NDA MATHS MOCK TEST - 102 (SOLUTION)

1.(B) Total No. of arrangements = $\frac{9!}{2!}$

The total No. of arrangements when 'E's comes together = 8!

The total No. of arrangements when 'E' do not come together = $\frac{9!}{2!} - 8! = \frac{7}{2} \times 8!$

The required probability = $\dfrac{\frac{7}{2}\times 8!}{\frac{9!}{2!}} = \frac{7}{9}$

2. (C) Equation of line is

$ax\tan\alpha - by\sec\alpha = ab$

Perpendicular distance from point $(0, \sqrt{a^2+b^2})$

$$d_1 = \left|\frac{0 - b\sec\alpha\left(\sqrt{a^2+b^2}\right) - ab}{\sqrt{(a\tan\alpha)^2 + (-b\sec\alpha)^2}}\right|$$

$$d_1 = \frac{b\sqrt{(a^2+b^2)}\sec\alpha + ab}{\sqrt{a^2\tan^2\alpha + b^2\sec^2\alpha}}$$

Similarly, perpendicular distance from point $(0, -\sqrt{a^2+b^2})$

$$d_2 = \left|\frac{0 - b\sec\alpha\left(-\sqrt{a^2+b^2}\right) - ab}{\sqrt{\alpha^2\tan^2\alpha + b^2\sec^2\alpha}}\right|$$

$$d_2 = \frac{b\left(\sqrt{a^2+b^2}\right)\sec\alpha - ab}{\sqrt{a^2\tan^2\alpha + b^2\sec^2\alpha}}$$

Now,

$$d_1\times d_2 = \frac{\left[b\left(\sqrt{a^2+b^2}\right)\sec\alpha + ab\right]\left[b\sqrt{a^2+b^2}\sec\alpha - ab\right]}{\sqrt{a^2\tan^2\alpha + b^2\sec^2\alpha}\sqrt{a^2\tan^2\alpha + b^2\sec^2\alpha}}$$

$$d_1\times d_2 = \frac{b^2(a^2+b^2)\sec^2\alpha - a^2b^2}{a^2\tan^2\alpha + b^2\sec^2\alpha}$$

$$d_1\times d_2 = \frac{b^2\left[a^2\sec^2\alpha + b^2\sec^2\alpha - a^2\right]}{a^2\tan^2\alpha + b^2\sec^2\alpha}$$

$$d_1\times d_2 = \frac{b^2\left[a^2(\sec^2\alpha - 1) + b^2\sec^2\alpha\right]}{a^2\tan^2\alpha + b^2\sec^2\alpha}$$

$$d_1\times d_2 = \frac{b^2(a^2\tan^2\alpha + b^2\sec^2\alpha)}{(a^2\tan^2\alpha + b^2\sec^2\alpha)} = b^2$$

3. (C) $\cos^2 53\frac{1}{2}^\circ - \cos^2 36\frac{1}{2}^\circ$

$= \cos^2 53\frac{1}{2}^\circ - \cos^2\left(90^\circ - 53\frac{1}{2}^\circ\right)$

$= \cos^2 53\frac{1}{2}^\circ - \sin^2 53\frac{1}{2}^\circ$

$= \cos\left(2\times 53\frac{1}{2}\right)^\circ = \cos(107)^\circ$

$= \cos(90 + 17)^\circ = -\sin 17^\circ$

4. (A) Given that $X = \begin{bmatrix} 2 & -3 \\ 1 & 4 \end{bmatrix}$, $B = \begin{bmatrix} 0 & 11 \\ 5 & 20 \end{bmatrix}$ and

$A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$

$AX = B$

$$\begin{bmatrix} a & b \\ c & d \end{bmatrix}\begin{bmatrix} 2 & -3 \\ 1 & 4 \end{bmatrix} = \begin{bmatrix} 0 & 11 \\ 5 & 20 \end{bmatrix}$$

$$\Rightarrow \begin{bmatrix} 2a+b & -3a+4b \\ 2c+d & -3c+4d \end{bmatrix} = \begin{bmatrix} 0 & 11 \\ 5 & 20 \end{bmatrix}$$

On comparing

$2a + b = 0$ and $-3a + 4b = 11$

On solving $a = -1$ and $b = 2$

Now,

$2c + d = 5$ and $-3c + 4d = 20$

On solving $c = 0$ and $d = 5$

$\therefore A = \begin{bmatrix} -1 & 2 \\ 0 & 5 \end{bmatrix}$

5. (C) $$\left[\frac{\cos\frac{\pi}{3} - i\left(1 - \sin\frac{\pi}{3}\right)}{\cos\frac{\pi}{3} + i\left(1 - \sin\frac{\pi}{3}\right)}\right]^2$$

$$\Rightarrow \left[\frac{\sin\left(\frac{\pi}{2} - \frac{\pi}{3}\right) - i\left[1 - \cos\left(\frac{\pi}{2} - \frac{\pi}{3}\right)\right]}{\sin\left(\frac{\pi}{2} - \frac{\pi}{3}\right) + \left[1 - \cos\left(\frac{\pi}{2} - \frac{\pi}{3}\right)\right]}\right]^2$$

$$\Rightarrow \left[\frac{\sin\frac{\pi}{6} - i\left(1 - \cos\frac{\pi}{6}\right)}{\sin\frac{\pi}{6} + i\left(1 - \cos\frac{\pi}{6}\right)}\right]^2$$

$$\Rightarrow \left[\frac{2\sin\frac{\pi}{12}.\cos\frac{\pi}{12} - i\times 2\cos^2\frac{\pi}{12}}{2\sin\frac{\pi}{12}.\cos\frac{\pi}{12} + i\times 2\cos^2\frac{\pi}{12}}\right]^2$$

$$\Rightarrow \left[\frac{\sin\frac{\pi}{12} - i\cos\frac{\pi}{12}}{\sin\frac{\pi}{12} + i\cos\frac{\pi}{12}}\right]^2$$

$$\Rightarrow \left[\frac{\left(\sin\frac{\pi}{12} - i\cos\frac{\pi}{12}\right)^2}{\left(\sin\frac{\pi}{12} + i\cos\frac{\pi}{12}\right)\left(\sin\frac{\pi}{12} - i\cos\frac{\pi}{12}\right)}\right]^2$$

$$\Rightarrow \frac{\left(\sin\frac{\pi}{12} - i\cos\frac{\pi}{12}\right)^4}{\left(\sin\frac{\pi}{12} - i^2\cos\frac{\pi}{12}\right)^2}$$

$$\Rightarrow \frac{\left(\sin\frac{\pi}{12} - i\cos\frac{\pi}{12}\right)^4}{1}$$

$$\Rightarrow \left[\cos\left(\frac{\pi}{2} - \frac{\pi}{12}\right) - i\sin\left(\frac{\pi}{2} - \frac{\pi}{12}\right)\right]^4$$

$$\Rightarrow \left(\cos\frac{5\pi}{12} - i\sin\frac{5\pi}{12}\right)^4$$

$$\Rightarrow \cos\left(4\times\frac{5\pi}{12}\right) - i\sin\left(4\times\frac{5\pi}{12}\right)$$

$$\Rightarrow \cos\frac{5\pi}{3} - i\sin\frac{5\pi}{3}$$

$$\Rightarrow \cos\left(2\pi - \frac{\pi}{3}\right) - i\sin\left(2\pi - \frac{\pi}{3}\right)$$

$$\Rightarrow \cos\frac{\pi}{3} + i\sin\frac{\pi}{3}$$

$$\Rightarrow \frac{1+i\sqrt{3}}{2}$$

6. (A) $[x^3 + 1] = (x + 1)(x^2 - x + 1)$

$[x^3 + 1] = (x + 1)(x + \omega)(x + \omega^2)$

7. (D) Let $y = \tan^{-1}\left(\frac{1-\sqrt{1-x^2}}{x}\right)$ and $z = \sin^{-1} x$

$x = \sin z$

On putting $x = \sin z$

$$\Rightarrow y = \tan^{-1}\left(\frac{1-\sqrt{1-\sin^2 z}}{\sin z}\right)$$

$$\Rightarrow y = \tan^{-1}\left(\frac{1-\cos z}{\sin z}\right)$$

$$\Rightarrow y = \tan^{-1}\left(\frac{2\sin^2\frac{z}{2}}{2\sin\frac{z}{2}.\cos\frac{z}{2}}\right)$$

$$\Rightarrow y = \tan^{-1}\left(\frac{\sin\frac{z}{2}}{\cos\frac{z}{2}}\right)$$

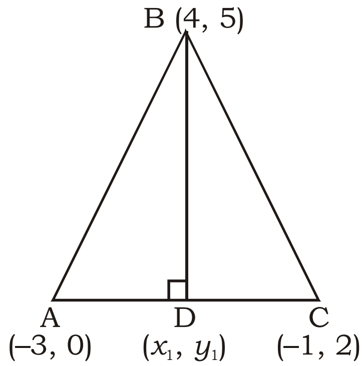
$$\Rightarrow y = \tan^{-1}\left(\tan\frac{z}{2}\right)$$

$$\Rightarrow y = \frac{z}{2}$$

On differentiating both side w.r.t. 'z'

$$\Rightarrow \frac{dy}{dz} = \frac{1}{2}$$

8. (C) Let $D = (x_1, y_1)$



Slope of line $AC(m_1) = \frac{2-0}{-1+3} = 1$

Slope of line BD $(m_2) = \frac{y_1 - 5}{x_1 - 4}$

Now, $m_1 \times m_2 = -1$

$1 \times \frac{y_1 - 5}{x_1 - 4} = -1$

$x_1 + y_1 = 9$ ...(i)

Equation of line (AC)

$y - 2 = \frac{2-0}{-1+3}(x + 1)$

$y - 2 = x + 1$

$x - y = -3$

point $D(x_1, y_1)$ lies on the line AC

$x_1 - y_1 = -3$ ...(ii)

from eq. (i) and eq. (ii)

$x_1 = 3, y_1 = 6$

Co-ordinate of foot of altitude = (3, 6).

9. (C) Let circumcentre of $\Delta ABC(P) = (x_1, y_1)$

$AP = BP = CP$

Now, $AP^2 = BP^2$

$(x_1 + 3)^2 + (y_1 - 0)^2 = (x_1 - 4)^2 + (y_1 - 5)^2$

$x_1^2 + 9 + 6x_1 + y_1^2 = x_1^2 + 16 - 8x_1 + y_1^2 + 25 - 10y_1$

$9 + 6x_1 = 16 - 8x_1 + y_1^2 + 25 - 10y_1$

$14x_1 + 10y_1 = 32$

$7x_1 + 5y_1 = 16$ ...(i)

Now, $AP^2 = CP^2$

$(x_1 + 3)^2 + (y_1 - 0)^2 = (x_1 + 1)^2 + (y_1 - 2)^2$

$x_1^2 + 9 + 6x_1 + y_1^2 = x_1^2 + 1 + 2x_1 + y_1^2 + 4 - 4y_1$

$9 + 6x_1 = 1 + 2x_1 + 4 - 4y_1$

$4x_1 + 4y1 = -4$

$x_1 + y_1 = -1$ ...(ii)

from eq. (i) and eq. (ii)

$x_1 = \frac{21}{2}$ and $y_1 = \frac{-23}{2}$

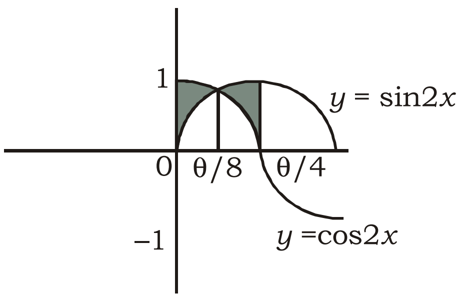
Hence circumcentre of ΔABC

$= \left(\frac{21}{2}, \frac{-23}{2}\right)$

10. (B) Centroid of ΔABC

$= \left[\frac{(-3)+4+(-1)}{3}, \frac{0+5+2}{3}\right] = \left(0, \frac{7}{3}\right)$

11. (B)



Area $= \int_0^{\frac{\pi}{8}} (\cos 2x - \sin 2x)\, dx$

Area $= \left[\frac{\sin 2x}{2} + \frac{\cos 2x}{2}\right]_0^{\frac{\pi}{8}}$

$= \frac{1}{2}\left[\left(\sin\frac{\pi}{4} + \cos\frac{\pi}{4}\right) - (\sin 0 + \cos 0)\right]$

$= \frac{1}{2}\left[\frac{1}{\sqrt{2}} + \frac{1}{\sqrt{2}} - 1\right]$

$= \frac{\sqrt{2}-1}{2}$ sq. unit

12. (A) Area $= \int_{\frac{\pi}{8}}^{\frac{\pi}{4}} (\sin 2x - \cos 2x)\, dx$

$= \left[\frac{-\cos 2x}{2} - \frac{\sin 2x}{2}\right]_{\frac{\pi}{8}}^{\frac{\pi}{4}}$

$= -\frac{1}{2}\left[\left(\cos\frac{\pi}{2} + \sin\frac{\pi}{2}\right) - \left(\cos\frac{\pi}{4} + \sin\frac{\pi}{4}\right)\right]$

$= -\frac{1}{2}\left[(0+1) - \left(\frac{1}{\sqrt{2}} + \frac{1}{\sqrt{2}}\right)\right]$

$= -\frac{1}{2}[1 - \sqrt{2}] = \frac{\sqrt{2}-1}{2}$ sq. unit

13. (B) $\sin\left[\tan^{-1}\left\{\tan\left(\frac{17\pi}{4}\right)\right\}\right]$

$\Rightarrow \sin\left[\tan^{-1}\left\{\tan\left(2\times 2\pi + \frac{\pi}{4}\right)\right\}\right]$

$\Rightarrow \sin\left[\tan^{-1}\left\{\tan\frac{\pi}{4}\right\}\right]$

$\Rightarrow \sin\frac{\pi}{4} = \frac{1}{\sqrt{2}}$

14. (D) $A = \begin{bmatrix} 3 & 3 \\ 3 & 3 \end{bmatrix}$

$A^2 = A.A = \begin{bmatrix} 3 & 3 \\ 3 & 3 \end{bmatrix}\begin{bmatrix} 3 & 3 \\ 3 & 3 \end{bmatrix}$

$A^2 = \begin{bmatrix} 18 & 18 \\ 18 & 18 \end{bmatrix}$

$A^2 = 2\begin{bmatrix} 9 & 9 \\ 9 & 9 \end{bmatrix} = 2\begin{bmatrix} 3^2 & 3^2 \\ 3^2 & 3^2 \end{bmatrix}$

$A^3 = A^2.A$

$A^3 = 2\begin{bmatrix} 9 & 9 \\ 9 & 9 \end{bmatrix}\begin{bmatrix} 3 & 3 \\ 3 & 3 \end{bmatrix}$

$A^3 = 2\begin{bmatrix} 54 & 54 \\ 54 & 54 \end{bmatrix}$

$A^3 = 2^2\begin{bmatrix} 27 & 27 \\ 27 & 27 \end{bmatrix} = 2^2\begin{bmatrix} 3^3 & 3^3 \\ 3^3 & 3^3 \end{bmatrix}$

Similarly,

$A^n = 2^{n-1}\begin{bmatrix} 3^n & 3^n \\ 3^n & 3^n \end{bmatrix}$

15. (C) $\tan^{-1}\left(\frac{a}{b}\right) + \tan^{-1}\left(\frac{a+b}{a-b}\right)$

$\Rightarrow \tan^{-1}\left[\frac{\frac{a}{b}+\frac{a+b}{a-b}}{1-\frac{a}{b}\times\frac{a+b}{a-b}}\right]$

$\Rightarrow \tan^{-1}\left[\frac{a^2-ab+ab+b^2}{ab-b^2-a^2-ab}\right]$

$\Rightarrow \tan^{-1}\left[\frac{a^2+b^2}{-(a^2+b^2)}\right] \Rightarrow \tan^{-1}(-1)$

$\Rightarrow \tan^{-1}\left[\tan\left(-\frac{\pi}{4}\right)\right] = \frac{-\pi}{4}$

16. (C) Let X and Y are two persons and they hit a target with the probability A and B respectively.

$\therefore\ P(A) = \frac{1}{3}$ and $P(B) = \frac{1}{4}$

P(Probability of hitting the target by any one X or Y)

$\Rightarrow P(A\cap \overline{B}) + P(\overline{A}\cap B) = P(A).P(\overline{B}) + P(\overline{A}).P(B)$

$= \frac{1}{3}\times\frac{3}{4} + \frac{2}{3}\times\frac{1}{4} = \frac{1}{4} + \frac{1}{6} = \frac{5}{12}$

17. (C) Differential equation

$\Rightarrow \cos\left(\frac{dy}{dx}\right) - x = 0$

$\Rightarrow \cos\left(\frac{dy}{dx}\right) = x$

$\Rightarrow \frac{dy}{dx} = \cos^{-1} x$

$\Rightarrow dy = \cos^{-1}x\, dx$

On integrating both side.

$\Rightarrow \int dy = \int 1.\cos^{-1}x\, dx$

$\Rightarrow y = \cos^{-1}x\int 1.dx - \int\left\{\frac{d}{dx}(\cos^{-1}x).\int 1.dx\right\}dx$

$\Rightarrow y = x\cos^{-1}x - \int\frac{-1}{\sqrt{1-x^2}}.x\,dx$

$\Rightarrow y = x.\cos^{-1}x - \frac{1}{2}\int\frac{-2x}{\sqrt{1-x^2}}dx$

$\Rightarrow y = x.\cos^{-1}x - \frac{1}{2}\frac{(1-x^2)^{\frac{-1}{2}+1}}{\frac{-1}{2}+1} + c$

$\Rightarrow y = x.\cos^{-1}x - \sqrt{1-x^2} + c$

18. (A) Let $y = \sin^{-1}\left(\frac{x}{\sqrt{1+x^2}}\right)$ and $z = \cos^{-1}x$

On putting $x = \tan\theta$, $\frac{dz}{dx} = \frac{-1}{\sqrt{1-x^2}}$

$\theta = \tan^{-1}x$

$y = \sin^{-1}\left(\frac{\tan\theta}{\sqrt{1+\tan^2\theta}}\right)$

$y = \sin^{-1}\left(\frac{\frac{\sin\theta}{\cos\theta}}{\frac{1}{\cos\theta}}\right)$

$y = \sin^{-1}(\sin\theta)$

$y = \theta$

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

Now, $\frac{dy}{dz} = \frac{dy}{dx}\times\frac{dx}{dz}$

$\frac{dy}{dz} = \frac{1}{1+x^2}\times -(\sqrt{1-x^2})$

$\frac{dy}{dz} = \frac{-\sqrt{1-x^2}}{1+x^2}$

19. (A) sin306° + cos308° + cos232° + sin126°

$\Rightarrow$ sin(360–54)+cos(360 – 52)+ cos (180+52) + sin(180– 54)

$\Rightarrow$ – sin54°+ cos52 – cos52 + sin54 = 0

20. (B) In ΔABC, $\overrightarrow{AB} = 2\hat{i} + 4\hat{j} - \hat{k}$

$\overrightarrow{AC} = 2\hat{i} + 2\hat{j} + 5\hat{k}$

$\overrightarrow{AB}\times\overrightarrow{AC} = \begin{vmatrix}\hat{i} & \hat{j} & \hat{k}\\ 2 & 4 & -1\\ 2 & 2 & 5\end{vmatrix}$

$\overrightarrow{AB}\times\overrightarrow{AC} = \hat{i}(20+2) - \hat{j}(10+2) + \hat{k}(4-8)$

$\overrightarrow{AB}\times\overrightarrow{AC} = 22\hat{i} - 12\hat{j} - 4\hat{k}$

Area of Δ ABC = $\frac{1}{2}|\overrightarrow{AB}\times\overrightarrow{AC}|$

$= \frac{1}{2}\sqrt{(22)^2+(-12)^2+(-4)^2}$

$= \frac{1}{2}\sqrt{484+144+16} = \frac{1}{2}\sqrt{644}$

$= \frac{1}{2}\times 2\sqrt{161} = \sqrt{161}$ sq. unit

21. (C) In the expansion of $\left(x^4 - \frac{1}{x^2}\right)^{13}$

$T_r = T_{(r-1)+1} = {}^{13}C_{r-1}(x^4)^{14-r}\left(\frac{-1}{x^2}\right)^{r-1}$

$T_r = {}^{13}c_{r-1}(-1)^{r-1}\, x^{58-6r}$

Now, $58 - 6r = -2$

$6r = 60 \Rightarrow \quad r = 10$

22. (A) $I = \int_{-1}^{1} \frac{|x|}{x}\, dx$

$I = 0 \quad$ [$\because$ function is an odd.]

23. (B) $I = \int e^{\frac{x^2-1}{x}}\, dx + \int \frac{x^2+1}{x}\, e^{\frac{x^2-1}{x}}\, dx$

$\Rightarrow I = e^{\frac{x^2-1}{x}} \int 1.dx = \int \left\{ \frac{d}{dx}\left(e^{\frac{x^2-1}{x}}\right).\int 1.dx \right\} dx$

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

$\Rightarrow I = e^{\frac{x^2-1}{x}}.x - \int e^{\frac{x^2-1}{x}}\, \frac{x.(2x)-(x^2-1).1}{x^2}\, .x\, dx +$

$\int \frac{x^2+1}{x}\, e^{\frac{x^2-1}{x}}\, dx + \text{c}$

$\Rightarrow I = xe^{\frac{x^2-1}{x}} - \int \frac{x^2+1}{x}\, e^{\frac{x^2-1}{x}}\, dx + \int \frac{x^2+1}{x}\, e^{\frac{x^2-1}{x}}\, dx$

$\Rightarrow I = xe^{\frac{x^2-1}{x}} + \text{c}$

24. (B) Given that $A = \begin{bmatrix} 3 & 2 \\ -2 & 4 \end{bmatrix}$

$A^2 - 7A + 16I_2 = 0$

$A^{-1}(A^2 - 7A + 16I_2) = A^{-1}O$

$A - 7I + 16A^{-1} = O$

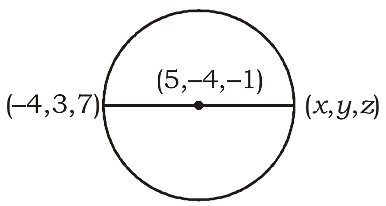
$16A^{-1} = -A + 7I$

$16A^{-1} = -\begin{bmatrix} 3 & 2 \\ -2 & 4 \end{bmatrix} + 7\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

$16A^{-1} = \begin{bmatrix} 4 & -2 \\ 2 & 3 \end{bmatrix}$

$A^{-1} = \frac{1}{16}\begin{bmatrix} 4 & -2 \\ 2 & 3 \end{bmatrix}$

25. (D)



Equation of sphere

$x^2 + y^2 + z^2 - 10x + 8y + 2z = 0$

Centre$(5, -4, -1)$

Let other end point of a sphere = (x, y, z)

Now,

$5 = \frac{-4 + x_1}{2} \Rightarrow x_1 = 14$

$-4 = \frac{3 + y_1}{2} \Rightarrow y_1 = -11$

$-1 = \frac{7 + z_1}{2} \Rightarrow z_1 = -9$

$\therefore$ other end point of a sphere = $(14, -11, -9)$

26. (A) A.T.Q.

$2a = 4 \times 2b$

$a = 4b$

$e = \sqrt{1 - \frac{b^2}{a^2}}$

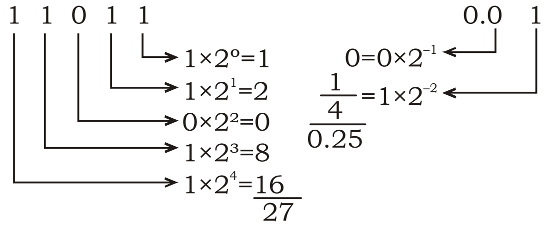
$e = \sqrt{1 - \frac{b^2}{16b^2}}$

$\Rightarrow e = \frac{\sqrt{15}}{4}$

27. (C) Class – size = Difference between two consecutive class marks = 9.5 – 8 = 1.5

28. (C) $\{(A \cap C) \cup (B \cap C)\} - (A \cap B \cap C)$

29. (B)



$(11011)_2 = (27)_{10}$, $(0.01)_2 = (0.25)_{10}$

Hence $(11011.01)_2 = (27.25)_{10}$

30. (B) The required probability

$= \frac{{}^6C_3 \times {}^4C_1}{{}^{10}C_4} = \frac{20 \times 4}{10 \times 3 \times 7} = \frac{8}{21}$

31. (D) Let $\vec{a} = -\lambda\hat{i} + 2\hat{j} + (1 - 3\lambda)\hat{k}$ and

$\vec{b} = 6\hat{i} - \lambda\hat{j} - 4\hat{k}$

$\vec{a}$ and $\vec{b}$ are perpendicular to each other, then

$\vec{a} \cdot \vec{b} = 0$

$\Rightarrow -\lambda \times 6 + 2 \times (-\lambda) + (1 - 3\lambda)(-4) = 0$

$\Rightarrow -6\lambda - 2\lambda - 4 + 12\lambda = 0$

$\Rightarrow 4\lambda = 4$

$\Rightarrow \lambda = 1$

32. (B) Let $\vec{a} = \frac{1}{2}\hat{i} + \hat{j} + \hat{k}$ and $\vec{b} = \hat{i} + \frac{1}{2}\hat{j} + \hat{k}$

$\cos\theta = \frac{\vec{a}.\vec{b}}{|\vec{a}|.|\vec{b}|}$

$= \frac{\left(\frac{1}{2}\hat{i} + \hat{j} + \hat{k}\right).\left(\hat{i} + \frac{1}{2}\hat{j} + \hat{k}\right)}{\sqrt{\left(\frac{1}{2}\right)^2 + (1)^2 + (1)^2}\sqrt{(1)^2 + \left(\frac{1}{2}\right)^2 + (1)^2}}$

$= \frac{\frac{1}{2} + \frac{1}{2} + 1}{\frac{3}{2} \times \frac{3}{2}}$

$\cos\theta = \frac{2 \times 4}{9}$

$\Rightarrow \theta = \cos^{-1}\left(\frac{8}{9}\right)$

33. (D) Equation $ax^2 + bx + c = 0$

$\alpha + \beta = \frac{-b}{a}$ ...(i)

$px^2 + qx + r = 0$

$\alpha - h + \beta - h = \frac{-q}{p}$

$\alpha + \beta - 2h = \frac{-q}{p}$

$\frac{-b}{a} - 2h = -\frac{q}{p}$

$2h = \frac{-b}{a} + \frac{q}{p}$

$\Rightarrow h = \frac{1}{2}\left[\frac{q}{p} - \frac{b}{a}\right]$

34.(B)

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        111
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         10
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quotient = $(1001)_2$ and remainder = $(10)_2$

35. (C) $\begin{vmatrix} 6i & 2i & 3 \\ 4 & -2i & -i \\ 5 & -6 & -2 \end{vmatrix} = x + iy$

$\Rightarrow 6i(4i - 6i) - 2i(-8 + 5i) + 3(-24 + 10i) = x + iy$

$\Rightarrow 6i(-2i) + 16i - 10i^2 - 72 + 30i = x + iy$

$\Rightarrow -12i^2 + 46i + 10 - 72 = x + iy$

$\Rightarrow -50 + 46i = x + iy$

On comparing

$\Rightarrow y = 46$

36. (A) A.T.Q,

$m[a + (m-1)d] = n[a + (n-1)d]$

$am + (m^2 - m)d = an + (n^2 - n)d$

$a(m-n) = d(n^2 - n - m^2 + m)$

$a(m-n) = d(m-n)\ [1 - m - n)$

$a - d(1 - m - n) = 0$

$a + (m + n - 1)d = 0$

Hence, $(m + n)^{th}$ term = 0

37. (B) $\begin{bmatrix} 1 & 1 & 0 \\ 1 & 1 & 1 \\ 1 & 0 & 1 \end{bmatrix}$ is an elementary matrix.

because its value = 1

38. (C) $(1 - \cos A + \sin A)^2 = 1 + \cos^2 A + \sin^2 A - 2\cos A - 2\sin A\cos A + 2\sin A$

$\Rightarrow (1 - \cos A + \sin A)^2 = 2 - 2\cos A - 2\sin A.\cos A + 2\sin A.$

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

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

39. (D) $\frac{\theta^o}{\theta^c} = \frac{180}{\pi}$ ...(i)

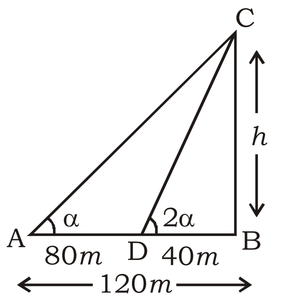
and $\theta^o \times \theta^c = \frac{80\pi}{9}$ ...(ii)

from eq. (i) and eq. (ii)

$\frac{\theta^o}{\theta^c} \times \theta^o \times \theta^c = \frac{180}{\pi} \times \frac{80\pi}{9}$

$(\theta^o)^2 = 1600 \Rightarrow \theta^o = 40^o$

40. (C)



Let $\angle BAC = \alpha$, $BC = h\ m$

then $\angle BDC = 2\alpha$

In ΔBAC

$\tan\alpha = \frac{h}{120}$ ...(i)

In ΔBDC

$\tan 2\alpha = \frac{BC}{BD}$

$\frac{2\tan\alpha}{1 - \tan^2\alpha} = \frac{h}{40}$

$\frac{2 \times \frac{h}{120}}{1 - \frac{h^2}{14400}} = \frac{h}{40}$

$$\frac{2\times120}{14400-h^2}=\frac{1}{40}$$

$14400 - h^2 = 9600$

$h^2 = 4800 \Rightarrow h = 40\sqrt{3}$

height of the tower = BC = $40\sqrt{3}$ m.

41. (B) Given that,

$$\int x^3 .\ln x\,dx = \frac{x^4}{a}\ln x + \frac{x^4}{b} + c \quad \ldots(i)$$

Let $I = \int x^3 .\ln x\,dx$

$$I = \ln x.\int x^3\,dx - \int\left\{\frac{d}{dx}(\ln x).\int x^3 dx\right\}dx$$

$$I = (\ln x).\frac{x^4}{4} - \int\frac{1}{x}\times\frac{x^4}{4}\,dx$$

$$I = \frac{x^4}{4}\ln x - \frac{1}{4}\times\frac{1}{4}x^4 + c$$

$$I = \frac{x^4}{4}\ln x + \frac{x^4}{(-16)} + c$$

On comparing with eq. (i)

$a = 4$ and $b = -16$

42. (D) Given that $f(x) = \dfrac{2x}{1-x}$

then $f(f(x)) = f\left[\dfrac{2x}{1-x}\right]$

$$f(f(x)) = \frac{2\left(\frac{2x}{1-x}\right)}{1-\frac{2x}{1-x}}$$

$$f(f(x)) = \frac{\frac{4x}{1-x}}{\frac{1-x-2x}{1-x}} = \frac{4x}{1-3x}$$

43. (D) $\tan^{-1}\left(\tan\dfrac{5\pi}{6}\right)$

$$\Rightarrow \tan^{-1}\left[\tan\left(\pi-\frac{\pi}{6}\right)\right]$$

$$\Rightarrow \tan^{-1}\left[-\tan\left(\frac{\pi}{6}\right)\right]$$

$$\Rightarrow \tan^{-1}\left(\tan\left(\frac{-\pi}{6}\right)\right] = \frac{-\pi}{6}$$

44. (C) We know that

$C_0 + C_1x + C_2x^2 + \ldots C_nx^n = (1+x)^n$

On putting $x = 1$

$C_0 + C_1 + C_2 + C_3 + \ldots C_n = (1+1)^n = 2^n$

45. (B) $f(x) = \dfrac{\sqrt{\log_e(3x^2-5x+1)}}{x^2+4x+12}$

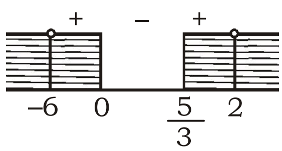
$\log_e(3x^2 - 5x + 1) \geq 0$ and $x^2 + 4x - 12 \neq 0$

$3x^2 - 5x + 1 \geq 1$ $\quad$ $(x+6)(x-2) \neq 0$

$3x^2 - 5x \geq 0$ $\quad$ $x \neq -6, 2$

$x(3x-5) \geq 0$

$x = 0, x = \dfrac{5}{3}$



domain = $\left[(-\infty,0]\cup\left[\frac{5}{3},\infty\right)\right] - \{-6,2\}$

46. (A) $I = \int e^x.\sin x\,dx \quad \ldots(i)$

$$I = \sin x\int e^x\,dx - \int\left\{\frac{d}{dx}(\sin x).\int e^x.dx\right\}dx$$

$I = (\sin x).e^x - \int\cos x.e^x\,dx + 2c$

$I = e^x.\sin x -$

3 + 1 1 i

2

$$I = e^x\sin x - \left[\cos x\,e^x - \int(-\sin x)e^x dx\right] + 2c$$

$I = e^x\sin x - \cos x.e^x - \int\sin x.e^x\,dx + 2c$

$I = e^x\sin x - \cos x.e^x + 2c$ [from eq. (i)]

$2I = e^x\sin x - \cos x.e^x - I + 2c$

$$I = \frac{\sin x - \cos x}{2}.e^x + c$$

47. (B) $y = \text{cosec}(\cot^{-1}x) \quad \ldots(i)$

On differentiating both side w.r.t. 'x'

$$\frac{dy}{dx} = -\text{cosec}(\cot^{-1}x).\cot(\cot^{-1}x).\left(\frac{-1}{1+x^2}\right)$$

$\dfrac{dy}{dx} = \dfrac{y.x}{1+x^2}$ [from eq. (i)]

$(1+x^2)\dfrac{dy}{dx} = xy$

48. (B) Let $a + ib = \sqrt{-1+3\sqrt{11}i}$

On squaring both side

$(a^2 - b^2) + 2abi = -1 + 3\sqrt{11}\, i$

On comparing

$a^2 - b^2 = -1$ and $2ab = 3\sqrt{11}$ ...(i)

$(a^2 + b^2)^2 = (a^2 - b^2)^2 + (2ab)^2$

$(a^2 + b^2)^2 = 1 + 99$

$(a^2 + b^2)^2 = 100$

$a^2 + b^2 = 10$ ...(ii)

from eq. (i) and eq. (ii)

$2a^2 = 9$ and $b^2 = 11$

$a = \pm \frac{3}{\sqrt{2}}, \; b = \pm \frac{\sqrt{11}}{\sqrt{2}}$

Square root of $(-1 + 3\sqrt{11}\, i) = \pm \frac{3+\sqrt{11}i}{\sqrt{2}}$

49. (C) $I = \int_0^{\frac{\pi}{2}} \frac{\sin^5 x}{\sin^5 x + \cos^5 x}\,dx$ ...(i)

$$I = \int_0^{\frac{\pi}{2}} \frac{\sin^5\left(\frac{\pi}{2} - x\right)}{\sin^5\left(\frac{\pi}{2} - x\right) + \cos^5\left(\frac{\pi}{2} - dx\right)}\,dx$$

$I = \int_0^{\frac{\pi}{2}} \frac{\cos^5 x}{\cos^5 x + \cos^5 x}\,dx$ ...(ii)

from eq. (i) and eq. (ii)

$$2I = \int_0^{\frac{\pi}{2}} \frac{\sin^5 x + \cos^5 x}{\sin^5 x + \cos^5 x}\,dx$$

$$2I = \int_0^{\frac{\pi}{2}} 1.dx$$

$$2I = [x]_0^{\frac{\pi}{2}} - 0 \Rightarrow I = \frac{\pi}{4}$$

50. (B) Digits 0, 1, 2, 3, 4, 6, 7, 8

7	8	8

= 7 × 8 × 8 = 448

'0' can not put here.

51. (A) Let $y = 7^{47}$

On taking log both side

$\log_{10} y = 47 \log_{10} 7$

$\log_{10} y = 47 \times 0.8451$

$\log_{10} y = 39.7197$

No. of digits in 7^{47}

= 39 + 1 = 40

52. (B) $\frac{1+\cos(A-B).\cos C}{1+\cos(A-C).\cos B}$

$$\Rightarrow \frac{1+\cos(A-B).\cos[180-(A+B)]}{1+\cos(A-C).\cos[180-(A+C)]}$$

$$\Rightarrow \frac{1-\cos(A-B).\cos(A+B)}{1-\cos(A-C).\cos(A+C)}$$

$$\Rightarrow \frac{1-\cos^2 A+\sin^2 B}{1-\cos^2 A+\sin^2 C}$$

$$\Rightarrow \frac{\sin^2 A+\sin^2 B}{\sin^2 A+\sin^2 C}$$

$\Rightarrow \frac{a^2+b^2}{a^2+c^2}$ [by Sine Rule]

53. (C) $\lim_{x\to 0} \frac{1-(\cos x)^{\frac{-2}{3}}}{1-(\cos x)^{\frac{-1}{3}}}$ $\left[\frac{0}{0}\right]$ Form

by L-Hospital's Rule

$$\Rightarrow \lim_{x\to 0} \frac{0-\left(\frac{-2}{3}\right)(\cos x)^{\frac{-5}{3}}(-\sin x)}{0-\left(\frac{-1}{3}\right)(\cos x)^{\frac{-4}{3}}(-\sin x)}$$

$$\Rightarrow \lim_{x\to 0} \frac{-\frac{2}{3}(\cos x)^{\frac{-5}{3}}}{-\frac{1}{3}(\cos x)^{\frac{-4}{3}}}$$

$$\Rightarrow \frac{-2.(1)^{\frac{-5}{3}}}{-1.(1)^{\frac{-4}{3}}} = 2$$

54. (B) $P(31, 17) = k.C(31, 14)$

$$\Rightarrow \frac{31!}{(31-17)!} = k.\frac{31!}{14!(31-14)!}$$

$$\Rightarrow \frac{1}{14!} = \frac{k}{14!17!} \Rightarrow k = 17!$$

55. (D) Sum of focal radii of any point on an ellipse = $2a$ = length of major axis

56. (C) Planes

$x + 2y - z = 7$ and $-x + y - 2z = 9$

angle between the planes.

$$\cos\theta = \frac{1\times(-1)+2\times 1+(-1)(-2)}{\sqrt{1^2+(-2)^2+(-1)^2}\sqrt{(-1)^2+1^2+(-2)^2}}$$

$$\cos\theta = \frac{3}{\sqrt{6}\sqrt{6}}$$

$$\cos\theta = \frac{1}{2} \Rightarrow \theta = \frac{\pi}{3}$$

57. (A) Let $z = \begin{bmatrix} \omega & \omega^2 & 1+\omega^2 \\ 1 & \omega & \omega+\omega^2 \\ \omega^2 & 1 & 1+\omega \end{bmatrix}$

$|z| = \begin{vmatrix} \omega & \omega^2 & 1+\omega^2 \\ 1 & \omega & \omega+\omega^2 \\ \omega^2 & 1 & 1+\omega \end{vmatrix}$

$C_1 \to C_1 + C_3$

$|z| = \begin{vmatrix} 1+\omega+\omega^2 & \omega^2 & 1+\omega^2 \\ 1+\omega+\omega^2 & \omega & \omega+\omega^2 \\ 1+\omega+\omega^2 & 1 & 1+\omega \end{vmatrix}$

$|z| = \begin{vmatrix} 0 & \omega^2 & 1+\omega^2 \\ 0 & \omega & \omega+\omega^2 \\ 0 & 1 & 1+\omega \end{vmatrix}$

$|z| = 0 = 1 + \omega + \omega^2$

58. (B) $A = \begin{bmatrix} -2 & 3 \\ 4 & 1 \end{bmatrix}$

Co-factors of A -

$C_{11} = (-1)^{1+1}(1) = 1$, $C_{12} = (-1)^{1+2}(4) = -4$

$C_{21} = (-1)^{2+1}(3) = -3$, $C_{22} = (-1)^{2+2}(-2) = -2$

$C = \begin{bmatrix} 1 & -4 \\ -3 & -2 \end{bmatrix}$

Adj $A = C^T = \begin{bmatrix} 1 & -3 \\ -4 & -2 \end{bmatrix}$

then $A(\text{Adj } A) = \begin{bmatrix} -2 & 3 \\ 4 & 1 \end{bmatrix} \begin{bmatrix} 1 & -3 \\ -4 & -2 \end{bmatrix}$

$A(\text{Adj } A) = \begin{bmatrix} -14 & 0 \\ 0 & -14 \end{bmatrix}$

59. (B) $x = 1 + \left(\frac{y}{5}\right) + \left(\frac{y}{5}\right)^2 + \left(\frac{y}{5}\right)^3 + \ldots$ where $|y| < 5$

$\Rightarrow x = \frac{1}{1 - \frac{y}{5}}$

$\Rightarrow x = \frac{5}{5 - y}$

$\Rightarrow 5x - xy = 5$

$\Rightarrow xy = 5x - 5$

$\Rightarrow y = \frac{5x - 5}{x}$

60. (B) $\sin(-1140) = -\sin(1140)$

$= -\sin(3 \times 360 + 60) = -\sin 60 = \frac{-\sqrt{3}}{2}$

61. (A) A' = cofactor of A

$|A'| = |\text{co-factor of } A|$

$|A'| = (A)^{3-1}$ [$\because$ order 3]

$|A'| = A^2$

62. (C) $\lim_{x \to 0} \frac{\sin x + \tan x}{x}$ $\left[\frac{0}{0}\right]$ Form

by L-Hospital's Rule

$\Rightarrow \lim_{x \to 0} \frac{\cos x + \sec^2 x}{1}$

$\Rightarrow \cos 0 + \sec^2 0 \Rightarrow 1 + 1 = 2$

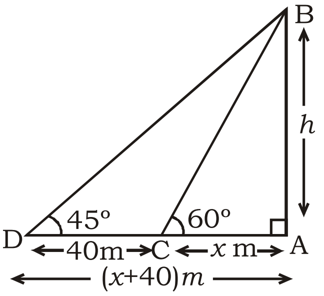
63. (C) $AA^T = 1$

$|AA^T| = 1$

$|A|^2 = 1$

$|A| = \pm 1$

64. (B)



Let height of the house (AB) = h m

$AC = x\,m$

ATQ, AD = $(x + 40)m$

In ΔABC

$\tan 60° = \frac{AB}{AC}$ $\sqrt{3} = \frac{h}{x}$ $\Rightarrow x = \frac{h}{\sqrt{3}}$

In ΔABD

$\tan 45° = \frac{AB}{AD}$

$1 = \frac{h}{x + 40}$

$x + 40 = h$

$\frac{h}{\sqrt{3}} + 40 = h$

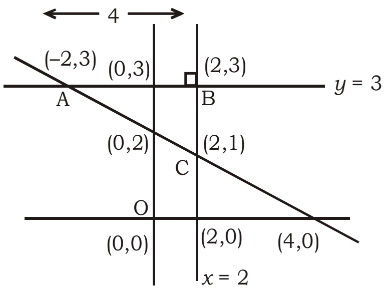
$h\left(1 - \frac{1}{\sqrt{3}}\right) = 40$

$h = \frac{40\sqrt{3}}{\sqrt{3} - 1}$

$h = \frac{40\sqrt{3}(\sqrt{3} + 1)}{3 - 1} = 20(3 + \sqrt{3})m$

height of the house = $20(3 + \sqrt{3})m$

65. (A)



line $x = 2$, $y = 3$ and $x + 2y = 4$

According to figure

AB = 4, BC = 2

Area of $\Delta ABC = \frac{1}{2} \times AB \times BC$

$= \frac{1}{2} \times 4 \times 2 = 4$ sq. unit

66. (D) $|\vec{a}| = \sqrt{3}$, $|\vec{b}| = 2$ and $|\vec{a} + \vec{b}| = 2\sqrt{3}$

$|\vec{a}+\vec{b}|^2 + |\vec{a}-\vec{b}|^2 = 2[|\vec{a}|^2 + |\vec{b}|^2]$

$(2\sqrt{3})^2 + |\vec{a}-\vec{b}|^2 = 2[(\sqrt{3})^2 + (2)^2]$

$12 + |\vec{a} - \vec{b}|^2 = 2[3 + 4]$

$12 + |\vec{a} - \vec{b}|^2 = 14$

$|\vec{a} - \vec{b}|^2 = 2 \Rightarrow |\vec{a} - \vec{b}| = \sqrt{2}$

67. (C) $\left(\frac{d^2y}{dx^2}\right)^{\frac{3}{4}} + 2\left(\frac{d^3y}{dx^3}\right)^{\frac{1}{2}} + \frac{dy}{dx} = 7$

$\left(\frac{d^2y}{dx^2}\right)^{\frac{3}{4}} = 7 - 2\left(\frac{d^3y}{dx^3}\right)^{\frac{1}{2}} - \frac{dy}{dx}$

$\left(\frac{d^2y}{dx^2}\right)^{\frac{3}{4}} = \left(7 - 2\left(\frac{d^3y}{dx^3}\right)^{\frac{1}{2}} - \frac{dy}{dx}\right)^4$

Order = 3, degree $= \frac{1}{2} \times 4 = 2$

68. (B) $\frac{\tan x + \sec x - 1}{\tan x - \sec x + 1}$

$\Rightarrow \frac{\tan x + \sec x - (\sec^2 x - \tan^2 x)}{\tan x - \sec x + 1}$

$\Rightarrow \frac{\tan x + \sec x - (\sec x + \tan x)(\sec x - \tan x)}{\tan x - \sec x + 1}$

$\Rightarrow \frac{(\tan x + \sec x)[1 - (\sec x - \tan x)]}{\tan x - \sec x + 1}$

$\Rightarrow \frac{(\tan x + \sec x)(\tan x - \sec x + 1)}{\tan x - \sec x + 1}$

$\Rightarrow \tan x + \sec x$

$\Rightarrow \frac{\sin x}{\cos x} + \frac{1}{\cos x} = \frac{1 + \sin x}{\cos x}$

69. (C) $f(x) = x^2 - 6x$, $x \in [0, 8]$

$f(x) = 2x - 6$

$f'(x) = 2$

for minima and maxima

$f'(x) = 0$

$2x - 6 = 0 \Rightarrow x = 3$

from eq. (i)

$f''(3) = 2$ (minima)

function $f(x)$ attains minimum value at **$x = 3$**

70. (A) $I = \int_{-\frac{\pi}{4}}^{\frac{\pi}{4}} \frac{\cos x}{\sin^5 x} dx$

$I = 0$ $[\because f(x)$ is an odd function$]$

71. (B) $f(x) = \begin{cases} x - 2, & x \le 5 \\ 3x - \lambda, & x > 5 \end{cases}$ is continuous

at $x = 5$, then

$\lim_{x \to 5^-} f(x) = \lim_{x \to 5^+} f(x) = f(5)$

$\lim_{x \to 5^+} f(x) = f(5)$

$\lim_{h \to 0} f(5 + h) = 5 - 2$

$\lim_{h \to 0} 3(5 + h) - \lambda = 3$

$15 - \lambda = 3 \Rightarrow \lambda = 12$

72. (C) Marks of students

30, 35, 36, 32, 31, 38, 40, 42

Mean $= \frac{30 + 35 + 36 + 32 + 31 + 38 + 40 + 42}{8}$

Mean $= \frac{284}{8} = 35.5$

$\therefore$ The required number of students = 4

73. (D) Determinant $\begin{vmatrix} 6 & 3 & 4 \\ 2 & 3 & 9 \\ 8 & -1 & 5 \end{vmatrix}$

Minor of 4 $= \begin{vmatrix} 2 & 3 \\ 8 & -1 \end{vmatrix}$

$= -2 - 24 = -26$

74. (A) Equation $2ax^2 - 5bx + 3c = 0$

Let roots = 3α, 4α

then

$3\alpha + 4\alpha = \frac{-(-5b)}{2a}$

$7\alpha = \frac{5b}{2a} \Rightarrow \alpha = \frac{5b}{14a}$ ....(i)

and $3\alpha . 4\alpha = \frac{3c}{2a}$

$\alpha^2 = \dfrac{c}{8a}$

$\left(\dfrac{5b}{14a}\right)^2 = \dfrac{c}{8a}$ [from eq. (i)]

$\dfrac{25b^2}{196a^2} = \dfrac{c}{8a} \Rightarrow 50b^2 = 49ac$

75. (C) $y = (1 - x^{\frac{1}{16}})(1 + x^{\frac{1}{8}})(1 + x^{\frac{1}{4}})(1 + x^{\frac{1}{16}})$

$\Rightarrow y = (1 + x^{\frac{1}{4}})(1 + x^{\frac{1}{8}})(1 - x^{\frac{1}{16}})(1 + x^{\frac{1}{16}})$

$\Rightarrow y = (1 + x^{\frac{1}{4}})(1 + x^{\frac{1}{8}})(1 - x^{\frac{1}{8}})$

$\Rightarrow y = (1 + x^{\frac{1}{4}})(1 - x^{\frac{1}{4}})$

$\Rightarrow y = 1 - x^{\frac{1}{2}}$

$\Rightarrow \dfrac{dy}{dx} = \dfrac{-1}{2\sqrt{x}}$

76. (B) $\int_1^2 \left\{k^2 + (1-k)x + 2x^3\right\} dx \le 10$

$\left[k^2x + (1-k)\dfrac{x^2}{2} + \dfrac{2x^4}{4}\right]_1^2 \le 10$

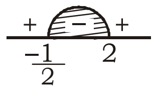
$(2k^2 + (1-k)\times 2 + 8) - \left(k^2 + (1-k)\times\dfrac{1}{2} + \dfrac{1}{2}\right) \le 10$

$k^2 - \dfrac{3k}{2} + 9 \le 10$

$2k^2 - 3k + 18 \le 20$

$2k^2 - 3k - 2 \le 0$

$(2k+1)(k-2) \le 0$



$\dfrac{-1}{2} \le k \le 2$

77. (B) Given that $\cos\theta = \sin^2\theta$

then $\sin^2\theta(1 + \sin^2\theta)$

$= \cos(1 + \cos\theta) = \cos\theta + \cos^2\theta$

$= \cos\theta + 1 - \sin^2\theta = \cos\theta + 1 - \cos\theta = 1$

78. (C) $I = \int \dfrac{x}{\sin^2 x.\cos^2 x}\, dx$

$I = \int \dfrac{x(\sin^2 x + \cos^2 x)}{\sin^2 x.\cos^2 x}\, dx$

$I = \int (x.\sec^2 x + x.\text{cosec}^2 x)\, dx$

$I = x\int \sec^2 x\, dx - \int\left\{\dfrac{d}{dx}(x).\int \sec^2 x\, dx\right\} dx$

$+ x\int \text{cosec}^2 x\, dx - \int\left\{\dfrac{d}{dx}(x).\int \text{cosec}^2 x\, dx\right\} dx$

$I = x.\tan x - \int 1.\tan x.dx + x(-\cot x) - \int 1.(-\cot x)\, dx$

$I = x.\tan x - \log\sec x - x\cot x + \log\sin x + c$

$I = x(\tan x - \cot x) - \log(\sin x.\cos x) + c$

$I = x(\tan x - \cot x) - \log\left(\dfrac{2\sin x.\cos x}{2}\right) + c$

$I = x(\tan x - \cot x) - \log(\sin 2x) + \log 2 + c$

$I = x(\tan x - \cot x) - \log(\sin 2x) + c$

79. (A) Equation of circle $x^2 + y^2 = 3$

$r = \sqrt{3}$

Area of circle $= \pi r^2 = \pi \times (\sqrt{3})^2 = 3\pi$ sq. unit

80. (A) $\phi = \{\}$

81. (B) Condition for sphere

$u^2 + v^2 + w^2 - d > 0$

82. (C) $\begin{vmatrix} 2a & -4b & 2c \\ -3p & 6q & -3r \\ l & -2m & n \end{vmatrix} = \lambda \begin{vmatrix} p & q & r \\ a & b & c \\ l & m & n \end{vmatrix}$

$\Rightarrow 2\times(-3) \begin{vmatrix} a & -2b & c \\ p & -2q & r \\ l & -2m & n \end{vmatrix} = -\lambda \begin{vmatrix} a & b & c \\ p & q & r \\ l & m & n \end{vmatrix}$

$\Rightarrow -6 \times (-2) \begin{vmatrix} a & b & c \\ p & q & r \\ l & m & n \end{vmatrix} = -\lambda \begin{vmatrix} a & b & c \\ p & q & r \\ l & m & n \end{vmatrix}$

On comparing

$12 = -\lambda \Rightarrow \lambda = -12$

83. (D) $\text{cosec}\theta - \cot\theta = 3$ ...(i)

$\text{cosec}\theta + \cot\theta = \dfrac{1}{3}$ ...(ii)

from eq. (i) and eq. (ii)

$2\text{cosec}\theta = 3 + \dfrac{1}{3}$

$2\text{cosec}\theta = \dfrac{10}{3} \Rightarrow \sin\theta = \dfrac{3}{5}$

Hence, $\cos\theta = \dfrac{4}{5}$

84. (A) $\sin\left(\sin^{-1}\dfrac{4}{5} + \cos^{-1} x\right) = 1$

$\Rightarrow \sin^{-1}\dfrac{4}{5} + \cos^{-1}x = \sin^{-1}(1)$

$\Rightarrow \sin^{-1}\dfrac{4}{5} + \cos^{-1}x = \dfrac{\pi}{2}$

$\Rightarrow \cos^{-1}x = \dfrac{\pi}{2} - \sin^{-1}\dfrac{4}{5}$

$\Rightarrow \cos^{-1}x = \cos^{-1}\dfrac{4}{5} \Rightarrow x = \dfrac{4}{5}$

85. (A) $f(x) = \frac{1}{\sqrt{55+x^2}}$

On differentiating both side w.r.t. 'x'

$$f'(x) = \frac{-(2x)}{2(55+x^2)^{\frac{3}{2}}}$$

$$f'(x) = \frac{-x}{(55+x^2)^{\frac{3}{2}}}$$

Now, $\lim_{x\to 3} \frac{f(3)-f(x)}{x^3-27}$ $\left[\frac{0}{0}\right]$ Form

by L-Hospital's Rule

$$\Rightarrow \lim_{x\to 3} \frac{-f'(x)}{3x^2}$$

$$\Rightarrow \lim_{x\to 3} \frac{x}{3x^2(55+x^2)^{\frac{3}{2}}}$$

$$\Rightarrow \lim_{x\to 3} \frac{1}{3x(55+x^2)^{\frac{3}{2}}}$$

$$\Rightarrow \frac{1}{3\times 3(55+3^2)^{\frac{3}{2}}} = \frac{1}{4608}$$

86. (C) Let $z = \frac{(1-2i)(2+i)}{(1-i)}$

$$z = \frac{4-3i}{(1-i)} \times \frac{1+i}{1+i}$$

$$z = \frac{4-3i+4i-3i^2}{1-i^2}$$

$$z = \frac{7+i}{2}$$

$$\arg(z) = \tan^{-1}\left(\frac{\frac{1}{2}}{\frac{7}{2}}\right)$$

$$\arg(z) = \tan^{-1}\left(\frac{1}{7}\right)$$

87. (D) $\sin 36^\circ = \frac{\sqrt{10-2\sqrt{5}}}{4}$

88. (B) 6 points out of 13 are in the same straight line,

then

the required no. of triangle = ${}^{13}C_3 - {}^{6}C_3$

$$= \frac{13!}{3!10!} - \frac{6!}{3!3!}$$

$= 286 - 20 = 266$

89. (C) $1^C = \left(1\times\frac{180}{\pi}\right)^\circ$

$$1^C = \left(\frac{180}{22}\times 7\right)^\circ$$

$$1^C = \left(\frac{630}{11}\right)^\circ = 57^\circ 16' 22''$$

90. (D) $\alpha = \frac{1-\sqrt{3}i}{2} = -\omega$

Now, $1 + \alpha^2 + \alpha^4 + \alpha^6 + \alpha^8$

$\Rightarrow 1 + (-\omega)^2 + (-\omega)^4 + (-\omega)^6 + (-\omega)^8$

$\Rightarrow 1 + \omega^2 + \omega^4 + \omega^6 + \omega^8$

$\Rightarrow 1 + \omega^2 + \omega + 1 + \omega^2$ $[\because \omega^3 = 1]$

$\Rightarrow 0 + 1 + \omega^2$

$\Rightarrow -\omega = \alpha$

91. (A)

$$\begin{vmatrix} a^2 & bc & \frac{1}{a} \\ b^2 & ca & \frac{1}{b} \\ c^2 & ab & \frac{1}{c} \end{vmatrix}$$

$$\Rightarrow \frac{1}{abc}\begin{vmatrix} a^3 & abc & 1 \\ b^3 & abc & 1 \\ c^3 & abc & 1 \end{vmatrix}$$

$$\Rightarrow \frac{abc}{abc} \therefore \begin{vmatrix} a^3 & 1 & 1 \\ b^3 & 1 & 1 \\ c^3 & 1 & 1 \end{vmatrix}$$

$\Rightarrow 0$ [$\because$ two columns are identical.]

92. (C) Let $y = \log_x x$ and $z = e^{x^2}$

$y = 1$,

$$\frac{dz}{dx} = 2xe^{x^2}$$

$$\frac{dy}{dx} = 0$$

$$\frac{dy}{dz} = \frac{dy}{dx} \times \frac{dx}{dz} = 0$$

93. (C)

94. (B) We know that

minimum value of

$$\left(ax^2 + \frac{b}{x^2}\right) = 2\sqrt{ab}$$

So minimum value of

$(8\tan^2\theta + 32\cot^2\theta)$

$= 2\sqrt{8\times 32} = 32$

95. (B) $[2\ \ 2\ \ -x]\begin{bmatrix}1 & 2 & 0\\5 & -3 & 2\\6 & -4 & -1\end{bmatrix}\begin{bmatrix}3\\4\\-2\end{bmatrix} = [0]$

$\Rightarrow [2\ \ 2\ \ -x]\begin{bmatrix}1\times3+2\times4+0\times2\\5\times3+(-3)\times4+2\times(-2)\\6\times3+(-4)\times4+(-1)\times(-2)\end{bmatrix} = [0]$

$\Rightarrow [2\ 2\ -x]\begin{bmatrix}11\\-1\\4\end{bmatrix} = [0]$

$\Rightarrow [2 \times 11 + 2 \times (-1) + (-x) \times 4] = [0]$

$\Rightarrow [20 - 4x] = [0]$

$\Rightarrow 20 - 4x = 0 \Rightarrow x = 5$

96. (B) Differential equation

$\frac{dy}{dx} + \frac{1+y^2}{1+x^2} = 0$

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

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

On integrating

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

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

$\Rightarrow \tan^{-1}\left(\frac{x+y}{1-xy}\right) = c$

$\Rightarrow \frac{x+y}{1-xy} = \tan c$

$\Rightarrow \frac{x+y}{1-xy} = C$

$\Rightarrow \frac{x+y}{1-xy} = C$

$\Rightarrow x + y = C(1 - xy)$

97. (C) Equation

$x^2 - 4x + 42 = 0$

Now, $b^2 - 4ac = (-4)^2 - 4 \times 1 \times 42$

$b^2 - 4ac = 16 - 168$

$b^2 - 4ac = -152 < 0$

Hence, roots are imaginary.

98. (C) Given that

$S_n = n^2 - 2n + 6$

$S_{n-1} = (n-1)^2 - 2(n-1) + 6$

$S_{n-1} = n^2 - 4n + 9$

Now, $T_n = S_n - S_{n-1}$

$T_n = n^2 - 2n + 6 - n^2 + 4n - 9$

$T_n = 2n - 3$

$T_{42} = 2 \times 42 - 3 = 81$

99. (A) A.T.Q.

$\frac{n(n-3)}{2} = 90$

$\Rightarrow n^2 - 3n = 180$

$\Rightarrow n^2 - 3n - 180 = 0$

$\Rightarrow (n - 15)(n + 12) = 0$

$n = 15, -12$

$\therefore$ The no. of sides of regular polygon = 15

100. (A) The required Probability

$P|A| = \frac{n|E|}{n|S|} = \frac{4}{52} = \frac{1}{13}$

101. (B) $\frac{1+\sin\theta}{1-\sin\theta} = 3$

$\Rightarrow 1 + \sin\theta = 3 - 3\sin\theta$

$\Rightarrow 4\sin\theta = 2$

$\Rightarrow \sin\theta = \frac{1}{2}$

$\Rightarrow \sin\theta = \sin\frac{\pi}{6}$

$\Rightarrow \theta = n\pi \pm (-1)^n \frac{\pi}{6}$

102. (A) Given that

$\int_{-3}^{2} f(x)\,dx = 5$ and $\int_{1}^{2}[3 - f(x)]\,dx = 10$

Now,

$\int_{1}^{2}[3 - f(x)]\,dx = 10$

$\Rightarrow \int_{1}^{2} 3\,.dx - \int_{1}^{2} f(x)\,dx = 10$

$\Rightarrow 3[x]_1^2 - \int_{1}^{2} f(x)\,dx = 10$

$\Rightarrow 3(2 - 1) - \int_{1}^{2} f(x)\,dx = 10$

$\Rightarrow \int_{1}^{2} f(x)\,dx = -7$

Now,

$\int_{-3}^{2} f(x)\,dx = \int_{-3}^{1} f(x)\,dx + \int_{1}^{2} f(x)\,dx$

$5 = \int_{-3}^{1} f(x)\,dx - 7$

$\Rightarrow \int_{-3}^{1} f(x)\,dx = 12$

103. (C) In the expansion of $\left(x^3 - \frac{1}{2x^{\frac{3}{2}}}\right)^8$

$$T_{r+1} = {}^8C_r (x^3)^{8-r} \left(\frac{-1}{2x^{\frac{3}{2}}}\right)^r$$

$$T_{r+1} = {}^8C_r \left(\frac{-1}{2}\right)^r x^{\frac{48-9r}{2}}$$

Now, $\frac{48-9r}{2} = 6$

$\Rightarrow \; 48 - 9r = 12$

$\Rightarrow r = 4$

Now, Coefficient of $x^6 = {}^8C_4 \left(\frac{-1}{2}\right)^4$

Coefficient of $x^6 = \frac{8!}{4!4!} \times \frac{1}{16}$

Coefficient of $x^6 = \frac{35}{8}$

104. (B) $I = \int_0^{\frac{\pi}{4}} \frac{\delta(2x)}{\delta(2x) + \delta\left(\frac{\pi}{2} - 2x\right)} dx$ ...(i)

$$I = \int_0^{\frac{\pi}{4}} \frac{\delta\left[2\left(\frac{\pi}{4} - x\right)\right]}{\delta\left[2\left(\frac{\pi}{4} - x\right) + \delta\left[\frac{\pi}{2} - 2\left(\frac{\pi}{4} - x\right)\right]\right]} dx$$

$$I = \int_0^{\frac{\pi}{4}} \frac{\delta\left(\frac{\pi}{2} - 2x\right)}{\delta\left(\frac{\pi}{2} - 2x\right) + \delta(2x)} dx \quad \text{...(ii)}$$

from eq. (i) and eq. (ii)

$$2I = \int_0^{\frac{\pi}{4}} \frac{\delta(2x) + \delta\left(\frac{\pi}{2} - 2x\right)}{\delta(2x) + \delta\left(\frac{\pi}{2} - 2x\right)} dx$$

$$2I = \int_0^{\frac{\pi}{4}} 1.dx \Rightarrow 2I = [x]_0^{\frac{\pi}{4}}$$

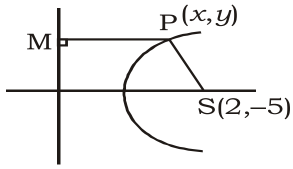
$$\Rightarrow 2I = \frac{\pi}{4} \Rightarrow I = \frac{\pi}{8}$$

105. (B) $[(A \cap B) \cup (C \cap D)]' = (A \cap B)' \cap (C \cap D)'$
$= (A' \cup B') \cap (C \cup D)'$

106. (C) $(A \cap \overline{B} \cap C)$

107. (D) We know that
15° < 45°
sin15° < sin45° and cos15° > cos 45°
sin15° < cos45°
Now, sin15° < cos45°< cos15°
then
sin15° < cos15°
Hence the value of (sin15° – cos15°) is negative but greater than – 1.

108. (B)



$x - 6y = 12$

We know that

$PS^2 = PM^2$

$$\Rightarrow \left[\sqrt{(x-2)^2 + (y+5)^2}\right]^2 = \left[\frac{x - 6y - 12}{\sqrt{(1)^2 + (-6)^2}}\right]^2$$

$\Rightarrow x^2 + 4 - 4x + y^2 + 25 + 10y$

$$= \frac{x^2 + 36y^2 + 144 - 12xy + 144y - 24x}{37}$$

On solving

$\Rightarrow 36x^2 + y^2 + 12xy - 124x + 929 = 0$

109. (A) $x = a\theta.\sin\theta$

$$\frac{dx}{d\theta} = a\theta.\cos\theta + a\sin\theta .1$$

$$\frac{dx}{d\theta} = a(\theta.\cos\theta + \sin\theta)$$

and $y = a\sin\theta.\cos\theta$

$$\frac{dy}{d\theta} = a\sin\theta.(-\sin\theta) + a\cos\theta.\cos\theta$$

$$\frac{dy}{d\theta} = a(\cos^2\theta - \sin^2\theta)$$

Now, $\frac{dy}{dx} = \frac{dy}{d\theta} \times \frac{d\theta}{dx}$

$$\frac{dy}{dx} = a(\cos^2\theta - \sin^2\theta) \times \frac{1}{a(\theta\cos\theta + \sin\theta)}$$

$$\frac{dy}{dx} = \frac{\cos 2\theta}{\theta\cos\theta + \sin\theta}$$

110. (B) One year = 365 days = 52 weeks and 1 day
S = {Mon, Tue, Wed, Thu, Fri, Sat, Sun}
$n(S) = 7$
E{Sun, Mon} $\Rightarrow n(E) = 2$

The required Probability $= \frac{n(E)}{n(S)} = \frac{2}{7}$

111. (B) Data 2, 3, 6, 8, 11, 12, 13, 5

$n = 8$

$\sum_{i=0}^{n} x_i = 2+3+6+8+11+12+13+5 = 60$

$\sum_{i=0}^{n} x_i^2 = 2^2 + 3^2 + 6^2 + 8^2 + 11^2 + 12^2 + 13^2 + 5^2 = 572$

$$\text{S.D } (\sigma) = \sqrt{\frac{\sum_{i=0}^{n} x_i^2}{n} - \left(\frac{\sum_{i=0}^{n} x_i}{n}\right)^2}$$

$$\text{S.D } (\sigma) = \sqrt{\frac{572}{8} - \left(\frac{60}{8}\right)^2}$$

$$\text{S.D } (\sigma) = \sqrt{\frac{572}{8} - \frac{225}{4}}$$

$$\text{S.D } (\sigma) = \sqrt{\frac{572-450}{8}}$$

$$\text{S.D } (\sigma) = \sqrt{\frac{122}{8}} = \sqrt{\frac{61}{4}}$$

Variance = $(\text{S.D})^2$

$$\text{Variance} = \left(\sqrt{\frac{61}{4}}\right)^2 = \frac{61}{4}$$

112. (C) Let two numbers are a and b.

A.T.Q.

$$\Rightarrow \frac{\frac{a+b}{2}}{\sqrt{ab}} = \frac{5}{4}$$

$$\Rightarrow \frac{a+b}{2\sqrt{ab}} = \frac{5}{4}$$

By Componendo and Dividendo Rule

$$\Rightarrow \frac{a+b+2\sqrt{ab}}{a+b-2\sqrt{ab}} = \frac{5+4}{5-4}$$

$$\Rightarrow \frac{(\sqrt{a}+\sqrt{b})^2}{(\sqrt{a}-\sqrt{b})^2} = \frac{9}{1} \Rightarrow \frac{\sqrt{a}+\sqrt{b}}{\sqrt{a}-\sqrt{b}} = \frac{3}{1}$$

by Componendo and Dividendo Rule

$$\Rightarrow \frac{\sqrt{a}+\sqrt{b}+\sqrt{a}-\sqrt{b}}{\sqrt{a}+\sqrt{b}-\sqrt{a}+\sqrt{b}} = \frac{3+1}{3-1}$$

$$\Rightarrow \frac{2\sqrt{a}}{2\sqrt{b}} = \frac{4}{2} \Rightarrow \sqrt{\frac{a}{b}} = \frac{2}{1}$$

$$\Rightarrow \frac{a}{b} = \frac{4}{1} \Rightarrow \text{a : b} = 4 : 1$$

113. (D) Equation of line

$5x + 9y = 9$

Equation of line which is perpendicular to the given line

$9x - 5y = c$ ...(i)

Now,

mid-point of two points (–2, 3) and (–4, –8)

$$= \left(\frac{-2-4}{2}, \frac{3-8}{2}\right) = \left(-3, \frac{-5}{2}\right)$$

eq. (i) passes through the point $\left(-3, \frac{-5}{2}\right)$

$$9(-3) - 5\left(\frac{-5}{2}\right) = C - 27 + \frac{25}{2} = C \Rightarrow C = \frac{-29}{2}$$

From eq. (i)

$$9x - 5y = \frac{-29}{2}$$

$18x - 10y + 29 = 0$

114. (B) $I = \int \frac{x^4 + x + 1}{x^2 + 1} dx$

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

$$I = \int x^2 .dx - \int 1.dx + \frac{1}{2} \int \frac{2x}{x^2+1} dx + \int \frac{2}{x^2+1} dx + \text{C}$$

$$I = \frac{x^3}{3} - x + \frac{1}{2} \log(x^2 + 1) + 2\tan^{-1}x + C$$

$$I = \frac{x^3}{3} - x + \log\sqrt{x^2 + 1} + 2\tan^{-1}x + C$$

115. (A) A.M. $\geq$ G.M. $\geq$ H.M.

116. (C) $\frac{\log_{27} 3 \times \log_{16} 2}{\log_{64} 4}$

$$\Rightarrow \frac{\frac{1}{\log_3 27} \times \frac{1}{\log_2 16}}{\frac{1}{\log_4 64}}$$

$$\Rightarrow \frac{\frac{1}{3\log_3 3} \times \frac{1}{4\log_2 2}}{\frac{1}{3\log_4 4}}$$

$$\Rightarrow \frac{\frac{1}{3} \times \frac{1}{4}}{\frac{1}{3}} = \frac{1}{4}$$

117. (B) $I = \int_0^{2\pi} |\sin x|\, dx$

$I = 2\int_0^{\pi} |\sin x|\, dx$ [∵ function is periodic.]

$I = -2[\cos x]_0^{\pi}$

$I = -2[\cos\pi - \cos 0]$

$I = -2[-1 - 1] = 4$

118. (C)

Class	x	f	$f \times x$
0-3	1.5	5	7.5
3-6	4.5	6	27.0
6-9	7.5	12	90.0
9-12	10.5	15	157.5
12-15	13.5	18	243.0
15-18	16.5	4	66.0

$\Sigma f = 60$, $\Sigma f \times x = 591$

Mean = $\dfrac{\Sigma f \times x}{\Sigma f}$

Mean = $\dfrac{591}{60} = 9.85$

119. (A) $y = \sin^{-1}(e^{x\log x})$

$\Rightarrow y = \sin^{-1}(e^{\log x^x})$

$\Rightarrow y = \sin^{-1}(x^x)$ ...(i)

Let $x^x = z$

taking log both side

$\Rightarrow x \log x = \log z$

On differentiating both side w.r.t. x.

$\Rightarrow x \times \dfrac{1}{x} + \log x = \dfrac{1}{z}\dfrac{dz}{dx}$

$\Rightarrow \dfrac{dz}{dx} = x^x(1 + \log x)$ ...(ii)

from eq. (i)

$\Rightarrow y = \sin^{-1} z$

On differentiating both side w.r.t . 'z'

$\Rightarrow \dfrac{dy}{dz} = \dfrac{1}{\sqrt{1-z^2}} = \dfrac{1}{\sqrt{1-x^{2x}}}$

Now, $\dfrac{dy}{dx} = \dfrac{dy}{dz} \times \dfrac{dz}{dx}$

$\dfrac{dy}{dx} = \dfrac{1}{\sqrt{1-x^{2x}}} \times \dfrac{1}{x^x(1+\log x)}$

$\dfrac{dy}{dx} = \dfrac{1}{x^x(1+\log x)\sqrt{1-x^{2x}}}$

120. (B) $x = 7 + 7^{\frac{1}{3}} + 7^{\frac{2}{3}}$

$\Rightarrow x - 7 = 7^{\frac{1}{3}} + 7^{\frac{2}{3}}$ ....(i)

$\Rightarrow (x-7)^3 = (7^{\frac{1}{3}} + 7^{\frac{2}{3}})^3$

$\Rightarrow x^3 - 243 - 3 \times x \times 7(x-7)$

$= 7 + 7^2 + 3 \times 7^{\frac{1}{3}} \times 7^{\frac{2}{3}}(7^{\frac{1}{3}} \times 7^{\frac{2}{3}})$

$\Rightarrow x^3 - 243 - 21x^2 + 147x = 56 + 21(x-7)$

$\Rightarrow x^3 - 243 - 21x^2 + 147x = 56 + 21x - 147$

$\Rightarrow x^3 - 21x^2 + 126x = 152$

$\Rightarrow x^3 - 21x^2 + 126x + 8 = 152 + 8$

$\Rightarrow x^3 - 21x^2 + 126x + 8 = 160$

■■■

NDA (MATHS) MOCK TEST - 102 (Answer Key)

1.	(B)	21.	(C)	41.	(B)	61.	(A)	81.	(B)	101.	(B)
2.	(C)	22.	(A)	42.	(D)	62.	(C)	82.	(C)	102.	(A)
3.	(C)	23.	(B)	43.	(D)	63.	(C)	83.	(D)	103.	(C)
4.	(A)	24.	(B)	44.	(C)	64.	(B)	84.	(A)	104.	(B)
5.	(C)	25.	(D)	45.	(B)	65.	(A)	85.	(A)	105.	(B)
6.	(A)	26.	(A)	46.	(A)	66.	(D)	86.	(C)	106.	(C)
7.	(D)	27.	(C)	47.	(B)	67.	(C)	87.	(D)	107.	(D)
8.	(C)	28.	(C)	48.	(B)	68.	(B)	88.	(B)	108.	(B)
9.	(C)	29.	(B)	49.	(C)	69.	(C)	89.	(C)	109.	(A)
10.	(B)	30.	(B)	50.	(B)	70.	(A)	90.	(D)	110.	(B)
11.	(B)	31.	(D)	51.	(A)	71.	(B)	91.	(A)	111.	(B)
12.	(A)	32.	(B)	52.	(B)	72.	(C)	92.	(C)	112.	(C)
13.	(B)	33.	(D)	53.	(C)	73.	(D)	93.	(C)	113.	(D)
14.	(D)	34.	(B)	54.	(B)	74.	(A)	94.	(B)	114.	(B)
15.	(C)	35.	(C)	55.	(D)	75.	(C)	95.	(B)	115.	(A)
16.	(C)	36.	(A)	56.	(C)	76.	(B)	96.	(B)	116.	(C)
17.	(C)	37.	(B)	57.	(A)	77.	(B)	97.	(C)	117.	(B)
18.	(A)	38.	(C)	58.	(B)	78.	(C)	98.	(C)	118.	(C)
19.	(A)	39.	(D)	59.	(B)	79.	(A)	99.	(A)	119.	(A)
20.	(B)	40.	(C)	60.	(B)	80.	(A)	100.	(A)	120.	(B)

Note : *If your opinion differ regarding any answer, please message the mock test and Question number to 8860330003*

Note : *If you face any problem regarding result or marks scored, please contact : 9313111777*

Note : *Whatsapp with Mock Test No. and Question No. at 705360571 for any of the doubts. Join the group and you may also share your sugesstions and experience of Sunday Mock Test.*