# NDA 2020: Solution

1. Ans. C.

Maximum number of points of intersection of n non-overlapping circles = $2 \times {}^nC_2$

Here, n = 5

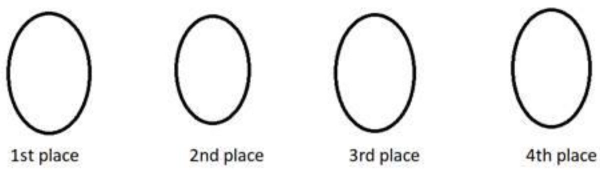
Hence, Maximum number of points of intersection of 5 non-overlapping circles = $2 \times {}^5C_2 = 2 \times \frac{5 \times 4 \times 3!}{2! \times 3!} = 20$

2. Ans. B.

Consider word : ABLE

Vowels : A , E

Consonants : B , L




If vowels can take only even place then first fix vowels at even places.

Then consonants can be arranged in two ways:

| 1st place | 3rd place |
|---|---|
| B | L |
| L | B |

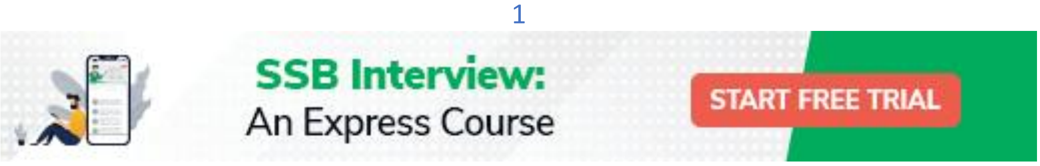
Also , these vowels can also be arranged in two ways.

Hence, Required Number of ways = $2 \times 2 = 4$

3. Ans. C.

$A = \begin{bmatrix} a & h & g \\ h & b & f \\ g & f & c \end{bmatrix}$ and $B = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$,





AB = $\begin{bmatrix} a & h & g \\ h & b & f \\ g & f & c \end{bmatrix} . \begin{bmatrix} x \\ y \\ z \end{bmatrix}$ = $\begin{bmatrix} ax+hy+gz \\ hx+by+fz \\ gx+fy+cz \end{bmatrix}$

4. Ans. D.

$\begin{vmatrix} i & i^2 & i^3 \\ i^4 & i^6 & i^8 \\ i^9 & i^{12} & i^{15} \end{vmatrix}$

We know that $i^2 = -1$

$\Rightarrow \begin{vmatrix} i & -1 & -i \\ 1 & -1 & 1 \\ i & 1 & -i \end{vmatrix}$

Operating $C_1 \to C_1 + C_2$

$\Rightarrow \begin{vmatrix} i-1 & -1 & -i \\ 0 & -1 & 1 \\ i+1 & 1 & -i \end{vmatrix}$

Operating $C_3 \to C_2 + C_3$

$\Rightarrow \begin{vmatrix} i-1 & -1 & -1-i \\ 0 & -1 & 0 \\ i+1 & 1 & 1-i \end{vmatrix}$

Expanding this determinant along $R_2$

$\Rightarrow -1\left|(i-1)(1-i)-(i+1)(-1-i)\right|$

$\Rightarrow -1\left|i+1-1+i+i-1+1+i\right| = -4i$

5. Ans. C.

S = {1, 2, 3, …)

A relation R on S × S is defined by xRy if $\log_a x > \log_a y$ when $a = \frac{1}{2}$.

Reflexive :

$\log_{\frac{1}{2}}(x)$ is not greater than $\log_{\frac{1}{2}}(x)$



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$\Rightarrow$ $(x,x) \notin R$ for any $x \in S$

⇒ R is not Reflexive.

Symmetric :

Let (x,y) belongs to relation R.

$\Rightarrow$ $\log_{\frac{1}{2}}(x) > \log_{\frac{1}{2}}(y)$

$\Rightarrow$ $\log_{\frac{1}{2}}(y)$ can not greater than $\log_{\frac{1}{2}}(x)$

$\Rightarrow$ $(y,x) \notin R$

⇒ R is not symmetric.

Transitive :

Let (x,y) and (y,z) belongs to relation R.

$\Rightarrow$ $\log_{\frac{1}{2}}(x) > \log_{\frac{1}{2}}(y)$ …………(1)

$\Rightarrow$ $\log_{\frac{1}{2}}(y) > \log_{\frac{1}{2}}(z)$ ……………….(2)

From (1) and (2)

$\Rightarrow$ $\log_{\frac{1}{2}}(x) > \log_{\frac{1}{2}}(z)$

⇒ (x,z) belongs to R.

⇒ Hence, R is transitive.

6. Ans. D.

Given : $1.5 \le x \le 4.5$

=> $\frac{3}{2} \le x \le \frac{9}{2}$

=> $\frac{3}{2} \le x$ and $x \le \frac{9}{2}$

=> $2x - 3 \ge 0$ and $2x - 9 \le 0$



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⇒ (2x − 3) (2x − 9) ≤ 0

7. Ans. B.

It is given that AB = C

⇒ $\begin{bmatrix} x+y & y \\ 2x & x-y \end{bmatrix} \cdot \begin{bmatrix} 2 \\ -1 \end{bmatrix} = \begin{bmatrix} 3 \\ 2 \end{bmatrix}$

⇒ $\begin{bmatrix} 2x+2y-y \\ 4x-x+y \end{bmatrix} = \begin{bmatrix} 3 \\ 2 \end{bmatrix}$

⇒ $\begin{bmatrix} 2x+y \\ 3x+y \end{bmatrix} = \begin{bmatrix} 3 \\ 2 \end{bmatrix}$

We know that two matrix are equal when corresponding elements of both matrix are equal.

⇒ $2x + y = 3$...............(1)

⇒ $3x + y = 2$...............(2)

Subtract (1) from (2)

⇒ x = -1

Put the value of x in (1)

⇒ y = 5

Hence, A = $\begin{bmatrix} 4 & 5 \\ -2 & -6 \end{bmatrix}$

Now, $|A| = \begin{vmatrix} 4 & 5 \\ -2 & -6 \end{vmatrix}$

⇒ $|A| = \begin{vmatrix} 4 & 5 \\ -2 & -6 \end{vmatrix} = -24 + 10 = -14$

8. Ans. C.



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$x=\log_c(ab)$, y = $\log_a$ (bc), z = $\log_b$ (ca)

$\Rightarrow x=\dfrac{\log ab}{\log c}$

$\Rightarrow x+1=\dfrac{\log ab}{\log c}+1$

$\Rightarrow x+1=\dfrac{\log ab+\log c}{\log c}=\dfrac{\log abc}{\log c}$

$\Rightarrow \dfrac{1}{x+1}=\dfrac{\log c}{\log abc}$ …….(1)

Similarly,

$\Rightarrow \dfrac{1}{y+1}=\dfrac{\log a}{\log abc}$ ……………….(2)

$\Rightarrow \dfrac{1}{z+1}=\dfrac{\log b}{\log abc}$ ……….(3)

Adding (1) , (2) and (3)

$\Rightarrow (1+x)^{-1}+(1+y)^{-1}+(1+z)^{-1}=\dfrac{\log a}{\log abc}+\dfrac{\log b}{\log abc}+\dfrac{\log c}{\log abc}$

$\Rightarrow (1+x)^{-1}+(1+y)^{-1}+(1+z)^{-1}=\dfrac{\log a+\log b+\log c}{\log abc}$

$\Rightarrow (1+x)^{-1}+(1+y)^{-1}+(1+z)^{-1}=\dfrac{\log abc}{\log abc}=1$

9. Ans. A.

Consider $\frac{1}{10}\log_5 1024-\log_5 10+\frac{1}{5}\log_5 3125$

$\Rightarrow \log_5(1024)^{\frac{1}{10}}-\log_5(10)+\log_5(3125)^{\frac{1}{5}}$

$\Rightarrow \log_5(2)^{10\times\frac{1}{10}}-\log_5(10)+\log_5(5)^{5\times\frac{1}{5}}$



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$\Rightarrow \log_5(2) - \log_5(10) + \log_5(5) = \log_5\left(\frac{2\times 5}{10}\right) = \log_5(1) = 0$

10. Ans. C.

$(1101101 + 1011011)_2 = (11001000)_2$

Now $(11001000)_2 = \left(1\times 2^7 + 1\times 2^6 + 0\times 2^5 + +0\times 2^4 + 1\times 2^3 + +0\times 2^2 + +0\times 2^1 + +0\times 2^0\right)_{10}$

$\Rightarrow (128+64+8)_{10} = (200)_{10}$

11. Ans. D.

If matrix $\begin{bmatrix} 0 & k & 4 \\ -k & 0 & -5 \\ -k & k & -1 \end{bmatrix}$ is singular then

$\Rightarrow \begin{vmatrix} 0 & k & 4 \\ -k & 0 & -5 \\ -k & k & -1 \end{vmatrix} = 0$

$\Rightarrow -k(k-5k) + 4(-k^2) = 0$

$\Rightarrow 4k^2 - 4k^2 = 0$

$\Rightarrow 0 = 0$

As value of determinant will always be zero irrespective of value of k.

So, k can take infinite number of values.

12. Ans. C.

If C(20, n+2) = C(20, n − 2)..............(1)

We know that if ${}^nC_x = {}^nC_y$

$\Rightarrow n = x + y$

From (1)

$\Rightarrow 20 = n+2 + n -2$

$\Rightarrow 20 = 2n$



$\Rightarrow$ n = 10

13. Ans. B.

Given $(1 + 2x - x^2)^6 = a_0 + a_1x + a_2x^2 + \ldots + a_{12}x^{12}$

Put x = -1

$$\left(1 + 2(-1) - (-1)^2\right)^6 = a_0 + a_1(-1) + a_2(-1)^2 + \ldots + a_{12}(-1)^{12}$$

$a_0 - a_1 + a_2 - a_3 + a_4 - \ldots + a_{12} = \left(1 + 2(-1) - (-1)^2\right)^6 = 64$

14. Ans. A.

Consider $\left(\frac{2}{x^2} - \sqrt{x}\right)^{10}$

We know that $T_{r+1} = {}^{10}C_r \left(\frac{2}{x^2}\right)^{10-r} \left(-\sqrt{x}\right)^r$

$$T_{r+1} = -{}^{10}C_r (2)^{10-r}\left(\frac{1}{x^{20-2r}}\right)(x)^{\frac{r}{2}} = -{}^{10}C_r (2)^{10-r}\left(\frac{1}{x^{20-2r}}\right)(x)^{\frac{r}{2}} = -{}^{10}C_r (2)^{10-r} x^{-20+2r+\frac{r}{2}} = -{}^{10}C_r (2)^{10-r} x^{-20+\frac{5r}{2}}$$

In order to find independent term of x: $-20 + \frac{5r}{2} = 0$

$\Rightarrow \frac{5r}{2} = 20$

$\Rightarrow r = 8$

Now , $T_{8+1} = {}^{10}C_8 (2)^2 = \frac{10 \times 9 \times 8!}{8! \times (10-8)!} \times (2)^2 = 180$

15. Ans. C.

A square matrix with complex entries is called Hermitian matrix if its conjugate transpose is equal to the original matrix.

Consider $A = \begin{bmatrix} 1-i & i \\ -i & 1-i \end{bmatrix}$

$$\overline{A} = \begin{bmatrix} 1+i & -i \\ i & 1+i \end{bmatrix}$$



$\overline{A^T} = \begin{bmatrix} 1+i & i \\ -i & 1+i \end{bmatrix}$ ..............(1)

As, $A \neq \overline{A^T}$

Hence, A is not Hermitian matrix.

A square matrix with complex entries is called skew-Hermitian matrix if its conjugate transpose is equal to the negative of the original matrix.

$-A = \begin{bmatrix} -1+i & -i \\ i & -1+i \end{bmatrix}$ .............(2)

From (1) and (2)

As, $-A \neq \overline{A^T}$

Hence, A is not skew-Hermitian matrix.

Now, consider $\left(\overline{A}\right)^T + A = \begin{bmatrix} 1+i & i \\ -i & 1+i \end{bmatrix} + \begin{bmatrix} 1-i & i \\ -i & 1-i \end{bmatrix} = \begin{bmatrix} 2 & 2i \\ -2i & 2 \end{bmatrix}$

Let $\left(\overline{A}\right)^T + A = B$

$B = \begin{bmatrix} 2 & 2i \\ -2i & 2 \end{bmatrix}$

$\Rightarrow \overline{B} = \begin{bmatrix} 2 & -2i \\ 2i & 2 \end{bmatrix}$

$\Rightarrow \overline{B^T} = \begin{bmatrix} 2 & 2i \\ -2i & 2 \end{bmatrix}$

As, $B = \overline{B^T}$

Hence, $\left(\overline{A}\right)^T + A$ is Hermitian matrix.

16. Ans. A.

Let $z = \frac{1-i\sqrt{3}}{1+i\sqrt{3}}$



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$$z = \frac{1-i\sqrt{3}}{1+i\sqrt{3}} = \frac{1-i\sqrt{3}}{1+i\sqrt{3}} \times \frac{1-i\sqrt{3}}{1-i\sqrt{3}} = \frac{\left(1-i\sqrt{3}\right)^2}{1+3} = \frac{1+3i^2-2\sqrt{3}i}{4} = \frac{-2-2\sqrt{3}}{4} = -\frac{1}{2}-\frac{\sqrt{3}}{2}i$$

Clearly, z lies in 3rd quadrant.

arg(z) =

$$180^\circ + \tan^{-1}\left(\frac{b}{a}\right) = 180^\circ + \tan^{-1}\left(\frac{-\frac{\sqrt{2}}{2}}{-\frac{1}{2}}\right) = 180^\circ + \tan^{-1}\left(\frac{-\frac{\sqrt{3}}{2}}{-\frac{1}{2}}\right) = 180^\circ + \tan^{-1}\left(\sqrt{3}\right) = 180^\circ + 60^\circ = 240^\circ$$

17. Ans. D.

Consider following two relations:

$\alpha + \beta = \alpha^2 + \beta^2$ ..........(1)

and

$\alpha\beta = \alpha^2\beta^2$..............(2)

First of all we will find values of $\alpha$ and $\beta$ using hit and trial such that both above mentioned relations are satisfied.

**Case 1:** $\alpha = 1, \beta = 0$

Sum of roots = 1

Product of roots = 0

Equation:

$$x^2 - (\text{Sum of roots})x + (\text{Product of roots}) = 0$$

$\Rightarrow$ $x^2 - x = 0$

**Case 2:** $\alpha = 0, \beta = 0$

Sum of roots = 0

Product of roots = 0

Equation:

$$x^2 - (\text{Sum of roots})x + (\text{Product of roots}) = 0$$



$\Rightarrow$ $x^2 = 0$

**Case 3:** Case:2 : $\alpha = 1, \beta = 1$

Sum of roots = 2

Product of roots = 1

Equation:

$x^2 - (\text{Sum of roots})x + (\text{Product of roots}) = 0$

$\Rightarrow$ $x^2 - 2x + 1 = 0$

**Case 4:** $\alpha = \omega, \beta = \omega^2$

Sum of roots = $\omega + \omega^2 = -1$

Product of roots = $\omega.\omega^2 = \omega^3 = 1$

Equation:

$x^2 - (\text{Sum of roots})x + (\text{Product of roots}) = 0$

$\Rightarrow$ $x^2 - x + 1 = 0$

So total number of possible equations = 4

18. Ans. B.

cot α and cot β are the roots of the equation $x^2 - 3x + 2 = 0$

$$\cot\alpha + \cot\beta = \frac{-(-3)}{1} = 3$$

$$\cot\alpha.\cot\beta = \frac{2}{1} = 2$$

$$\Rightarrow \cot(\alpha+\beta) = \frac{\cot\alpha.\cot\beta - 1}{\cot\alpha + \cot\beta} = \frac{2-1}{3} = \frac{1}{3}$$

19. Ans. C.

Given $p^2$, $q^2$ and $r^2$ (where p, q, r > 0) are in GP

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$\Rightarrow \frac{q^2}{p^2} = \frac{r^2}{q^2}$

$\Rightarrow \frac{q}{p} = \frac{r}{q}$ …………………(1)

⇒ p, q and r are in GP.

From (1)

$\Rightarrow \frac{q}{p} = \frac{r}{q}$

Taking logarithm

$\Rightarrow \log\left(\frac{q}{p}\right) = \log\left(\frac{r}{q}\right)$

$\Rightarrow \log q - \log p = \log r - \log q$

$\Rightarrow 2\log q = \log p + \log r$

⇒ ln p, ln q and ln r are in AP.

20. Ans. C.

A is a matrix of order 3 × 5 and B is a matrix of order 5 × 3

Then order of AB = 3 × 3

B is a matrix of order 5 × 3 and A is a matrix of order 3 × 5

Then order of BA = 5 × 5

21. Ans. C.

If sin x + sin y = cos y – cos x

$\Rightarrow 2\sin\left(\frac{x+y}{2}\right)\cos\left(\frac{x-y}{2}\right) = 2\sin\left(\frac{x+y}{2}\right)\sin\left(\frac{x-y}{2}\right)$

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



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22. Ans. D.

sin(α + 1°) + cos(β + 1°) =

$$\sin(15^\circ+1^\circ)+\cos(15^\circ+1^\circ)=\sin 16^\circ+\cos 16^\circ=\sqrt{2}\left[\frac{1}{\sqrt{2}}\sin 16^\circ+\frac{1}{\sqrt{2}}\cos 16^\circ\right]=\sqrt{2}\left[\cos 45^\circ \sin 16^\circ+\sin 45^\circ \cos 16^\circ\right]$$

= $\sqrt{2}\left[\sin 61^\circ\right]$ =

$$\sqrt{2}\left[\sin 61^\circ\right]=\sqrt{2}\left[\sin(60^\circ+1^\circ)\right]=\sqrt{2}\left[\sin 60^\circ \cos 1^\circ+\cos 60^\circ \sin 1^\circ\right]$$

$$=\sqrt{2}\left[\frac{\sqrt{3}}{2}\cos 1^\circ+\frac{1}{2}\sin 1^\circ\right]=\frac{\sqrt{2}}{2}\left[\sqrt{3}\cos 1^\circ+\sin 1^\circ\right]$$

$$=\frac{1}{\sqrt{2}}\left(\sqrt{3}\cos 1^\circ+\sin 1^\circ\right)$$

23. Ans. D.

sin 7α - cos 7β = $\sin 105^\circ-\cos 105^\circ=\sin(90^\circ+15^\circ)-\cos(90^\circ+15^\circ)=\cos 15^\circ+\sin 15^\circ$

Now, $\sin 15^\circ+\cos 15^\circ=\sin 15^\circ+\cos(90^\circ-75^\circ)=\sin 15^\circ+\sin 75^\circ$

We know that $\sin C+\sin D=2\sin\left(\frac{C+D}{2}\right)\cos\left(\frac{C-D}{2}\right)$

Hence, $\sin 15^\circ+\sin 75^\circ$ = $2\sin\left(\frac{15^\circ+75^\circ}{2}\right)\cos\left(\frac{15^\circ-75^\circ}{2}\right)=2\sin 45^\circ \cos 30^\circ$ =

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

24. Ans. D.

sin α + cos β = $\sin 15^\circ+\cos 15^\circ=\sin 15^\circ+\cos(90^\circ-75^\circ)=\sin 15^\circ+\sin 75^\circ$

We know that $\sin C+\sin D=2\sin\left(\frac{C+D}{2}\right)\cos\left(\frac{C-D}{2}\right)$



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Hence, $\sin 15^\circ + \sin 75^\circ$ = $2\sin\left(\frac{15^\circ+75^\circ}{2}\right)\cos\left(\frac{15^\circ-75^\circ}{2}\right) = 2\sin 45^\circ \cos 30^\circ$ = $2\times\frac{1}{\sqrt{2}}\times\frac{\sqrt{3}}{2}=\frac{\sqrt{3}}{\sqrt{2}}$

25. Ans. C.

$t_{10} = \sin^{10} 45^\circ + \cos^{10} 45^\circ$ = $\left(\frac{1}{\sqrt{2}}\right)^{10}+\left(\frac{1}{\sqrt{2}}\right)^{10} = 2\times\frac{1}{2^5}=\frac{1}{2^4}$ = $\frac{1}{16}$

26. Ans. B.

Consider $t_1^2 - t_2$ = $(\sin\theta+\cos\theta)^2-(\sin^2\theta+\cos^2\theta)$

$\Rightarrow$ $1+2\sin\theta\cos\theta-1$

$\Rightarrow$ $\sin 2\theta$

27. Ans. A.

Consider $t_n = \sin^n \theta + \cos^n \theta$.

Now, $\frac{t_3-t_5}{t_5-t_7}$ = $\frac{\sin^3\theta+\cos^3\theta-\sin^5\theta-\cos^5\theta}{\sin^5\theta+\cos^5\theta-\sin^7\theta-\cos^7\theta}$

$\Rightarrow$ $\frac{\sin^3\theta(1-\sin^2\theta)+\cos^3\theta(1-\cos^2\theta)}{\sin^5\theta(1-\sin^2\theta)+\cos^5\theta(1-\cos^2\theta)}$

$\Rightarrow$ $\frac{\sin^3\theta(\cos^2\theta)+\cos^3\theta(\sin^2\theta)}{\sin^5\theta(\cos^2\theta)+\cos^5\theta(\sin^2\theta)}$

$\Rightarrow$ $\frac{\sin^2\theta\cos^2\theta(\sin\theta+\cos\theta)}{\sin^2\theta\cos^2\theta(\sin^3\theta+\cos^3\theta)}$

$\Rightarrow$ $\frac{t_1}{t_3}$

28. Ans. B.

p tan x = q tan y

$\Rightarrow$ $\frac{p}{q}=\frac{\tan y}{\tan x}$



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$\Rightarrow \frac{p^2}{q^2} = \frac{\tan^2 x}{\tan^2 y}$ .............(1)

Now, a $\sin^2 x$ + b $\cos^2 x$ =c..............(2)

From (2)

$\Rightarrow$ $a \sin^2 x + b(1 - \sin^2 x) = c$

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

$\Rightarrow$ $\sin^2 x(a - b) = c - b$

$\Rightarrow$ $\sin^2 x = \frac{c - b}{a - b}$

From (2)

$\Rightarrow$ $a(1 - \cos^2 x) + b \cos^2 x = c$

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

$\cos^2 x = \frac{c - a}{b - a}$

Hence, $\tan^2 x = \frac{\sin^2 x}{\cos^2 x} = \frac{\frac{c-b}{a-b}}{\frac{c-a}{b-a}} = \frac{c - b}{a - c}$ ...............(3)

Consider b $\sin^2 y$ + a $\cos^2 y$ = d.............(4)

From (4)

$\Rightarrow$ $b \sin^2 y + a(1 - \sin^2 y) = d$

$\Rightarrow$ $b \sin^2 y + a - a \sin^2 y = d$

$\Rightarrow$ $\sin^2 y(b - a) = d - a$

$\Rightarrow$ $\sin^2 y = \frac{d - a}{b - a}$

From (4)



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$\Rightarrow b\left(1-\cos^2 y\right)+a\cos^2 y=d$

$\Rightarrow b-b\cos^2 y+a\cos^2 y=d$

$\cos^2 y=\frac{d-b}{a-b}$

Divide (2) by (3)

$\Rightarrow \frac{d-a}{b-d}$ = $\tan^2$ y………………(5)

From (3) and (5)

$\Rightarrow \frac{p^2}{q^2}=\frac{\tan^2 x}{\tan^2 y}=\frac{(a-d)(c-a)}{(b-c)(d-b)}$

29. Ans. C.

Consider b $\sin^2$y + a $\cos^2$y = d…………..(1)

From (1)

$\Rightarrow b\sin^2 y+a\left(1-\sin^2 y\right)=d$

$\Rightarrow b\sin^2 y+a-a\sin^2 y=d$

$\Rightarrow \sin^2 y\left(b-a\right)=d-a$

$\Rightarrow \sin^2 y=\frac{d-a}{b-a}$ ……………..(2)

From (1)

$\Rightarrow b\left(1-\cos^2 y\right)+a\cos^2 y=d$

$\Rightarrow b-b\cos^2 y+a\cos^2 y=d$

$\cos^2 y=\frac{d-b}{a-b}$ …………….(3)

Divide (2) by (3),

$\Rightarrow \frac{d-a}{b-d}$ = $\tan^2$ y



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30. Ans. A.

a $\sin^2 x$ + b $\cos^2 x$ =c..............(1)

From (1)

$\Rightarrow$ $a\sin^2 x + b\left(1-\sin^2 x\right) = c$

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

$\Rightarrow$ $\sin^2 x\left(a-b\right) = c-b$

$\Rightarrow$ $\sin^2 x = \dfrac{c-b}{a-b}$

From (1)

$\Rightarrow$ $a\left(1-\cos^2 x\right) + b\cos^2 x = c$

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

$\cos^2 x = \dfrac{c-a}{b-a}$

Hence, $\tan^2 x = \dfrac{\sin^2 x}{\cos^2 x} = \dfrac{\frac{c-b}{a-b}}{\frac{c-a}{b-a}} = \dfrac{c-b}{a-c}$

31. Ans. B.

We know that intercept form of the equation of plane

$$\frac{x}{a}+\frac{y}{b}+\frac{z}{c}=1$$

*in* question it is given that the value of intercept of z axis is c=5

and xy axis is parallel so it means x=0,y=0

Therefore $\dfrac{0}{a}+\dfrac{0}{b}+\dfrac{z}{5}=1$

z=5

32. Ans. C.

The eight compartments of the coordinate planes divide the space.

Eight compartments which are known as eight octants and since each



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of the coordinates of a point in them may be positive or negative, there are

$2^3$ =8 points whose coordinate have the same numerical values.

33. Ans. D.

*There* given direction ratio are a+b,b+a,c+a

Now, Direction ratios are

$$\frac{a+b}{\sqrt{(a+b)^2+(b+a)^2+(c+a)^2}},\frac{b+a}{\sqrt{(a+b)^2+(b+a)^2+(c+a)^2}},\frac{c+a}{\sqrt{(a+b)^2+(b+a)^2+(c+a)^2}}$$

according to question sum of square of direction cosines

$$\left[\frac{a+b}{\sqrt{(a+b)^2+(b+a)^2+(c+a)^2}}+\frac{b+a}{\sqrt{(a+b)^2+(b+a)^2+(c+a)^2}}+\frac{c+a}{\sqrt{(a+b)^2+(b+a)^2+(c+a)^2}}\right]^2$$

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

$$=\frac{(a+b)^2+(b+a)^2+(c+a)^2}{(a+b)^2+(b+a)^2+(c+a)^2}=1$$

We know that the sum of the square of its direction cosine are 1.

$$\cos^2\alpha+\cos^2\beta+\cos^2\gamma=1$$

34. Ans. B.

The coordinate of general point on $\frac{x-0}{1}=\frac{y-0}{0}=\frac{z-0}{0}=\lambda$

*i.e* x=$\lambda$,y=0,z=0

Let the coordinate of L be$(\lambda,0,0)$

*Direction* ratio of PL are

$\lambda$-2,-3,-4

Direction of given line are 1,0,0

Since PL is perpendicular to the given line

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

$\lambda$=2,L(2,0,0)

PL=$\sqrt{(2-2)^2+(0+3)^2+(0+4)^2}=\sqrt{25}=5$ units

35. Ans. D.

Let 'r' be the radius of the sphere in the given plane.

Hence r can be defined by-



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$$r=\frac{ax_1+by_2+cz_1+d}{\sqrt{a^2+b^2+c^2}}$$
$$r=\frac{6+6+6-4}{\sqrt{6^2+3^2+2^2}}$$
$$r=\frac{14}{\sqrt{49}}$$
$$r=2units$$

So, $diameter=2\times radius=4units$

36. Ans. D.

We know that Mean= Sum of all observation/Total number of observation

It is given that a data of n observation has mean 2M so this can be written as,

$$2M=\frac{Sum \text{ of all observation}}{n}$$
$$sum \text{ of all observation } =2\text{Mn}$$

While another data set 2n observation has mean M

So,

Sum of all observation =2Mn

Then the mean of the combined data set of 3n observation will be

$$\bar{x}=\frac{2Mn+2Mn}{n+2n}$$
$$\bar{x}=\frac{4Mn}{3n}$$
$$\bar{x}=\frac{4M}{3}$$

37. Ans. D.

Deviation of an observation from 2.5 will be defined as=2.5-(that particular observation)

Hence according to the given conditions we can evaluate the following two equations-

$$2.5n-\sum_{i=1}^{n}x_i=-50 \qquad ...i$$

$$3.5n-\sum_{i=1}^{n}x_i=50 \qquad ...ii$$



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After subtracting eqn. (i) from eqn. (ii)

n=100.

38. Ans. C.

$$\begin{aligned} &Given\ \text{that}\ P(A\cup B)=\frac{5}{6}\\ &P(A\cap B)=\frac{1}{3}\\ &P(\overline{A})=\frac{1}{2}\\ &P(\overline{A})=1-P(A)\\ &P(A)=\frac{1}{2}\\ &P(A\cup B)=P(A)+P(B)-P(A\cap B)\\ &\frac{5}{6}=\frac{1}{2}+P(B)-\frac{1}{3}\\ &P(B)=\frac{2}{3} \end{aligned}$$

P(A) P(B)= $\frac{1}{2}\times\frac{2}{3}$ = $\frac{1}{3}$

P(A)+P(B)= $\frac{1}{2}+\frac{2}{3}=\frac{7}{6}>A\cup B=\frac{5}{6}$ >

39. Ans. C.

When three dice are rolled then

let S be the sample and A be the event occurrence of one face having the number

$$n(S)=6\times5\times4=120$$

$$\begin{aligned} n(A)&=n\left(1^{st}\ dice\ shown 6\right)+n\left(2^{nd}\ dice\ shown 6\right)+n\left(3^{rd}\ dice\ shown 6\right)\\ &=(1\times5\times4)+(5\times1\times4)+(5\times4\times1)\\ &=60 \end{aligned}$$

Hence required probability $=\frac{n(A)}{n(S)}=\frac{60}{120}=\frac{1}{2}$

40. Ans. B.

According to question arithmetic mean =6



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It means

$$\frac{4x+9(x-1)}{x+x-1}=6$$
$$\Rightarrow \frac{4x+9x-9}{x+x-1}=6$$
$$\Rightarrow \frac{13x-6}{2x-1}=6$$
$$\Rightarrow 13x-9=12x-6$$
$$\Rightarrow x=-6+9$$
$$x=3$$

41. Ans. D.

Here ABCD is rectangle which have


Length AB=l and breadth BC=b

Let area is y

$l+b=k$

$l=k-b$ (given)

Now, area $y=lb=l\left(k-l\right)=kl-l^2$

For maximum area y,

$$\frac{dy}{dl}=0......(i)$$
$$k-2l=0$$
$$l=\frac{k}{2}$$

When differentiating eqn (i) $\frac{dy^2}{dl^2}=-2<0$

Hence y has maximum value when $l=\frac{k}{2}$



$\Rightarrow \; b = \frac{k}{2} \therefore$ maximum area $\frac{k}{2} . \frac{k}{2} = \frac{k^2}{4}$

42. Ans. A.

The given Differential equation $\ln(\frac{dy}{dx}) = x$

We know that $\{\ln(a) = b\}$

$[\text{then } a = e^b]$

So $\ln\left(\frac{dy}{dx}\right) = x$

$\frac{dy}{dx} = e^x ......(i)$

So, $dy = e^x dx \; .........(ii)$

Integrating equation (ii) on both side

$\int dy = e^x \int dx$

Therefore, we get $y = e^x + c \;\; [here \; c \; is \; constant \; of \; integration]$

43. Ans. B.

From the equation of the function $y = \frac{1}{x-1}$ it is evident that here x is define for all real number except $x = 1$

For domain $x = \frac{y+1}{y};\; y \neq 0$

Domain is all real number except $y = 0$

Now at $x = 0 \Rightarrow y = -1$, hence the graph intersects y-axis at (0, -1).

44. Ans. C.

According to the given question

We have f(x)= $\ln x$



So, differentiating on both side

We get f'(x)= $\frac{1}{x}$

Here f'(x)>0 and it is an increasing function

Therefore, f(x) increases in the interval ($0,\infty$)

Now, f(x)= $\tan x$

So, differentiating on both side

We get f'(x)= $\sec^2 x$

Here f'(x)>0 and it is an increasing function

So, it also increases in the interval $\left(-\frac{\pi}{2},\frac{\pi}{2}\right)$.

Hence both the given statements are true.

45. Ans. A.

We know that range of cosine function is [-1,1]

Means $-1 \le \cos\theta \le 1$

Here $\theta$=(A+$\frac{\pi}{3}$) where $A \in R$

Now,

$-1 \le \cos(A+\frac{\pi}{3}) \le 1$

Now multiplying by 3

Therefore $-3 \le 3\cos(A+\frac{\pi}{3}) \le 3$

So there minimum value of $\cos(A+\frac{\pi}{3}) = -3$

46. Ans. B.

In the given differential Equation is x(dx – dy) + y (dy – dx) = 0



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Now, x dx - x dy + y dy- ydx=0……(i)

(x-y)dx=(x-y)dy……..(ii)

Integrating both side

$$\int (x-y)\,dx = \int (x-y)\,dy$$

Therefore,

$$\frac{x^2}{2} - xy = xy - \frac{y^2}{2}$$
$$\frac{x^2+y^2}{2} = 2xy + c$$
$$x^2 + y^2 = 2xy + c$$

47. Ans. A.

$As$ we know that differentiation of $\tan^{-1}x$ w.r.t x is $\dfrac{1}{1+x^2}$

$$\text{and } \cot^{-1}x = -\frac{1}{1+x^2}$$
$$\text{Now, } \frac{d(\tan^{-1}x)}{d(\cot^{-1}x)} = \frac{d(\tan^{-1})}{dx}\cdot\frac{dx}{d(\cot^{-1}x)}$$
$$= \left(\frac{1}{1+x^2}\right) \times -\left(\frac{1+x^2}{1}\right) = -1$$

48. Ans. A.

$$Given\ \lim_{x\to 0}\frac{3^x+3^{-x}-2}{x}$$
$$\text{it is } \left(\frac{0}{0}\right) \text{ indeterminate form}$$

$$Given\ \lim_{x\to 0}\frac{3^x+3^{-x}-2}{x}$$
$$\text{it is } \left(\frac{0}{0}\right) \text{ indeterminate form}$$



by using L'Hospital rule

Differentiating numerator and denominator

$$\text{so, } \frac{d}{dx}\left(\frac{3^x + 3^{-x} - 2}{x}\right) = \frac{\left(3^x - 3^{-x}\right)\ln 3}{1}$$

$$\text{Therefore } \lim_{x \to 0} \frac{\left(3^x - 3^{-x}\right)\ln 3}{1} = 0$$

49. Ans. C.

Now, we can write as $\sin x \cos x = \frac{1}{2}\sin 2x$

To find out maximum of the $\sin x \cos x$ differentiate it w.r.t x and then equate it to 0.

$$\frac{d}{dx}\left(\frac{1}{2}\sin 2x\right) = \frac{1}{2}\frac{d}{dx}\sin 2x = \frac{1}{2}2\cos 2x = 0$$

$$\cos 2x = 0$$

$$\cos 2x = \cos\frac{n\pi}{2}, \textit{where } n = 1,3,5\ldots\text{(odd integer)}$$

$$2x = \frac{n\pi}{2}$$

$$x = \frac{n\pi}{4}, \textit{where } n = 1,3,5\ldots\text{(odd integer)}$$

For maximum value n= $1,5,9\ldots\ldots$ because $3,7$ .....will result in minimum value.

$$\therefore \sin\frac{\pi}{4}\cos\frac{\pi}{4} = \frac{1}{2}$$

50. Ans. A.

The given function f(x)= $e^{-|x|}$

At first, we check continuity of f(x) at x=0

Left hand limit:- In this case x<0 $\therefore |x| = -x$

So function f(x)= $f(x) = e^{-(-x)} = e^x$

$$\lim_{x \to 0^-} f(x) = \lim_{h \to 0} f(0-h)$$

$$= \lim_{h \to 0} e^{(0-h)} = \lim_{h \to 0} e^{h} = 1$$



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Now, Right-hand limit

$x>0 \therefore |x| = x$

So, $f(x)=e^{-|x|} = e^{-x}$

Now $\lim\limits_{x\to 0^+} f(x) = \lim\limits_{h\to 0} f(0+h)$

$= \lim\limits_{h\to 0} e^{-(0+h)} = e^0 = 1$

Value of function $f(x)=e^{-|x|}$ at $x=0$

$f(0)=e^{-|0|} = 1$

So, LHL=RHL=f(x)=1

Therefore f(x)= $e^{-|x|}$ at x=0 is continuous

Now we check f(x)= $e^{-|x|}$ is differentiable at x=0 or not

Value of function f’(0)= $1$

RHD

f’(0)= $\lim\limits_{h\to 0} \frac{f(0+h)-f(0)}{h}$

$= \lim\limits_{h\to 0} \frac{e^{|0+h|}-1}{h} = 0$

So it is clear that RHD $\neq$ f’(0) and hence f(x)= $e^{-|x|}$ is not differentiable at x=0

51. Ans. B.

We know sine rule ,

$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

(1) We have,

$b = c$

$\Rightarrow \sin B = \sin C$



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And, $A = 2B$

$\Rightarrow \sin A = \sin 2B$

$\Rightarrow \sin(180 - (B + C)) = \sin 2B$

$\Rightarrow \sin(B + C) = 2\sin B\cos B$

$\Rightarrow \sin B\cos C + \cos B\sin C = 2\sin B\cos B$

$\Rightarrow \sin B\cos C + \cos B\sin\mathrm{B} = 2\sin B\cos B$ $[\because \sin B = \sin C]$

$\Rightarrow \sin B(\cos C + \cos B) = 2\sin B\cos B$

$\Rightarrow \cos C + \cos B = 2\cos B$

$\Rightarrow \cos C = \cos B$

If $\sin B = \sin C$ and $\cos C = \cos B$

means, $B = C = 45^\circ$

Then $A = 90^\circ$. So, in this triangle there is no obtuse angle. so this triangle ABC is not obtuse angle triangle.

This statement is wrong.

(2) If $A = 40^\circ$ and $B = 65^\circ$

We know that $A + B + C = 180^\circ$

$\Rightarrow C = 180 - 45 - 65 = 75^\circ$

We know sine rule ,

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$\Rightarrow \frac{a}{\sin 40^\circ} = \frac{b}{\sin 65^\circ} = \frac{c}{\sin 75^\circ}$$



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$$\Rightarrow \frac{a}{\sin 40^\circ} = \frac{c}{\sin 75^\circ}$$

$$\Rightarrow \frac{a}{c} = \sin 40^\circ \cos ec 75^\circ$$

So , here $\frac{a}{c} \neq \sin 40^\circ \cos ec 15^\circ$

Then this statement is right.

52. Ans. D.

(1) If $ABC$ is a right-angled triangle.

$\angle A = 90^\circ$ and $\sin B = \frac{1}{3}$

then $\cos ec C = \frac{BC}{BA} = \frac{3}{\sqrt{9-1}} = \frac{3}{8}$

So, first statement is wrong.

(2) $b \cos B = c \cos C$

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

$$\Rightarrow b^2(a^2 + c^2 - b^2) = c^2\left(a^2 + b^2 - c^2\right)$$

$$\Rightarrow b^2a^2 + b^2c^2 - b^4 = c^2a^2 + c^2b^2 - c^4$$

$$\Rightarrow b^2a^2 - a^2c^2 = b^4 - c^4$$

$$\Rightarrow a^2\left(b^2 - c^2\right) = \left(b^2\right)^2 - \left(c^2\right)^2$$

$$\Rightarrow a^2\left(b^2 - c^2\right) = \left(b^2 + c^2\right)\left(b^2 - c^2\right)$$

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



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So, this is right angled triangle. then statement-2 is wrong.

53. Ans. B.

We have,

$\cos 48^\circ - \cos 12^\circ$

$\Rightarrow -2\sin\left(\frac{48^\circ + 12^\circ}{2}\right)\sin\left(\frac{48^\circ - 12^\circ}{2}\right) \left[\because \cos x - \cos y = -2\sin\left(\frac{x+y}{2}\right)\sin\left(\frac{x-y}{2}\right)\right]$

$\Rightarrow -2\sin\left(\frac{60^\circ}{2}\right)\sin\left(\frac{36^\circ}{2}\right)$

$\Rightarrow -2\sin 30^\circ \sin 18^\circ$

$\Rightarrow -2\times\frac{1}{2}\times\left(\frac{\sqrt{5}-1}{4}\right)$

$\Rightarrow \frac{1-\sqrt{5}}{4}$

54. Ans. B.

We know that

$\cos A \cos 2A \cos 2^2 A \ldots \cos 2^{n-1} A = \frac{\sin 2^n A}{2^n \sin A}$

We have,

$8\cos 10^\circ \cos 20^\circ \cos 40^\circ$

$\Rightarrow 8\times\frac{\sin\left(2^3\times 10^\circ\right)}{2^3 \sin 10^\circ}$

$\Rightarrow 8\times\frac{\sin 80^\circ}{8\sin 10^\circ}$

$\Rightarrow \frac{\sin\left(90^\circ - 10^\circ\right)}{\sin 10^\circ}$



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$\Rightarrow \dfrac{\cos 10^\circ}{\sin 10^\circ} = \cot 10^\circ \quad \left[\because \sin\left(90^\circ - x\right) = \cos x \;\&\; \dfrac{\cos x}{\sin x} = \cot x\right]$

55. Ans. D.

We know that the limit of $\cos x$ is $[-1,1]$.

We have,

$y = 2 + \cos x$

Then the limit of $y$ is $[-1+2, 1+2] = [1,3]$

So, the ordinate of $y = 2 + \cos x$ is $[1,3]$.

56. Ans. A.

We know that $\sin 3\theta = 3\sin\theta - 4\sin^3\theta$

and, $\cos 3\theta = 4\cos^3\theta - 3\cos\theta$

We have,

$\sin 3x + \cos 3x + 4\sin^3 x - 3\sin x + 3\cos x - 4\cos^3 x$

$\Rightarrow 3\sin x - 4\sin^3 x + 4\cos^3 x - 3\cos x + 4\sin^3 x - 3\sin x + 3\cos x - 4\cos^3 x$

$\Rightarrow$ 0

57. Ans. D.

We have,

$3\sin 2A = 2\sin 2B$

$\Rightarrow 6\sin A\cos A = 2\sin 2B$

$\Rightarrow \dfrac{3\sin A}{\cos A} = \dfrac{\sin 2B}{\cos^2 A}$

$\Rightarrow \tan A = \dfrac{1}{3}\dfrac{\tan 2B\cos 2B}{\cos^2 A}$



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$\Rightarrow \tan A = \frac{1}{3}\frac{\tan 2B\left(3\sin^2 A\right)}{\cos^2 A}$ $\left[\cos 2B = 3\sin^2 A\right]$

$\Rightarrow \tan A = \tan 2B \tan^2 A$

$\Rightarrow \tan A \tan 2B = 1$

$\Rightarrow \tan A = \cot 2B$

$\Rightarrow \tan A = \tan\left(\frac{\pi}{2} - 2B\right)$ $\left[\because \cot x = \tan\left(\frac{\pi}{2} - x\right)\right]$

$\Rightarrow A = \frac{\pi}{2} - 2B$

$\Rightarrow A + 2B = \frac{\pi}{2}$

58. Ans. B.

We have,

$\tan\theta = \frac{\cos 17^\circ - \sin 17^\circ}{\cos 17^\circ + \sin 17^\circ}$

$\Rightarrow \tan\theta = \frac{\cos 17^\circ\left(1 - \tan 17^\circ\right)}{\cos 17^\circ\left(1 + \tan 17^\circ\right)}$

$\Rightarrow \tan\theta = \frac{1 - \tan 17^\circ}{1 + \tan 17^\circ}$

$\Rightarrow \tan\theta = \frac{\tan 45^\circ - \tan 17^\circ}{1 + \tan 45^\circ \tan 17^\circ}$ $\left[\because \tan 45^\circ = 1\right]$

$\Rightarrow \tan\theta = \tan\left(45^\circ - 17^\circ\right)$ $\left[\because \tan(a-b) = \frac{\tan a - \tan b}{1 + \tan a \tan b}\right]$

$\Rightarrow \theta = 28^\circ$

59. Ans. C.



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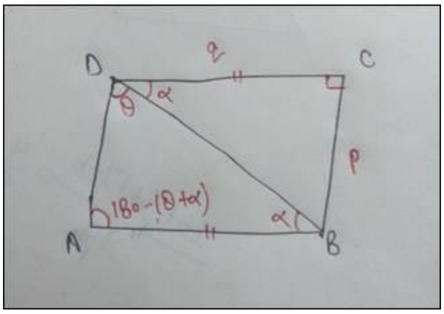
In $\Delta BCD$,

$$BD^2 = BC^2 + CD^2$$

$$\Rightarrow BD^2 = p^2 + q^2$$

$$\Rightarrow BD = \sqrt{p^2 + q^2}$$




In $\Delta ABD$ ,

$$\frac{AB}{\sin\theta} = \frac{BD}{\sin\left(180^\circ - (\theta + \alpha)\right)} = \frac{AD}{\sin\alpha}$$

$$\Rightarrow \frac{AB}{\sin\theta} = \frac{BD}{\sin(\theta + \alpha)}$$

$$\Rightarrow AB = \frac{BD\sin\theta}{\sin(\theta + \alpha)}$$

$$\Rightarrow AB = \frac{BD^2\sin\theta}{\mathrm{BD}\sin(\theta + \alpha)}$$

$$\Rightarrow AB = \frac{BD^2\sin\theta}{\mathrm{BD}(\sin\theta\cos\alpha + \cos\theta\sin\alpha)}$$

$$\Rightarrow AB = \frac{\left(p^2 + q^2\right)\sin\theta}{\sqrt{p^2 + q^2}\left(\sin\theta\frac{q}{\sqrt{p^2 + q^2}} + \cos\theta\frac{p}{\sqrt{p^2 + q^2}}\right)}$$



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$$\Rightarrow \quad AB = \frac{\left(p^2+q^2\right)\sin\theta}{q\sin\theta + p\cos\theta}$$

60. Ans. C.

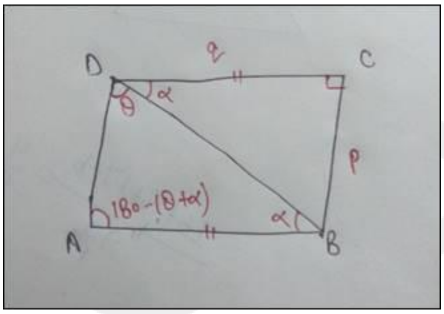
We know that $AB$ and $CD$ are parallel and BC is perpendicular to them .

We know sine rule ,

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

In $\Delta ABD$ ,

$$\frac{AB}{\sin\theta} = \frac{BD}{\sin\left(180^\circ - (\theta+\alpha)\right)} = \frac{AD}{\sin\alpha}$$




(1) $\frac{AB}{\sin\theta} = \frac{AD}{\sin\alpha}$

$$\Rightarrow \quad AB\sin\alpha = AD\sin\theta$$

(2) $\frac{AB}{\sin\theta} = \frac{BD}{\sin\left(180^\circ - (\theta+\alpha)\right)}$

$$\Rightarrow \quad AB\sin(\theta+\alpha) = BD\sin\theta$$

61. Ans. A. B.

We have,

$$\tan^2 A = \frac{k-3}{3k-1}$$



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$\Rightarrow \tan A = \sqrt{\dfrac{k-3}{3k-1}}$

The value of $k$ from $\frac{1}{2}$ to 2 , $\tan A$ is imaginary.

And, the value from $\frac{1}{3}$ to 3 , $\tan A$ is also imaginary .

other than these values $\tan A$ is real.

62. Ans. B.

We have, $\dfrac{\tan 3A}{\tan A} = k$

$\Rightarrow \dfrac{\sin 3A.\cos A}{\cos 3A.\sin A} = k$

$\Rightarrow \dfrac{\sin 3A.\cos A + \cos 3A.\sin A}{\sin 3A.\cos A - \cos 3A.\sin A} = \dfrac{k+1}{k-1}$

$\Rightarrow \dfrac{\sin(3A+A)}{\sin(3A-A)} = \dfrac{k+1}{k-1}$

$\Rightarrow \dfrac{\sin 4A}{\sin 2A} = \dfrac{k+1}{k-1}$

$\Rightarrow \dfrac{2\sin 2A \cos 2A}{\sin 2A} = \dfrac{k+1}{k-1}$

$\Rightarrow 2\cos 2A = \dfrac{k+1}{k-1}$

$\Rightarrow 2\left(1-2\sin^2 A\right) = \dfrac{k+1}{k-1}$

$\Rightarrow 2-4\sin^2 A = \dfrac{k+1}{k-1}$

$\Rightarrow 4\sin^2 A = 2-\dfrac{k+1}{k-1}$



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$\Rightarrow$ $4\sin^2 A = \dfrac{2k-2-k-1}{k+1} = \dfrac{k-3}{k+1}$

$\Rightarrow$ $\sin^2 A = \dfrac{1}{4}.\dfrac{k-3}{k-1}$

And, $\cos^2 A = 1 - \dfrac{1}{4}\left(\dfrac{k-3}{k-1}\right)$

$\Rightarrow$ $\cos^2 A = \dfrac{4k-4-k+3}{k-1} = \dfrac{3k-1}{k-1}$

So, $\tan^2 A = \dfrac{\sin^2 A}{\cos^2 A} = \dfrac{\left(\dfrac{k-3}{k-1}\right)}{\left(\dfrac{3k-1}{k-1}\right)} = \dfrac{k-3}{3k-1}$

63. Ans. A.

We have,

If the number of elements belonging to neither X, nor Y, nor Z is equal to p.

Now,

$n\left(\overline{X}\right) = p+b+c+17$

We have $n(Z) = 12+18+17+c = 90$

$c = 90-12-18-17 = 43$

$n\left(\overline{X}\right) = p+b+43+17$

$\Rightarrow$ $n\left(\overline{X}\right) = p+b+60$

64. Ans. D.

We have

$n(X) = a+16+12+18 = a+46$



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$n(Y)=16+b+18+17=51+b$

$n(Z)=90$

$n(X\cap Y)=16+18=34$

$n(Y\cap Z)=17+18=35$

$n(X\cap Z)=12+18=30$

$n(X\cap Y\cap Z)=18$

Now,

$n(X)+n(Y)+n(Z)-n(X\cap Y)-n(Y\cap Z)-n(X\cap Z)+n(X\cap Y\cap Z)$

$\Rightarrow\ a+46+51+b+90-34-35-30+18$

$\Rightarrow\ a+b+106$

65. Ans. C.

We have,

No of elements in Z = 90

And, No of elements in Y = $16+18+17+b$ = $51+b$

So, $\frac{n(Y)}{n(Z)}=\frac{4}{5}$

$\Rightarrow\ \frac{51+b}{90}=\frac{4}{5}$

$\Rightarrow\ 51+b=72$

$\Rightarrow\ b=21$

66. Ans. C.

We have the equations of a pair of opposite sides of a square .

$3x-4y-5=0$



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$3x - 4y + 15 = 0$

As we can see that both lines slopes are equal. So, both lines are a parallel.

So, distance between parallel lines is side of a square.

We know that the distance between the parallel lines $ax + by + c_1 = 0$ and $ax + by + c_2 = 0$, is

$$\frac{|c_1 - c_2|}{\sqrt{a^2 + b^2}}$$

We have $3x - 4y - 5 = 0$ and $3x - 4y + 15 = 0$, so distance

$$d = \frac{|-5 - 15|}{\sqrt{3^2 + 4^2}} = \frac{20}{5} = 4$$

So, area of a square = $(side)^2 = 4^2 = 16$

67. Ans. B.

We know that if $m_1$ and $m_2$ are the slopes of two lines, then the acute angle $\theta$ between them is given by

$$\tan\theta = \left|\frac{m_1 - m_2}{1 + m_1 m_2}\right|$$

$$\Rightarrow \tan\theta = \left|\frac{2 - \sqrt{3} - 2 - \sqrt{3}}{1 + \left(2 - \sqrt{3}\right)\left(2 + \sqrt{3}\right)}\right|$$

$$\Rightarrow \tan\theta = \left|\frac{-2\sqrt{3}}{1 + 4 - 3}\right|$$

$$\Rightarrow \tan\theta = \left|-\sqrt{3}\right| = \sqrt{3}$$

$$\Rightarrow \theta = 60^\circ$$

But, obtuse angle = $180^\circ - \theta$



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$= 180 - 60 = 120^\circ$

68. Ans. C.

We know that the foot $(h,k)$ of the perpendicular drawn from the point $(x_1, y_1)$ on the line $ax + by + c = 0$ is given by

$$\frac{h - x_1}{a} = \frac{k - y_1}{b} = -\left(\frac{ax_1 + by_1 + c}{a^2 + b^2}\right)$$

We have,

The foot of the perpendicular drawn from the point (0, k) to the line 3x – 4y – 5 = 0 is (3, 1).

$$\frac{3-0}{3} = \frac{1-k}{-4} = -\left(\frac{3 \times 0 - 4 \times k - 5}{3^2 + (-4)^2}\right)$$

$$\Rightarrow \quad 1 = \frac{k-1}{4} = -\left(\frac{-4k-5}{25}\right)$$

$$\Rightarrow \quad k - 1 = 4$$

$$\Rightarrow \quad k = 5$$

69. Ans. B.

We know that the triangle midpoint theorem, it says that the line segment connecting the mid points of two sides of a triangle is parallel to the third side and is congruent to one half of the third side.

So here $DE$ is the parallel to $BC$ and also $DE = \frac{1}{2}BC$.

Given $D(2,5)$ and $E(5,9)$.

$$DE = \sqrt{(5-2)^3 + (9-5)^2}$$

$$\Rightarrow \quad DE = \sqrt{9+16}$$

$$\Rightarrow \quad DE = 5$$



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Then,

$BC = 2 \times DE$

$\Rightarrow\ BC = 2 \times 5 = 10$

70. Ans. C.

We know if the points $A(x_1, y_1)$, $B(x_2, y_2)$ and $C(x_3, y_3)$ are collinear, then

$$\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix} = 0$$

So, here the points area $(a,b)$ , $(c,d)$ and $(a-c, \mathrm{b}-d)$ , then

$$\begin{vmatrix} a & b & 1 \\ c & d & 1 \\ a-c & b-d & 1 \end{vmatrix} = 0$$

$\Rightarrow\ a(d-b+d) - b(c-a+c) + 1(bc-cd-ad+cd) = 0$

$\Rightarrow\ 2ad - ab - 2bc + ab + bc - ad = 0$

$\Rightarrow\ ad = bc$

71. Ans. B.

We have,

the parabola $y^2 = x$ .

We compare this with $y^2 = 4ax$ . So, $a = \frac{1}{4}$

Let $O(0,0)$ be the vertex and $P\left(at^2, 2at\right)$ be the other end of the chord $OP$ of the parabola $y^2 = x$ . Then,

$$OP = \sqrt{\left(at^2 - 0\right)^2 + (2at - 0)^2}$$



$\Rightarrow \ OP = at\sqrt{4+t^2}$

Now, put $a = \frac{1}{4}$

Then, $OP = \frac{t}{4}\sqrt{4+t^2}$

Since $OP$ makes angle $\theta$ with x-axis.

$\tan\theta = \frac{2at-0}{at^2-0}$

$\Rightarrow \ \tan\theta = \frac{2}{t}$

$\Rightarrow \ t = \frac{2}{\tan\theta}$

Hence, $OP = \frac{2}{4\tan\theta}\sqrt{4+\left(\frac{2}{\tan\theta}\right)^2}$

$\Rightarrow \ OP = \frac{2}{4\tan\theta}\sqrt{4+\frac{4}{\tan^2\theta}}$

$\Rightarrow \ OP = \frac{2}{4\tan\theta}\frac{2\sqrt{\tan^2\theta+1}}{\tan\theta}$

$\Rightarrow \ OP = \frac{\sqrt{\sec^2\theta}}{\tan^2\theta} \ \left[\because \tan^2 x+1 = \sec^2 x\right]$

$\Rightarrow \ OP = \frac{\cos\theta}{\sin^2\theta} \ \left[\because \sec x = \frac{1}{\cos x} \ \& \ \tan x = \frac{\sin x}{\cos x}\right]$

$\Rightarrow \ OP = \cos\theta.\cos ec^2\theta$

72. Ans. C.

We have, the lines

$x+2=0$



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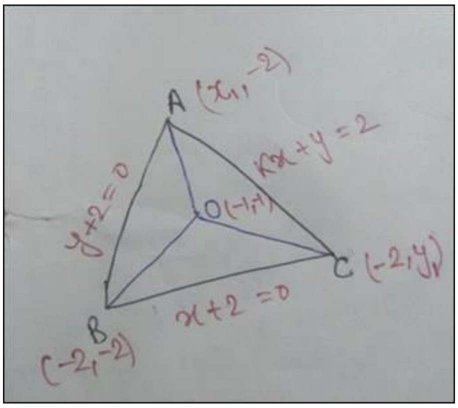
$y+2=0$

$kx+y+2=0$




$\therefore$ Sides of triangles are

$x=-2$

$y=-2$

$kx+y=-2$

So coordinates of triangles are

$A(x_1,-2)$, $B(-2,-2)$ and $C(-2,y_1)$

We know that length from circumcentre to each coordinates are equal. here circumcentre $O=(-1,-1)$

For circumcentre, $OA^2=OB^2$

$(x_1+1)^2+(-2+1)^2=(-2+1)^2+(-2+1)^2$

$x_1=1-1=0$

And, $OC^2=OB^2$

$(-2+1)^2+(y_1+1)^2=(-2+1)^2+(-2+1)^2$

$y_1+1=1$

$y_1=0$



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So, $A(0,-2)$ and $C(-2,0)$

Then, $AC$ equations = $y+2=\frac{0+2}{-2+0}(x+0)$

= $x+y+2=0$

Then, compare with $kx+y+2=0$ means $k=1$

73. Ans. B.

We have,

$$25x^2+16y^2=400$$

$$\Rightarrow \frac{x^2}{16}+\frac{y^2}{25}=1$$

We compare this equation with equation of ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$.

$a^2=16$ and $b^2=25$

Eccentricity $(e)=\sqrt{1-\frac{a^2}{b^2}}$ as $a<b$

$$e=\sqrt{1-\frac{16}{25}}=\sqrt{\frac{9}{25}}=3/5$$

So, the coordinates of foci are $(0,\pm be)$.

i.e. $(0,3)$ and $(-3,0)$

Thus, $Q$ and $R$ are the foci of ellipse.

Since, the sum of the focal distances of a point on an ellipse is equal to its major axis.

$$\therefore\ PQ+QR=2b=2\times5=10$$

74. Ans. C.



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Firstly we see that the point $(1,-1)$ is satisfies $3x+2y-5=0$ or not.

$3\times 1+2\times(-1)-5=3-2-5=-4\neq 0$

So, the point $(1,-1)$ is belongs to other diagonal.

We know that the diagonals of square are perpendicular to each other then multiplications of slopes is equal to $-1$ .

$m_1.m_2=-1$

Then, we calculate slope of $3x+2y-5=0$

$\Rightarrow\ y=-\frac{3}{2}x+\frac{5}{2}$

$\Rightarrow\ m_1=\frac{-3}{2}$

Now, $m_1.m_2=-1$

$\Rightarrow\ m_2=\frac{2}{3}$

So, equation of other diagonal is $y=m_2x+c$

$\Rightarrow\ y=\frac{2}{3}x+c$

As we know that the point $(1,-1)$ satisfies $y=\frac{2}{3}x+c$

Then, $-1=\frac{2}{3}\times 1+c$

$\Rightarrow\ c=-1-\frac{2}{3}=\frac{-5}{3}$

So, the equation of diagonal = $y=\frac{2}{3}x-\frac{5}{3}$

$\Rightarrow\ 2x-3y=5$



75. Ans. C.

We have,

$(x-2a)(x-2b)+(y-2c)(y-2d)=0$

$\Rightarrow x^2-2ax-2bx+4ab+y^2-2cy-2dy+4cd=0$

$\Rightarrow x^2+y^2+2(-a-b)x+2(-c-d)y+4ab+4cd=0$

We know that the equation $x^2+y^2+2gx+2fy+c=0$ represents a circle having centre at

$(-g,-f)$.

So we compare $x^2+y^2+2(-a-b)x+2(-c-d)y+4ab+4cd=0$ with standard one.

Then, $g=(-a-b)$ and $f=(-c-d)$

Then centre is $(a+b,c+d)$.

76. Ans. A.

For any non-singular matrix $A$ of order $n$ , we have

$|adjA|=|A|^{n-1}$ and $adj(adjA)=|A|^{n-2}A$

Also, $adj(adjA)=|A|^{n-2}A$ is obtained by replacing $A$ by $adj\ A$ in the relation $A(adjA)=|A|I_n=(adjA)A$ .

$\therefore$ For a $3\times3$ matrix , we have

$|adjA|=|A|^2$ and $adj(adjA)=|A|A$

We replace $A$ by $adj\ A$ .

So, here $A(adj\ A)=(adj\ A)A$ is true. But $|adjA|=|A|$ is not true.



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77. Ans. A.

We have,

$(1+x)^9$

We know that $(x+a)^n = {}^nC_0x^na^0 + {}^nC_1x^{n-1}a^1 + {}^nC_2x^{n-2}a^2 + \ldots + {}^nC_rx^{n-r}a^r + \ldots. + {}^nC_nx^0a^n$

Then,

$(1+x)^9 = {}^9C_01^9x^0 + {}^9C_1(1)^{9-1}x^1 + \ldots. + {}^9C_51^{9-5}x^5 + {}^9C_61^{9-6}x^6 + {}^9C_71^{9-7}x^7 + {}^9C_81^{9-8}x^8 + {}^9C_91^0x^9$

$(1+x)^9 = 1 + 9x + \ldots. + 126x^5 + 84x^6 + 36x^7 + 9x^8 + x^9$

So, sum of last five coefficient = $126 + 84 + 36 + 9 + 1$

= 256

78. Ans. A.

We have,

$$D = \begin{vmatrix} p & q & r \\ q & r & p \\ r & p & q \end{vmatrix}$$

$\Rightarrow D = p\left(qr - p^2\right) - q\left(q^2 - pr\right) + r\left(qp - r^2\right)$

$\Rightarrow D = pqr - p^3 - q^3 + pqr + pqr - r^3$

$\Rightarrow D = 3pqr - \left(p^3 + q^3 + r^3\right)$

Given that p, q and r be three distinct positive real numbers.

Let $p = 1, q = 2, r = 3$

then $1^3 + 2^3 + 3^3 = 36$ and $3 \times 1 \times 2 \times 3 = 18$

As $p^3 + q^3 + r^3 > 3pqr$



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So, $D<0$

79. Ans. C.

Let $A=\{1,2,3,4\}$

Then, Subsets of $A$,

$$B=\Phi,\{1\},\{2\},\{3\},\{4\},\{1,2\},\{2,3\},\{1,3\},\{2,4\},\{1,4\},\{3,4\},\{1,2,3\},\{1,2,4\}$$
$$\{2,3,4\},\{1,3,4\},\{1,2,3,4\}$$

And we know that a subset B of a set A is called a proper subset of A if $A\neq B$.

Then, proper subset of A

$$=\{1\},\{2\},\{3\},\{4\},\{1,2\},\{2,3\},\{1,3\},\{2,4\},\{1,4\},\{3,4\},$$
$$\{1,2,3\},\{2,3,4\},\{1,3,4\}$$

We know that whenever a set B is a subset of set A, we say that A is a superset of B or $A\supseteq B$

So, super set of $\{3\}$ in subset of B

$$==\{1\},\{2\},\{4\},\{1,2\},\{2,4\},\{1,4\},\{1,2,4\}$$

80. Ans. B.

We have,

$$\frac{\cos\theta+i\sin\theta}{\cos\theta-i\sin\theta}$$

$$\Rightarrow \frac{\cos\theta+i\sin\theta}{\cos\theta-i\sin\theta}\times\frac{\cos\theta+i\sin\theta}{\cos\theta+i\sin\theta}$$ [ By rationalization ]

$$\Rightarrow \frac{(\cos\theta+i\sin\theta)^2}{\cos^2\theta+\sin^2\theta}$$

$$\Rightarrow \cos^2\theta-\sin^2\theta+2i\sin\theta\cos\theta \quad \left[\because \cos^2\theta+\sin^2\theta=1\right]$$



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$\Rightarrow \cos 2\theta + i\sin 2\theta \left[\because \cos^2\theta - \sin^2\theta = \cos 2\theta \ \& \ 2\sin\theta\cos\theta = \sin 2\theta\right]$

So, modulus of $\cos 2\theta + i\sin 2\theta$

$\Rightarrow \sqrt{\cos^2 2\theta + \sin^2 2\theta}$

$\Rightarrow$ 1

81. Ans. C.

The given function $\frac{3x^2+8-4k}{x}$

Integrating the above function

$= \int \frac{3x^2+8-4k}{x}dx$

$= \int\left(3x + \frac{8-4k}{x}\right)dx$

$= 3\frac{x^2}{2} + (8-4k)\ln x + c$

For the solution to be rational $(8-4k)\ln x$ must be zero.

Hence $8-4k = 0 \rightarrow k = 2$

82. Ans. B.

Given function $|x - 1|$ is a mod function.

So any value that will come out of it , would be a positive value or zero.

Hence the minimum value of |x – 1| would be zero only.

83. Ans. A.

let $I = \int \frac{dx}{x(x^n+1)} = \int \frac{x^{n-1}dx}{x^n(x^n+1)}$

$let\ x^n + 1 = t \Rightarrow x^{n-1}dx = dt$



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$$= \frac{1}{n}\int \frac{dt}{(t-1)t}$$
$$= \frac{1}{n}\int \left(\frac{1}{t-1} - \frac{1}{t}\right)dt$$
$$= \frac{1}{n}\ln\left(\frac{t-1}{t}\right) + c$$
$$= \frac{1}{n}\ln\left(\frac{x^n}{x^n+1}\right) + c$$

84. Ans. B.

Given $x^m y^n = a^{m+n}$

Differentiating w.r.t. x

$$\frac{d}{dx}x^m y^n = \frac{d}{dx}a^{m+n}$$
$$x^m n y^{n-1}\frac{dy}{dx} + m x^{m-1} y^n = 0$$
$$x^m n y^{n-1}\frac{dy}{dx} = -m x^{m-1} y^n$$
$$\frac{dy}{dx} = \frac{-m x^{m-1} y^n}{x^m n y^{n-1}}$$
$$\frac{dy}{dx} = \frac{-my}{nx}$$

85. Ans. A.

Given that $f(x) = 2x - x^2$ and $f(x+2) + f(x-2) = ?$ at x=0

So $$f(x+2) + f(x-2) = 2\times(x+2) - (x+2)^2 + 2\times(x-2) - (x-2)^2$$

Putting x=0

$$= 2\times(0+2) - (0+2)^2 + 2\times(0-2) - (0-2)^2$$
$$= 2\times 2 - 2^2 - 2\times 2 - 2^2$$
$$= -8$$

86. Ans. C.

Given curves $y^2 = 2x$ and $y=x$

Solving both for points of intersection

Putting $y=x \Rightarrow x^2 = 2x$

x=2 and hence y=2 and x=0, y=0



the two points are (0,0) and (2,2)

now calcuting the area enclosed between the two curves.

Enclosed area= area under parabola in the fisrt quadrant - area under straight line in the fisrt quadrant

Enclosed area= $\int_0^2 (y_1 - y_2)\,dx$

$$= \int_0^2 \left(\sqrt{2x} - x\right) dx$$
$$= \int_0^2 \sqrt{2x}\,dx - \int_0^2 x\,dx$$
$$= \sqrt{2}\left(\frac{x^{\frac{3}{2}}}{\frac{3}{2}}\right)_0^2 - \left(\frac{x^2}{2}\right)_0^2$$
$$= \sqrt{2} \times \frac{2}{3}\left(2^{\frac{3}{2}} - 0\right) - \frac{2^2}{2} - 0$$
$$= \frac{8}{3} - \frac{4}{2}$$
$$= \frac{16-12}{6}$$
$$= \frac{4}{6}$$
$$= \frac{2}{3}$$

87. Ans. A.

As we know the range of the function cosx for any value of x is [-1, 1]

$$-1 \le x \le 1$$

As here in the question the given function is $f(x) = \cos^{-1}(x-2)$

So the domain of f(x) is

$$-1 \le x - 2 \le 1$$
$$1 \le x \le 3$$

So, the domain of the function f(x) = $\cos^{-1}$ (x – 2) is $[1,3]$

88. Ans. C.

Given that $\int \left(e^{\log x} + \sin x\right) \cos x\,dx$



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$$= \int (x + \sin x) \cos x \, dx$$
$$= \int (x \cos x + \sin x \cos x) dx$$
$$= \int (x \cos x) dx + \int (\sin x \cos x) dx$$
$$= (x \sin x + \cos x.1) + \int \left(\frac{2}{2} \sin x \cos x\right) dx + c$$
$$= x \sin x + \cos x + \int \left(\frac{\sin 2x}{2}\right) dx + c$$
$$= x \sin x + \cos x + \frac{1}{2}\left(\frac{-\cos 2x}{2}\right) + c$$
$$= x \sin x + \cos x - \frac{\cos 2x}{4} + c$$
$$= x \sin x + \cos x - \frac{1 - 2\sin^2 x}{4} + c$$
$$= x \sin x + \cos x - \frac{1}{4} + \frac{2\sin^2 x}{4} + c$$
$$= x \sin x + \cos x + \frac{\sin^2 x}{2} + \left(c - \frac{1}{4}\right)$$
$$= x \sin x + \cos x + \frac{\sin^2 x}{2} + C$$

89. Ans. B.

Given equation dy = (1 + $y^2$) dx

$$\frac{dy}{(1 + y^2)} = dx$$

Integrating both sides

$$\int \frac{dy}{(1 + y^2)} = \int dx$$
$$\tan^{-1}(y) = x + c$$
$$y = \tan(x + c)$$

90. Ans. B.

Given that the function $f(x) = \frac{\sin x}{x}$, is continuous at x=0

As we know the condition of function to be continuous is $\lim_{x \to a} f(x) = f(a)$

Hence

$$\lim_{x \to 0} f(0) = f(0)$$
$$\lim_{x \to 0} \frac{\sin x}{x} = f(0)$$

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Applying L Hospitals rule

$$\lim_{x\to 0}\frac{\cos x}{1} = f(0)$$
$$\frac{\cos 0^\circ}{1} = f(0)$$
$$1 = f(0)$$
$$f(0) = 1$$

91. Ans. C.

Given y = $3x^2 + 2$

So value of y when x=10 ⇒

$$y_1 = 3\times 10^2 + 2$$
$$y_1 = 302$$

Similarly value of y when x=10.1

$$y_2 = 3\times 10.1^2 + 2$$
$$y_2 = 3\times 102.01 + 2$$
$$y_2 = 308.03$$

Hence $y_2 - y_1 = 308.03 - 302$

$$y_2 - y_1 = 6.03$$

92. Ans. B.

$$\int_0^{\pi/4}\left(\tan^3 x + \tan x\right)dx$$
$$= \int_0^{\pi/4}\tan x\left(\tan^2 x + 1\right)dx$$
$$= \int_0^{\pi/4}\tan x.\sec^2 x dx$$
$$= \int_0^{\pi/4}\tan x.\sec x.\sec x dx$$

Assuming $\sec x = t$

So $\sec x.\tan x dx = dt$

Putting it, we get $= \int t dt$

$$= \frac{t^2}{2}$$



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Putting back $\sec x = t$

$$= \left[\frac{\sec^2 x}{2}\right]_0^{\pi/4}$$

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

$$= \frac{1}{2}[1]$$

$$= \frac{1}{2}$$

93. Ans. B.

Given that $p(x) = (4e)^{2x}$

Integrating both the sides

$$\int p(x)\,dx = \int (4e)^{2x}\,dx$$

$$\int p(x)\,dx = \int 4^{2x}.e^{2x}\,dx$$

$$\int p(x)\,dx = 4^{2x}.\int e^{2x}\,dx - \int\left(\frac{d}{dx}4^{2x}.\int e^{2x}\,dx\right)dx + c$$

$$\int p(x)\,dx = 4^{2x}.\frac{e^{2x}}{2} - \int\left(4^{2x}.2.\ln 4.\frac{e^{2x}}{2}\right)dx + c$$

$$\int p(x)\,dx = \frac{p(x)}{2} - \ln 4.\int\left(4^{2x}.e^{2x}\right)dx + c$$

$$\int p(x)\,dx = \frac{p(x)}{2} - \ln 4.\int p(x)\,dx + c$$

$$\int p(x)\,dx + \ln 4.\int p(x)\,dx = \frac{p(x)}{2} + c$$

$$\left(\int p(x)\,dx\right)(1+\ln 4) = \frac{p(x)}{2} + c$$

$$\int p(x)\,dx = \frac{p(x)}{2(1+\ln 4)} + c$$

$$\int p(x)\,dx = \frac{p(x)}{2(1+2\ln 2)} + c$$

94. Ans. B.



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Given $e^{\theta\varphi} = c + 4\theta\varphi$

And $\varphi = f(\theta)$ , φdθ=?

Taking log both sides $e^{\theta\varphi} = c + 4\theta\varphi$

$$\log\left(e^{\theta\varphi}\right) = \log\left(c + 4\theta\varphi\right)$$
$$\theta\varphi = \log\left(c + 4\theta\varphi\right)$$
$$\varphi + \theta\frac{d\varphi}{d\theta} = \frac{1}{c + 4\theta\varphi}\left(0 + 4\varphi + 4\theta\frac{d\varphi}{d\theta}\right)$$
$$\varphi + \theta\frac{d\varphi}{d\theta} = \frac{1}{e^{\theta\varphi}}\left(4\varphi + 4\theta\frac{d\varphi}{d\theta}\right)$$
$$\varphi + \theta\frac{d\varphi}{d\theta} = \frac{4\varphi}{e^{\theta\varphi}} + \frac{4\theta}{e^{\theta\varphi}}\frac{d\varphi}{d\theta}$$
$$\frac{d\varphi}{d\theta}\left(\theta - \frac{4\theta}{e^{\theta\varphi}}\right) = \frac{4\varphi}{e^{\theta\varphi}} - \varphi$$
$$\frac{d\varphi}{d\theta}\theta\left(\frac{e^{\theta\varphi} - 4}{e^{\theta\varphi}}\right) = \varphi\frac{4 - e^{\theta\varphi}}{e^{\theta\varphi}}$$
$$\frac{d\varphi}{d\theta}\theta\left(\frac{e^{\theta\varphi} - 4}{e^{\theta\varphi}}\right) = \varphi \times -\left(\frac{e^{\theta\varphi} - 4}{e^{\theta\varphi}}\right)$$
$$\frac{d\varphi}{d\theta}\theta = -\varphi$$
$$\theta d\varphi = -\varphi d\theta$$
$$\varphi d\theta = -\theta d\varphi$$

95. Ans. B.

Given $f(x) = 3x^2 - 5x + p$

Hence $f(0) = 0 - 0 + p$

$f(0) = p$

similarly $f(1) = 3.1^2 - 5 + p$

$f(1) = p - 2$

it is given that $f(0)$ *and* $f(1)$ are opposite in sign.



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Hence

$$\begin{aligned} p &= -p+2 \\ 2p &= 2 \\ p &= 1 \end{aligned}$$

96. Ans. B.

Given that X bakes a cake with probability to fail to rise =0.02= $\frac{2}{100}$

And he bakes 50% 0f cakes at the restaurant.

Similarly Y bakes a cake with probability to fail to rise =0.03= $\frac{3}{100}$

And he bakes 30% 0f cakes at the restaurant.

Similarly X bakes a cake with probability to fail to rise =0.05= $\frac{5}{100}$

And he bakes 20% 0f cakes at the restaurant.

HENCE the required probability that X bakes a cake and it fails

to rise = $\dfrac{\frac{2}{100}\times\frac{50}{100}}{\frac{2}{100}\times\frac{50}{100}+\frac{3}{100}\times\frac{30}{100}+\frac{5}{100}\times\frac{20}{100}}$

$$\begin{aligned} &= \frac{2\times 50}{2\times 50+3\times 30+5\times 20} \\ &= \frac{100}{100+90+100} \\ &= \frac{100}{290} \\ &= \frac{10}{29} \end{aligned}$$

97. Ans. D.

We have P(A) = 0.6, P(B) = 0.5 and P(A ∩ B) = 0.4, So

$$\begin{aligned} P(A\cup B) &= P(A)+P(B)-P(A\cap B) \\ &= 0.6+0.5-0.4 = 0.7 \end{aligned}$$



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$$P\left(\bar{A}\cup B\right)=P(B-A)=P(B)-P(A\cap B)$$
$$=0.5-0.4=0.1$$

$$P\left(\bar{A}\cup\bar{B}\right)=P(A\cap B)'=1-P(A\cup B)$$
$$=1-0.7=0.4$$

98. Ans. D.

we have parameters n = 10 and $p=\frac{1}{5}$ for variable X.

Given that $Y = 10 - X$ or $X + Y = 10$

Since both the variable are linearly dependent so the parameters n remains unchanged.

And $P_x + P_y = 1 \Rightarrow P_y = 1-\frac{1}{5}=\frac{4}{5}$

99. Ans. B.

Given that $\overline{X}=65$, $\overline{Y}=67$, $\sigma_x=2.5$, $\sigma_y=3.5$ and $r(X,Y)=0.8$.

We know that equation of regression of Y on X ⇒ $Y-\overline{Y}=b_{YX}\left(X-\overline{X}\right)$

Where $b_{YX}=r.\frac{\sigma_X}{\sigma_Y}$

So $b_{YX}=0.8.\frac{2.5}{3.5}$

$=\frac{28}{25}$

Hence equation of regression of Y on X ⇒ $Y-\overline{Y}=b_{YX}\left(X-\overline{X}\right)$



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$$Y-67=\frac{28}{25}(X-65)$$
$$Y=\frac{28}{25}\times X-\frac{28}{25}\times 65+67$$
$$Y=1.12X-72.8+67$$
$$Y=1.12X-5.8$$

100. Ans. C.

Given that there are 10 lottery tickets, from which 2 tickets are drawn simultaneously.

So the all possible sets of prime numbers= (2,3), (2,5), (2,7), (3,5),(3,7), (5,7)

Hence probability= $\frac{number of\ favourable\ sets}{total\ number\ of\ sets}$

$$=\frac{6}{^{10}C_2}$$

$$=\frac{6}{\frac{10\times 9}{2}}$$
$$=\frac{6}{45}$$
$$=\frac{2}{15}$$

101. Ans. D.

The number of ways to select 3 persons from a group of 2 boys and 2 girls= $^4C_3$ =4

The number of ways to select 2 boys and 1 girl

from a group of 2 boys and 2 girls= $^2C_2\times {^2C_1}$ =2

Hence Probability is given as= $\frac{2}{4}=\frac{1}{2}$

102. Ans. A.

The number of ways to select 4 gold coins out of 15= $^{15}C_4$



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The number of ways to select 4 counterfeits gold coins out of 6 = ${}^{6}C_{4}$

Hence Probability = $\frac{{}^{6}C_{4}}{{}^{15}C_{4}} = \frac{1}{91}$

103. Ans. A.

Let H represents the set of husband & W represents the set of wife.

Since the events are given to be independent= $P(H \cup W) = 0$

Hence P(HUW)=P(H)P'(W+P(W)P'(H) +P(W)P(H)
= (1/7).(4/5) + (1/5).(6/7) +(1/7)+(1/5)
=11/35

104. Ans. B.

We know that

$$\text{Arithmetic Mean} = \frac{\text{Total sum of observations}}{\text{Number of observations}}$$

Total sum of observations=40X1000=4000

$$\text{Correct Arithmetic Mean} = \frac{4000+53-83}{100}$$ =39.70

105. Ans. B.

As February will have 29 days in a Leap Year,

Hence Number of Weeks= $\frac{29}{7} = 4 \text{ Weeks and } 1 \text{ day}$

This 1 day can be either of the days of the week,

Hence the probability that February of a leap year will have five Sundays= $\frac{1}{7}$

106. Ans. D.

We know that



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$$\text{coefficient of variation}=\left(\frac{\text{Standard Deviation}}{\text{Mean}}\times 100\right)$$

Mean= $\frac{\sum x_i}{n}=\frac{20}{10}=2$

Standard Deviation= $\frac{1}{n}\sqrt{n\sum x_i^2-\left(\sum x_i\right)^2}$

$=\frac{1}{10}\sqrt{(10)(200)-(20)^2}$

=4

Coefficient of variation= $\frac{4}{2}\times 100$

=200

107. Ans. B.

We know that Standard Deviation is given by= $\frac{1}{n}\sqrt{n\sum x_i^2-\left(\sum x_i\right)^2}$

Where n is the number of observations.

$$\sum x_i = 0, \sum x_i^2 = 32$$
$$Form \;\; n=8$$
$$=\frac{1}{8}\sqrt{(8)(32)}$$
$$=2$$

(All the above values can be inferred from the given set of observations)

108. Ans. C.

Let A=35 h=10



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| Interval | Mid valve | Physics(fi) | $u_i$ | $f_i u_i$ |
|---|---|---|---|---|
| 10-20 | 15 | 8 | -2 | -16 |
| 20-30 | 25 | 11 | -1 | -11 |
| 30-40 | 35 | 30 | 0 | 0 |
| 40-50 | 45 | 26 | 1 | 26 |
| 50-60 | 55 | 15 | 2 | 30 |
| 60-70 | 65 | 10 | 3 | 30 |

We know that Mean is defined as= $A+h\left[\frac{\sum f_i u_i}{\sum f_i}\right]$

= $35+\frac{59}{100}\times 10=40.9$

109. Ans. A.

The highest frequency of physics is in the interval 30-40

Mean of physics=39.4

Mean of maths=36.2

Mode of physics=30

Mode of math=38

Applying 2median=3Mean-mode

We get median of math=35.3

Median of physics=44.1

Hence median of physics is greater than median of math.

110. Ans. C.

If we calculate the difference between the students of Physics & Mathematics in each range we will find out that in the range 40-50 the difference is 11 which is highest among the all interval given.

111. Ans. A.

$\lim_{x\to 0}\frac{\sin x\log(1-x)}{x^2}$



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The given limit can be break upon as-

$$=\left[\lim_{x\to 0}\frac{\sin x}{x}\right]\left[\lim_{x\to 0}\frac{\log(1-x)}{x}\right]$$

= (1)(-1)=-1

112. Ans. B.

We have $k\frac{dy}{dx}=\int\left[1+\left(\frac{dy}{dx}\right)^2\right]^{\frac{2}{3}}dx$

Differentiating both sides,we get,

$$\frac{d}{dx}\left[k\frac{dy}{dx}\right]=\frac{d}{dx}\left[\int\left[1+\left(\frac{dy}{dx}\right)^2\right]^{\frac{2}{3}}dx\right]$$

$$k\frac{d^2y}{dx^2}=\left[1+\left(\frac{dy}{dx}\right)^2\right]^{\frac{2}{3}}$$

Cubing both sides, we get-

$$\left[k\frac{d^2y}{dx^2}\right]^3=\left[1+\left(\frac{dy}{dx}\right)^2\right]^2$$

Hence Order=2 and Degree=3

113. Ans. C.

$$\lim_{x\to 1}\frac{x^4-1}{x-1}=\lim_{x\to k}\frac{x^3-k^3}{x^2-k^2},$$

$$\lim_{x\to 1}\frac{x^4-1}{x-1}=\lim_{x\to 1}\frac{(x-1)(x+1)(x^2+1)}{x-1}=4$$

And- $\lim_{x\to k}\frac{x^3-k^3}{x^2-k^2}=\lim_{x\to k}\frac{(x-k)(x^2+k^2+xk)}{(x-k)(x+k)}=\frac{3}{2}k$

But it is given that-

$$\lim_{x\to 1}\frac{x^4-1}{x-1}=\lim_{x\to k}\frac{x^3-k^3}{x^2-k^2},$$



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$\frac{3}{2}k = 4$

$k = \frac{8}{3}$

114. Ans. A.

Circumference of circle= $2\pi r$ (r is the radius of the circle)

Change in circumference= $2\pi \frac{dr}{dt}$ ( $\frac{dr}{dt}$ is given as 0.7 cm/sec.)

=4.4 cm/sec

115. Ans. D.

$\lim_{x \to 1} \frac{x + x^2 + x^3 - 3}{x - 1}$

Applying L'Hospital Rule,

$\lim_{x \to 1} \frac{1 + 2x + 3x^2}{1} = 6$

116. Ans. B.

We know that if three vectors are coplanar then their Scalar Triple Product is 0.

Scalar Triple product is defined as

$[abc] = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}$

Where $\bar{a} = a_1 \hat{i} + a_2 \hat{j} + a_3 \hat{k}$

$\bar{b} = b_1 \hat{i} + b_2 \hat{j} + b_3 \hat{k}$

$\bar{c} = c_1 \hat{i} + c_2 \hat{j} + c_3 \hat{k}$



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$$[abc]=\begin{vmatrix} 2 & 1 & 0 \\ -3 & 2 & 1 \\ 1 & -3 & p \end{vmatrix}=0$$

Hence, =2(2p+3)-1(-3p-1) =7p+7

7p+7=0

P=-1

117. Ans. A.

We know that

$$|\vec{a}\times\vec{b}|^2+|\vec{a}\cdot\vec{b}|^2=|\vec{a}|^2|\vec{b}|^2$$

$$144=(4)^2|\vec{b}|^2$$

$$|\vec{b}| = \pm 3$$

118. Ans. C.

Let AB & BC be the consecutive sides of the given parallelogram.

Then the diagonals of the parallelogram is defined by =AB-BC & AB+BC

AB-BC = $\hat{i}-2\hat{j}+8\hat{k}$

AB+BC = $3\hat{i}-6\hat{j}+2\hat{k}$

Their dot product is given as=31

Hence magnitude = 31

119. Ans. C.

Let α, β and γ are the angles vector OA makes with the x,y and z axis respectively.

Then,



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$$\cos^2\alpha+\cos^2\beta+\cos^2\gamma=1$$

$$\frac{1}{2}+\frac{1}{4}+\cos^2\gamma=1 \qquad [\alpha=45^o,\beta=60^o]$$

$$\cos^2\gamma=\frac{1}{4}$$

$$\cos\gamma=\pm\frac{1}{2}$$

It is given that

$$\overline{OA}=\left|\overline{OA}\right|(\cos\alpha\,\hat{i}+\cos\beta\,\hat{j}+\cos\gamma\,\hat{k})$$

$= 6\sqrt{2}\,\hat{j}+6\hat{i}\pm6\hat{k}$

120. Ans. A.

. $\bar{a}$ is defined as-

$\bar{a}=|\bar{a}|\cos\theta\,\hat{i}+|\bar{a}|\sin\theta\,\hat{j}$ where $\theta$ is the angle made by the vector with positive x-axis.

$=(1)\cos 30^0\,\hat{i}+(1)\sin 30^0\,\hat{j}$

$=\frac{\sqrt{3}\,\hat{i}+1\,\hat{j}}{2}$



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