\pi \sqrt{\frac{m}{k}}
 \end{aligned}$$

13. Ans (B)

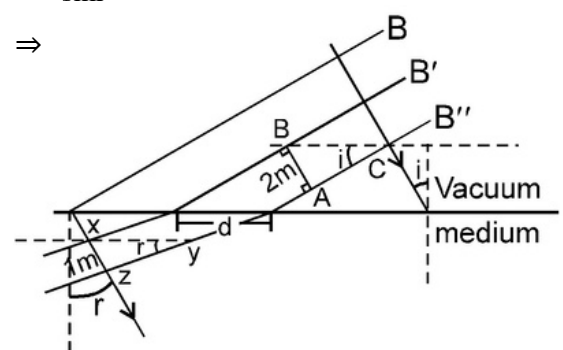
$$\begin{aligned}
 I &= \frac{1}{2} m r^2 \text{ or } \sqrt{\frac{2I}{m}} \\
 E_0 &= \frac{\sqrt{2I}}{0c} \sqrt{\frac{2 \times 500 \times 10^9 \times 36\pi}{7 \times 3 \times 10^8}} \\
 E_0 &= 2\sqrt{3} \times 10^2 \text{ N/C}
 \end{aligned}$$

14. Ans (D)

$$B_0 = \frac{E_0}{c} \text{ and } V \rightarrow \text{ should be } \parallel \text{ to } E \rightarrow \times B \rightarrow$$

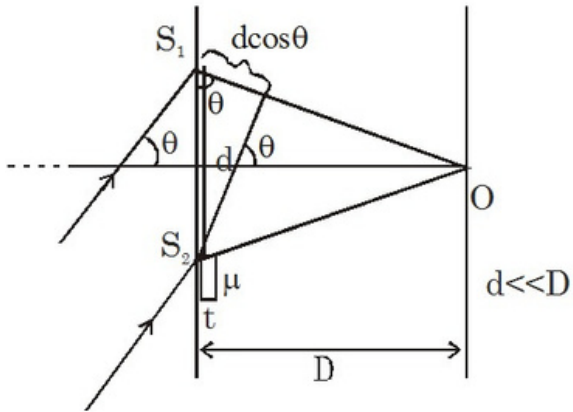
15. Ans (A)

$$\begin{aligned}
 \text{In } \Delta ABC; \sin(i) &= \frac{a}{d} \quad \text{In } \Delta xyz; \sin(r) = \frac{1}{d} \\
 \frac{\sin i}{\sin r} &= 2 = \mu
 \end{aligned}$$



PART 1 : PHYSICS
SECTION-II

16. Ans (A)

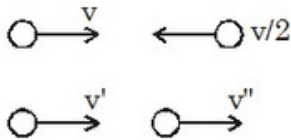


$$d \sin \theta = (\mu - 1)t$$

17. Ans (C)

β rays which are emitted from a radioactive material are electrons or positrons emitted by a nucleons.

18. Ans (D)



λ same p same

$$mv - \frac{2mv}{2} = mv' + 2mv''$$

$$1 = \frac{v'' - v'}{v + 2v''}$$

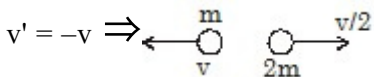
$$v' = -2v''$$

$$v'' - v' = \frac{3v}{2}$$

$$3v'' = \frac{3v}{2}$$

$$3v'' = \frac{3v}{2}$$

$$v'' = \frac{v}{2}$$



19. Ans (C)

· E of all and compare

Find (D)

20. Ans

$$h(2\nu) = h\nu + \frac{1}{2}mv_{2\max}^2 \quad v_{\max} = \sqrt{\frac{2h\nu}{m}}$$

1. Ans (5)

Ionization energy of hydrogen atom = W_0

for H and He^+ :

$$\frac{1}{2}\mu V_{He^+}^2 = W$$

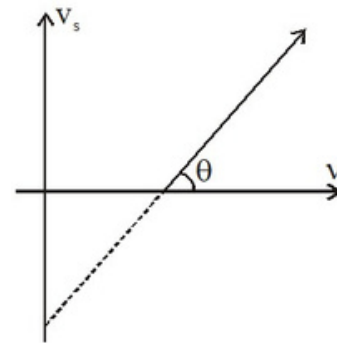
$$\mu = \frac{m_H m_{He^+}}{m_H + m_{He^+}} = \frac{4m_H}{5} \quad \therefore m_{He^+} \approx 4m_H$$

Ionization energy for hydrogen atom is same in both cases.

$$\frac{1}{2} (4m_H) V^2 = W$$

$$\frac{E_{He^+}}{5} = W_0 \Rightarrow E_{He^+} = 5W_0 = \alpha W_0 \quad \alpha = 5$$

2. \Rightarrow Ans (1)



$$eV_s = h\nu - \phi$$

$$V_s = \frac{h}{e} \nu - \frac{\phi}{e}$$

$$\Rightarrow \text{slope} = \frac{h}{e} = \text{constant}$$

$$\Rightarrow \text{ratio} = 1$$

3. $(\mu_2 - \mu_1)t = 3\lambda$

4. Ans (8)

$$\beta = 10 \log \left(\frac{P}{P_0} \right)$$

$$70 = 10 \log \left(\frac{60}{P_0} \right)$$

$$x = 10 \log \left(\frac{20}{P_0} \right)$$

Subtract

$$x - 70 = 10 \log(2)$$

$$x - 70 = 3$$

$$x = 73$$

$$\frac{x+7}{10} = \frac{80}{10} = 8$$

5. Ans (2)

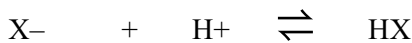
$$T = 2\pi\sqrt{\frac{l}{g}} \Rightarrow$$

$$\frac{T'}{T} = \sqrt{\frac{l'}{l}} = \sqrt{\frac{(\rho\pi \frac{4r^2}{2} \frac{l}{4r^2})}{(\rho\pi r^2) r^2}}$$

$$T' = 2T$$

PART 2 : CHEMISTRY
SECTION-I

1. Ans (B)



$$\frac{10 \times 0.1M}{20} + \frac{10 \times 0.1M}{20} = 0$$

$$\text{Final } 0 \quad 0 \quad 0.05 M$$

(10 ml HCl solution is needed for equivalent point)

$$\text{At equivalent point } [H^+] = \sqrt{K_a \times C}$$

$$= \sqrt{10^{-8} \times 0.05}$$

$$\therefore \text{pH} = -\log(5 \times 10^{-10})^{1/2} = 4.65$$

Fact based.

2.

3. Ans (B)

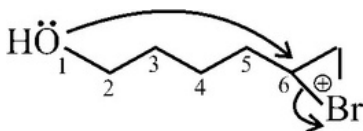


4. Ans (B)

Electrophilic addition takes place on alkene (that's alkene act as nucleophile)

5. Ans (D)

6. Theory
Ans (A)



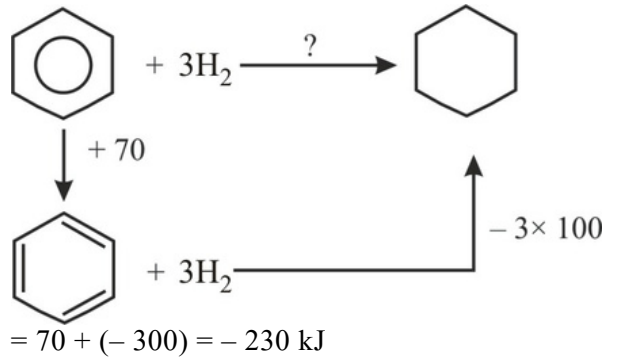
7. Ans (C)

$$\Delta H = qp \text{ \& } \Delta U = \Delta H - \Delta(PV) = \Delta H - P \cdot \Delta V$$

$$= 100 \text{ kJ} - 10 \times 10^5 \times \frac{1}{2} \times 10^{-3} \times 10^{-3}$$

$$\Delta U = 100 \text{ kJ} - 0.5 \text{ kJ} = 99.5 \text{ kJ.}$$

8. Ans (D)



9. Ans (D)

$$\Delta S = nC_v \ln \frac{T_2}{T_1} + nR \ln \frac{V_2}{V_1}$$

$$= C_v \ln 2 + R \ln \left(\frac{1}{2} \right)^2$$

$$= (C_v - R) \ln 2$$

10. Ans (D)

$$P_{\text{Total}} = P_{\text{HNO}_3} + P_{\text{NO}_2} + P_{\text{H}_2\text{O}} + P_{\text{O}_2}$$

$$\therefore P_{\text{NO}_2} = 4P_{\text{O}_2} \text{ \& } P_{\text{H}_2\text{O}} = 2P_{\text{O}_2}$$

$$\therefore P_{\text{Total}} = P_{\text{HNO}_3} + 7P_{\text{O}_2}$$

$$\Rightarrow 30 - 2 = P_{\text{O}_2} \times 7 \Rightarrow P_{\text{O}_2} = 4$$

$$K_p = \frac{(P_{\text{NO}_2})^4 \cdot P_{\text{H}_2\text{O}} \cdot P_{\text{O}_2}}{P_{\text{HNO}_3}^4}$$

$$= \frac{(4 \times 4)^4 \times (2 \times 4)^2 \times 4}{2^4} = 2^{20}$$

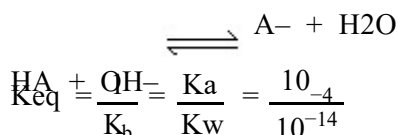
$$K_p = K_c (RT)^{\Delta n_g} = K_c \times (0.08 \times 400)^3$$

$$K_c = \frac{2^{20}}{(32)^3} = 32$$

11. Ans (B)

If backward reaction is endothermic means forward reaction is exothermic hence on addition of Cl₂ reaction will go forward & temp. will increase.

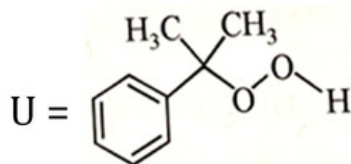
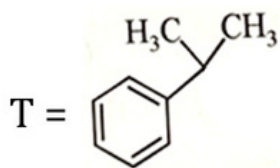
12. Ans (C)



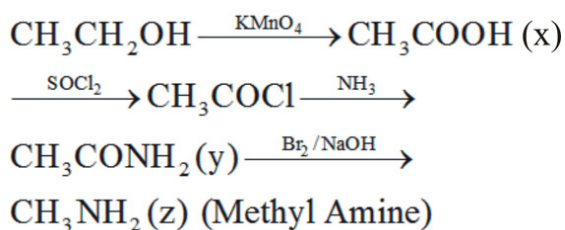
13. Ans (C)

Acid halide is most reactive due to $-I$ of Cl.

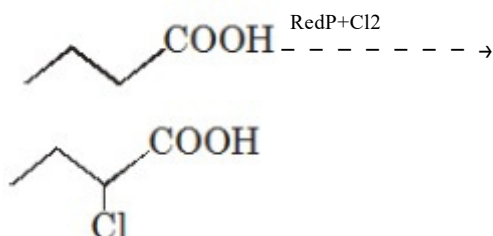
14. Ans (B)



15. Ans (C)



16. Ans (D)



it is a HVZ reaction.

17. Ans (C)

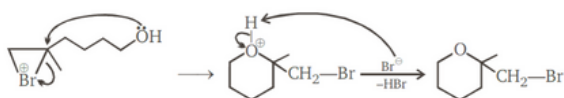
In Glucose and galactose different is only around one carbon so they called epimer.

18. Ans (C)

Given structure is Thymine and Thymine being paired with adenine

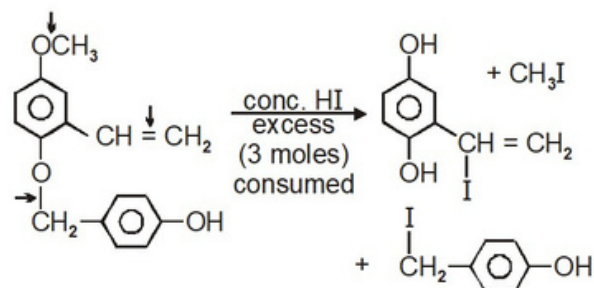
19. Ans (A)

20. Fact Ans (C)



PART 2 : CHEMISTRY
SECTION-II

1. Ans (3)



2. Ans (2)



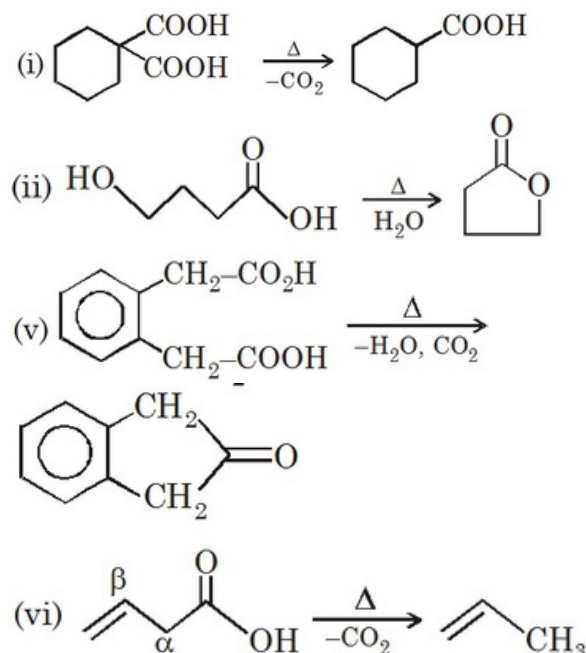
3. Ans (2)

$$W = 300 - 400 = -100 \text{ J}$$

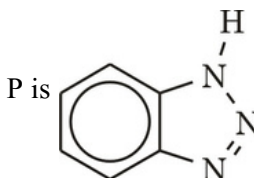
$$W = 0.5 \times \Delta V \text{ bar-litre}$$

$$\Delta V = \frac{100}{0.5 \times 100} = 2$$

4. Ans (4)



5. Ans (1)



PART 3 : MATHEMATICS

SECTION-I

1. Ans (C)
 $\int \frac{x + \cos 2x + 1}{x \cos 2x} dx = f(x) + K \log|x| + C$ and

$f(\pi/4) = 1$

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

$\tan x + 2 \log|x| + C$

$f(x) = \tan x, K = 2$ (by comparing)

Now, $f(0) + 10K = \tan 0 + 10 \cdot 2 = 0 + 20 = 20$

2. Ans (C)

$I = \int e^{\tan^{-1}x(1+x+x^2)} \left(-\frac{1}{1+x^2}\right) dx$

$= -\int e^{\tan^{-1}x} \left(1 + \frac{x}{x}\right) dx$

$= -\int$

$= -\int e^{\tan^{-1}x} dx - \int x \frac{e^{\tan^{-1}x}}{1+x^2} dx$
 $= -\int e^{\tan^{-1}x} dx - \int x \frac{e^{\tan^{-1}x}}{1+x^2} dx$

$= -x e^{\tan^{-1}x} + c$

3. Ans (A)

Let

$A = \lim_{n \rightarrow \infty} \left(\frac{1}{n^2} \sec^2 \frac{1}{n} + \frac{2}{n^2} \sec^2 \frac{2}{n} + \dots + n \frac{\sec^2 1}{n^2} \right)$

$= \lim_{n \rightarrow \infty} \frac{1}{n} \sum_{r=1}^n \sec^2 \left(\frac{r}{n} \right)$

$= \lim_{n \rightarrow \infty} \frac{1}{n} \sum_{r=1}^n \sec^2 \left(\frac{r}{n} \right)$

$A = \int_0^1 x \sec^2(x) dx$

\therefore

Put $x^2 = t$

$2x dx = dt \quad x dx = \frac{dt}{2}$

$\Rightarrow A = \frac{1}{2} \int_0^1 \sec^2 t dt$

$\therefore \frac{1}{2} \tan 1$

4. Ans (C)

Put $y = vx$

$v + x \frac{dv}{dx} = -\frac{1+3v^2}{3+v^2}$

$x \frac{dv}{dx} = -\frac{(v+1)^3}{3+v^2}$

$\frac{dv}{(3+v^2)} + \frac{dx}{x} = 0$

$\int \frac{4dv}{(v+1)^3} + \int \frac{dv}{v+1} - \int \frac{2dv}{(v+1)^2} + \int \frac{dx}{x} = 0$

$-\frac{2}{(v+1)^2} + \ln(v+1) + \frac{2}{v+1}$

$-\frac{2x^2}{(x+y)^2} + \ln \frac{x+y}{x} + \frac{2x}{x+y} + \ln x = c$

$\frac{2xy}{(x+y)^2} + \ln(x+y) = c$

$\therefore c = 0, \text{ as } x = 1, y = 0$

$\therefore \frac{2xy}{(x+y)^2} + \ln(x+y) = 0$

5. Ans (D)

$I = \int_{\frac{\pi}{4}}^{\frac{\pi}{2}} \frac{x + \frac{\pi}{4}}{2 - \cos 2x} dx \quad (1)$

$x \rightarrow -x$

$I = \int_{\frac{\pi}{4}}^{\frac{\pi}{2}} \frac{-x + \frac{\pi}{4}}{2 - \cos 2x} dx \quad (2)$

$(1) + (2)$

$2I = \int_{\frac{\pi}{4}}^{\frac{\pi}{2}} \frac{\frac{\pi}{2}}{2 - \cos 2x} dx$

$I = \frac{\pi}{4} \cdot 2 \int_{\frac{\pi}{4}}^{\frac{\pi}{2}} \frac{dx}{2 - \cos 2x}$

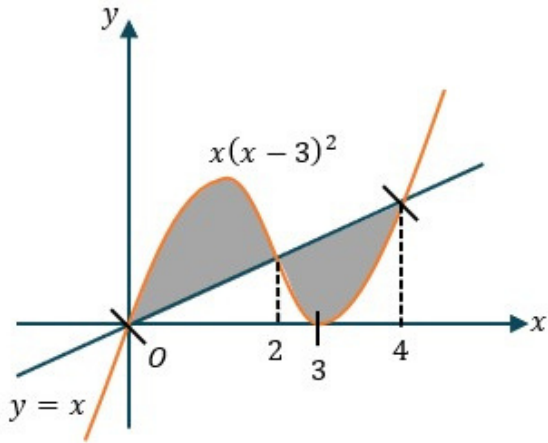
$I = \frac{\pi}{4} \cdot 2 \int_0^1 \frac{(1 + \tan 2x) dx}{2(1 + \tan 2x) - (1 - \tan 2x)}$

$I = \frac{\pi}{4} \int_0^1 \frac{dt}{3t^2 + 1}$

$\Rightarrow I = \frac{\pi \tan^{-1} \sqrt{3}}{2\sqrt{3}}$

$I = \frac{\pi 2}{6\sqrt{3}}$

6. Ans (D)



$$x(x-3)^2 = x$$

$$x = 0, 2, 4$$

⇒

$$\begin{aligned} \text{Required area} &= \int_0^2 (x(x-3)^2 - x) dx + \int_2^4 (x - x(x-3)^2) dx \\ &= \int_0^2 (x^3 - 6x^2 + 8x) dx - \int_2^4 (x^3 - 6x^2 + 8x) dx \\ &= \left[\frac{x^4}{4} - 2x^3 + 4x^2 \right]_0^2 - \left[\frac{x^4}{4} - 2x^3 + 4x^2 \right]_2^4 \\ &= 4 + 4 = 8 \text{ sq units} \end{aligned}$$

7. Ans (A)

$$x = \frac{1-t^2}{1+t^2}, y = \frac{2t}{1+t^2}$$

$$t = \tan \theta$$

$$x = \frac{1 - \tan^2 \theta}{1 + \tan^2 \theta}, y = \frac{2 \tan \theta}{1 + \tan^2 \theta}$$

$$x = \cos 2\theta, y = \sin 2\theta$$

$$x^2 + y^2 = 1$$

$$\text{Area} = \pi r^2 = \pi \dots \dots \dots r = 1$$

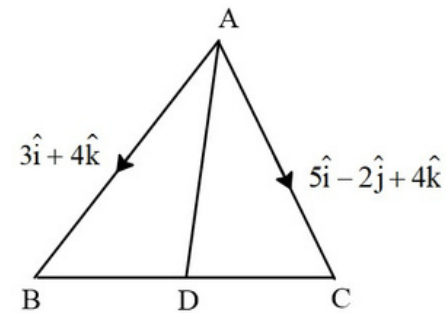
(D)

8. Ans

$$\sin^{-1} \frac{|2 \times 3 + (-1) \times 6 + 2 \times (-2)|}{\sqrt{2^2 + (-1)^2 + 2^2} \sqrt{3^2 + 6^2 + (-2)^2}}$$

9. Ans (C)

Let D be the mid-point of BC. Then,



$$\vec{AD} = \frac{\vec{AB} + \vec{AC}}{2}$$

$$(3\hat{i} + 4\hat{k}) + (5\hat{i} - 2\hat{j} + 4\hat{k})$$

$$\vec{AD} = \frac{8\hat{i} - 2\hat{j} + 8\hat{k}}{2} = 4\hat{i} - \hat{j} + 4\hat{k}$$

⇒

$$|\vec{AD}| = \sqrt{16+1+16} = \sqrt{33}$$

⇒

10. (D)

Ans It is given that $\vec{a} + 2\vec{b}$ is collinear with \vec{c} and

\vec{b} is collinear with \vec{a} .

$$\therefore \vec{a} + 2\vec{b} = x\vec{c}, \text{ and } \vec{b} + 3\vec{c} = y\vec{a} \text{ for some}$$

$x, y \in \mathbb{R}$

$$\therefore \vec{a} + 2\vec{b} + 6\vec{c} = (x+6)\vec{c}$$

$$\text{Also, } \vec{a} + 2\vec{b} + 6\vec{c} = (1+2y)\vec{a}$$

$$\therefore (x+6)\vec{c} = (1+2y)\vec{a}$$

$$x+6=0 \text{ and } 1+2y=0. \vec{a}, \vec{c} \text{ are non-}$$

⇒

collinear] $x=-6$ and $y=-1/2$

$$\Rightarrow \vec{a} + 2\vec{b} + 6\vec{c} = 0$$

⇒

11. Ans (C)

$$a = 2\hat{i} - 6\hat{j} - 3\hat{k}$$

$$b = 4\hat{i} + 3\hat{j} - \hat{k}$$

Unit vector perpendicular to plane of \vec{a} and \vec{b} is given by :-

$$\pm \frac{\vec{a} \times \vec{b}}{|\vec{a} \times \vec{b}|}$$

$$\vec{a} \times \vec{b} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & -6 & -3 \\ 4 & 3 & -1 \end{vmatrix}$$

$$= 15\hat{i} - 10\hat{j} + 30\hat{k}$$

$$= 5(3\hat{i} - 2\hat{j} + 6\hat{k})$$

$$|\vec{a} \times \vec{b}| = 5\sqrt{3^2 + (-2)^2 + 6^2}$$

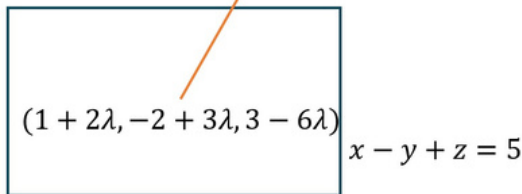
$$= 5 \times 7$$

$$\Rightarrow \text{Unit vector} = \frac{3\hat{i} - 2\hat{j} + 6\hat{k}}{7}$$

12.

A(1, -2, 3)

$$\vec{r} = (1, -2, 3) + \lambda(2, 3 - 6)$$



$$(1+2\lambda) + 2 - 3\lambda + 3 - 6\lambda = 5$$

$$\frac{1}{-9 - 11 - 15} \Rightarrow \lambda = 7$$

$$\text{so, } P = \sqrt{\frac{7^2 - 9}{2} + \frac{(-2+11)^2}{7} + \frac{(3-15)^2}{7}}$$

$$AP = \sqrt{\frac{4}{49} + \frac{9}{49} + \frac{36}{49}} = 1$$

13. Ans (C)

$$\because A : B : C = 3 : 5 : 4$$

$$\Rightarrow A + B + C = 12x = 180^\circ \Rightarrow x = 15^\circ$$

$$\therefore A = 45^\circ, B = 75^\circ, C = 60^\circ$$

$$\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c} = K \text{ (say)}$$

$$\therefore a = \frac{1}{\sqrt{2}}K, b = \frac{\sqrt{3}+1}{2\sqrt{2}}K, c = \frac{\sqrt{3}}{2}K$$

$$\therefore a + b + c\sqrt{2} = 3b$$

14. Ans (A)

We have

$$\frac{2 \cos A}{a} + \frac{\cos B}{b} + \frac{2 \cos C}{c} = \frac{a+b}{bc} + \frac{b}{ac}$$

Multiplying both sides by abc, we get

$$\Rightarrow 2bc \cos A + ac \cos B + 2ab \cos C = a^2 + b^2$$

$$\Rightarrow \frac{(b^2 + c^2 - a^2)}{(a^2 + c^2 - b^2)} + (a^2 + b^2 - c^2) = a^2 + b^2$$

$$\Rightarrow c^2 + a^2 - b^2 = 2a^2 - 2b^2$$

$$\Rightarrow b^2 + c^2 = a^2$$

$\therefore \Delta ABC$ is right angled at A.

$$\Rightarrow \angle A = 90^\circ$$

15. Let the equation be $x^2 + y^2 + 2gx + 2fy + c = 0$

it passes through (-1, -3) and (3, 0) therefore

$$10 - 2g - 6f + c = 0 \quad \dots(i)$$

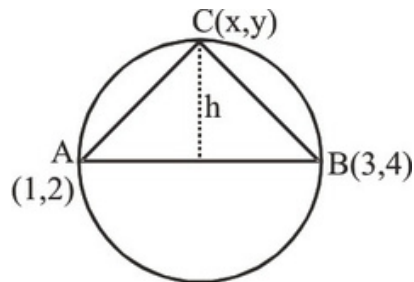
$$9 + 6g + c = 0 \quad \dots(ii)$$

Slope of tangent = -4/3

$$\left(\frac{0+f}{3+g}\right)\left(\frac{-4}{3}\right) = -1$$

$$\Rightarrow 3g - 4f + 9 = 0 \quad \dots(iii)$$

16. Ans (B)



$\therefore A$ & B are end's of diameter, diameter = $2\sqrt{2}$

Let height of ΔABC is h . \therefore radius = $\sqrt{2}$

Now, 1. Base $\times h = 1$ {Base=diameter}

$$\frac{1}{2} \times 2\sqrt{2} \times h = 1$$

$$\Rightarrow h = \frac{1}{\sqrt{2}}$$

$$\Rightarrow h < r$$

therefore no. of position of C is 4.

17. Ans (C)

Let PQ be a diameter of the circle

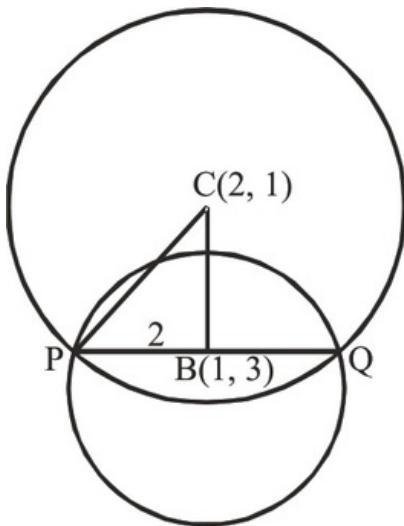
$x^2 + y^2 - 2x - 6y + 6 = 0$ such that PQ is a chord of the circle having its centre at C(2, 1).

Clearly,

$$\text{Radius} = CP = \sqrt{BC^2 + BP^2}$$

$$\text{Radius} = \sqrt{(2-1)^2 + (1-3)^2 + 2^2} = 3$$

⇒



18. Ans (B)

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

$$\Rightarrow x^2 dy + dx = 0$$

$$\Rightarrow \frac{x^2}{\sqrt{1+x^4}} dy + \frac{dx}{\sqrt{1+x^4}} = 0$$

$$\Rightarrow \frac{dy}{\sqrt{1+y^4}} + \frac{dx}{\sqrt{1+x^4}} = 0$$

$$\Rightarrow \frac{dy}{\sqrt{1+y^4}} + \frac{dx}{\sqrt{1+x^4}} = 0$$

$$\Rightarrow \frac{dy}{\sqrt{1+y^4}} + \frac{dx}{\sqrt{1+x^4}} + 4 = 4$$

⇒

19. Ans (A)

$$f'(x) = -\frac{1}{x^2} - \pi^2 \sin(\pi x)$$

$$\Rightarrow f(x) = \int -\frac{1}{x^2} - \pi^2 \sin(\pi x) \cdot dx$$

$$\Rightarrow f(x) = 1 + \frac{\pi^2}{x} \cdot \frac{\cos(\pi x)}{\pi} + c$$

$$\left\{ \begin{array}{l} \because f'(2) = \pi + \frac{1}{2} \\ \frac{1}{2} + \pi \cos(2x) + c = \pi + \frac{1}{2} \\ \Rightarrow c = 0 \end{array} \right.$$

$$f'(x) = \frac{1}{x} + \pi \cos(\pi x)$$

$$\Rightarrow f(x) = \int \left(\frac{1}{x} + \pi \cos(\pi x) \right) \cdot dx$$

$$\Rightarrow f(x) = \ln(x) + \frac{\pi \sin(\pi x)}{\pi} + C_1$$

$$\left\{ \begin{array}{l} \because f(1) = 0 \\ \Rightarrow \sin \pi + c_1 = 0 \\ \Rightarrow c_1 = 0 \end{array} \right.$$

$$f(x) = \ln(x) + \sin(\pi x)$$

$$\Rightarrow f\left(\frac{1}{2}\right) = \ln\left(\frac{1}{2}\right) + \sin\left(\frac{\pi}{2}\right) = 1 - \ln(2)$$

20. ∴ (C)

$$\int_6^{f(x)} 4t^3 dt = (x-2)g(x)$$

6

Differentiate both sides

$$\lim_{x \rightarrow 2} g(x) = \frac{\lim_{x \rightarrow 2} \int_6^{f(x)} 4t^3 dt}{x-2} = \frac{6}{x-2}$$

Use L'hospital's rule

$$= \lim_{x \rightarrow 2} \frac{f'(x) \cdot 4f^3(x)}{1} = 18$$

PART 3 : MATHEMATICS
SECTION-II

1. Ans (1)

$$\int_{-1}^1 \frac{dx}{(1+x^3 + \sqrt{1+x^6})}$$

$$\frac{1}{(1+x^3) + (\sqrt{1+x^6})} \times \frac{1+x^3 - \sqrt{1+x^6}}{1+x^3 - \sqrt{1+x^6}} \times \frac{1+x^3 + \sqrt{1+x^6}}{1+x^3 + \sqrt{1+x^6}}$$

$$= \frac{(1+x^3) - \sqrt{1+x^6}}{(1+x^3)^2 - (1+x^6)}$$

$$\frac{1+x^3 - \sqrt{1+x^6}}{1+x^6 + 2x^3 - 1 - x^6} = \frac{1}{2x^3} + \frac{x^3}{2x^3} - \frac{\sqrt{1+x^6}}{2x^3}$$

$$\int_{-1}^1 \frac{1}{2x^3} dx + \int_{-1}^1 \frac{1}{2} dx - \int_{-1}^1 \frac{\sqrt{1+x^6}}{2x^3} dx$$

$$\int_{-1}^1 \frac{1}{2x^3} dx + \int_{-1}^1 \frac{1}{2} dx + \int_{-1}^1 \frac{\sqrt{1+x^6}}{x^3} dx = 1$$

odd function

2. Ans (8)

$$x dy - (y^2 - 4y) dx = 0, x > 0$$

$$\int \frac{dy}{y^2 - 4y} = \int \frac{dx}{x}$$

$$\int \left(\frac{1}{y-4} - \frac{1}{y} \right) dy = 4 \int \frac{dx}{x}$$

$$\log_e |y-4| - \log_e |y| = 4 \log_e x + \log_e c$$

$$\frac{|y-4|}{|y|} = cx^4 \rightarrow c=1$$

$$|y-4| = |y| x^4$$

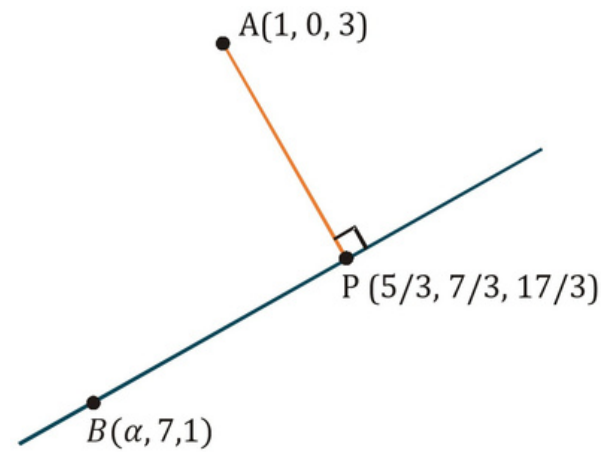
C-1 and C-2

$$y-4 = yx^4 \quad y-4 = -yx^4$$

$$y = \frac{4}{1-x^4} \quad y = \frac{4}{1+x^4}$$

$$y(1) = \text{ND (rejected)} \quad y(1) = 2$$

3. Ans (4)



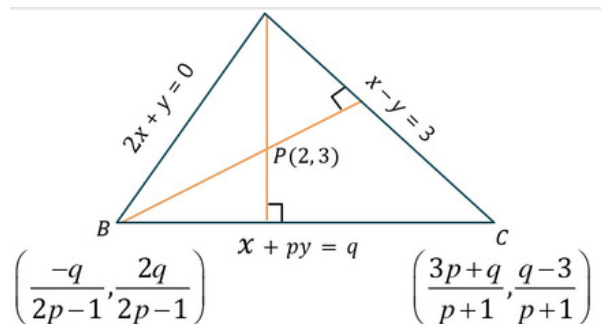
$$\text{D.R. of BP} = \left\langle \frac{5-\alpha}{3}, \frac{7-7}{3}, \frac{17-1}{3} \right\rangle$$

$$\text{D.R. of AP} = \left\langle \frac{5-1}{3}, \frac{7-0}{3}, \frac{17-3}{3} \right\rangle$$

$$BP \perp AP$$

$$\Rightarrow \alpha = 4$$

4. P is orthocentre



$$AP \perp BC$$

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

$$\Rightarrow \frac{5}{p} \Rightarrow p=5$$

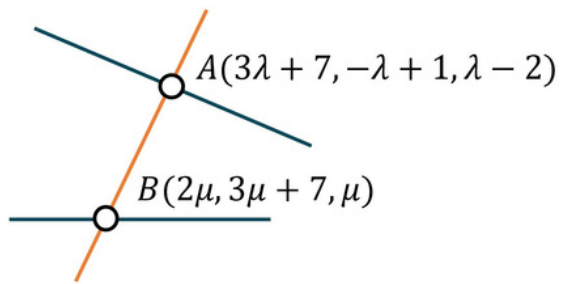
$$\Rightarrow BP \perp AC$$

$$\therefore \frac{1 \cdot 27 - 2q}{18+q} = -1 \quad q=27+18$$

$$\Rightarrow q = 45 \quad \Rightarrow$$

$$\Rightarrow p + q = 5 + 45 = 50.$$

5. Ans (84)



DR's of AB

$$(3\lambda - 2\mu + 7, -\lambda - 3\mu - 6, \lambda - \mu - 2)$$

$$\frac{3\lambda - 2\mu + 7}{1} = \frac{-\lambda - 3\mu - 6}{-4} = \frac{\lambda - \mu - 2}{2}$$

Taking first (2) $-12\lambda + 8\mu - 28 = -\lambda - 3\mu - 6$

$$\lambda - \mu + 2 = 0$$

Taking second & third

$$-2\lambda - 6\mu - 12 = -4\lambda + 4\mu + 8$$

$$\lambda - 5\mu - 10 = 0$$

After solving above two equation

$$\lambda = -5, \mu = -3$$

$$A = (-8, 6, -7)$$

$$B = (-6, -2, -3)$$

$$(AB)^2 = 4 + 64 + 16 = 84$$