26th Feb. 2021 | Shift - 1
MATHEMATICS

JEE I NEET I Foundation

MOTION™

25000+
SELECTIONS SINCE 2007

Topic :- P & C
Subtopic:- (M217)
Level :- Easy

1. The number of seven digit integers with sum of the digits equal to 10 and formed by using the digits 1, 2 and 3 only is

(1) 77
(2) 42
(3) 35
(4) 82

केवल अकों 1, 2 तथा 3 के प्रयोग से सात अंको के पूर्णांको, जिनके अंको का योगफल 10 है, की संख्या है :

(1) 77
(2) 42
(3) 35
(4) 82

Ans. (1)

Sol. CASE-I: 1, 1, 1, 1, 1, 2, 3

$$\text{WAYS} = \frac{7!}{5!} = 42$$

CASE-II: 1, 1, 1, 1, 2, 2, 2

$$\text{WAYS} = \frac{7!}{4!\cdot 3!} = 35$$

TOTAL WAYS = 42 + 35 = 77

Topic :- B.t.
Subtopic:- (M25)
Level :- Medium

2. The maximum value of the term independent of 't' in the expansion of $\left(tx^{\frac{1}{5}}+\frac{(1-x)^{\frac{1}{10}}}{t}\right)^{10}$ where $x \in (0,1)$ is:

(1) $\frac{10!}{\sqrt{3}(5!)^2}$

(2) $\frac{2.10!}{3(5!)^2}$

(3) $\frac{10!}{3(5!)^2}$

(4) $\frac{2.10!}{3\sqrt{3}(5!)^2}$

$\left(tx^{\frac{1}{5}}+\frac{(1-x)^{\frac{1}{10}}}{t}\right)^{10}$, जहाँ $x \in (0,1)$ है, के प्रसार में, 't' से स्वतंत्र पद का अधिकतम मान है :

(1) $\frac{10!}{\sqrt{3}(5!)^2}$

(2) $\frac{2.10!}{3(5!)^2}$

(3) $\frac{10!}{3(5!)^2}$

(4) $\frac{2.10!}{3\sqrt{3}(5!)^2}$

Ans. (4)

Sol. $T_{r+1} = {}^{10}C_r (tx^{1/5})^{10-r}\left[\frac{(1-x)^{1/10}}{t}\right]^r$

$= {}^{10}C_r t^{(10-2r)} \times x^{\frac{10-r}{5}} \times (1-x)^{\frac{r}{10}}$

$\Rightarrow$ 10 – 2r = 0 $\Rightarrow$ r = 5

$T_6 = {}^{10}C_5 x\sqrt{1-x}$

$\frac{dT_6}{dx} = {}^{10}C_5\left[\sqrt{1-x} - \frac{x}{2\sqrt{1-x}}\right] = 0$

= 1 – x = x/2 $\Rightarrow$ 3x = 2

$\Rightarrow$ x = 2/3

$$T_6|_{max} = \frac{10!}{5!5!} \times \frac{2}{3\sqrt{3}}$$

Topic :- D.I.
Subtopic:- (M108)
Level :- Medium

3. The value of $\sum_{n=1}^{100} \int_{n-1}^{n} e^{x-[x]}dx$, where [x] is the greatest integer $\leq x$, is:

(1) 100 (e–1)
(2) 100e
(3) 100(1-e)
(4) 100 (1 + e)

$\sum_{n=1}^{100} \int_{n-1}^{n} e^{x-[x]}dx$, जहाँ [x] महत्तम पूर्णांक $\leq x$ है, का मान है :

(1) 100 (e–1)
(2) 100e
(3) 100(1-e)
(4) 100 (1 + e)

Ans. **(1)**

Sol. $\sum_{n=1}^{100} \int_{n-1}^{n} e^{x-[x]}dx$

$$= \int_0^1 e^{\{x\}}dx + \int_1^2 e^{\{x\}}dx + \int_2^3 e^{\{x\}}dx + \ldots\ldots + \int_{99}^{100} e^{\{x\}}dx \quad (\because \{x\} = x - [x])$$

$$= e^x|_0^1 + e^{(x-1)}|_1^2 + e^{(x-2)}|_2^3 + \ldots\ldots + e^{(x-99)}|_{99}^{100}$$

$$= (e-1) + (e-1) + (e-1) + \ldots..(e-1)$$

$$= 100(e-1)$$

Topic :- Tangent & Normal
Subtopic:- (M291)
Level :- Medium

4. The rate of growth of bacteria in a culture is proportional to the number of bacteria present and the bacteria count is 1000 at initial time t = 0. The number of bacteria is increased by 20% in 2 hours. If the population of bacteria is 2000 after $\frac{k}{\log_e\left(\frac{6}{5}\right)}$ hours, then $\left(\frac{k}{\log_e 2}\right)^2$ is equal to

(1) 4
(2) 2
(3) 16
(4) 8

एक कलचर में जीवाणुओं की वृद्धि की दर जीवाणुओं की संख्या के समानुपातिक है तथा प्रारम्भ में समय t = 0 पर जीवाणुओं की संख्या 1000 है। 2 घंटों में जीवाणुओं की संख्या में 20% की वृद्धि होती है। यदि $\frac{k}{\log_e\left(\frac{6}{5}\right)}$ घंटो के पश्चात् जीवाणुओं की संख्या 2000 है, तो $\left(\frac{k}{\log_e 2}\right)^2$ बराबर है :

(1) 4
(2) 2
(3) 16
(4) 8

Ans. **(1)**

Sol. $\frac{dx}{dt} \propto x$

$\frac{dx}{dt} = \lambda x$

$\int_{1000}^{x} \frac{dx}{x} = \int_{0}^{t} \lambda dt$

$\ln x - \ln 1000 = \lambda t$

$\ln\left(\frac{x}{1000}\right) = \lambda t$

Put t = 2, x = 1200

$\ln\left(\frac{12}{10}\right) = 2\lambda \Rightarrow \lambda = \frac{1}{2}\ln\frac{6}{5}$

Now $\ln\left(\frac{x}{1000}\right) = \frac{t}{2}\ln\left(\frac{6}{5}\right)$

$x = 1000e^{\frac{t}{2}\ln\left(\frac{6}{5}\right)}$

$x = 2000$ at $t = \dfrac{k}{\ln\left(\frac{6}{5}\right)}$

$\Rightarrow 2000 = 1000\ e^{\frac{k}{2\ln(6/5)}\times\ln(6/5)}$

$\Rightarrow 2 = e^{k/2}$

$\Rightarrow \ln 2 = \dfrac{k}{2}$

$\Rightarrow \dfrac{k}{\ln 2} = 2$

$\Rightarrow \left(\dfrac{k}{\ln 2}\right)^2 = 4$

Topic :- Vector
Subtopic:- (M163)
Level :- Easy

5. If $\vec{a}$ & $\vec{b}$ are perpendicular vactors, then $\vec{a}\times\left(\vec{a}\times\left(\vec{a}\times\left(\vec{a}\times\vec{b}\right)\right)\right)$ is equal to

(1) $\frac{1}{2}|\vec{a}|^4\vec{b}$

(2) $\vec{a}\times\vec{b}$

(3) $|\vec{a}|^4\vec{b}$

(4) $\vec{0}$

यदि $\vec{a}$ तथा $\vec{b}$ लंबवत हैं, तो $\vec{a}\times\left(\vec{a}\times\left(\vec{a}\times\left(\vec{a}\times\vec{b}\right)\right)\right)$ बराबर है :

(1) $\frac{1}{2}|\vec{a}|^4\vec{b}$

(2) $\vec{a}\times\vec{b}$

(3) $|\vec{a}|^4\vec{b}$

(4) $\vec{0}$

Ans. (3)

Sol. $\vec{a}\times\left(\vec{a}\times\left((\vec{a}.\vec{b})\vec{a}-|\vec{a}|^2\vec{b}\right)\right)$

$\vec{a}\times(-|\vec{a}|^2(\vec{a}\times\vec{b})) = -|\vec{a}|^2((\vec{a}.\vec{b})\vec{a}-|\vec{a}|^2\vec{b})$

$= -(\vec{a}.\vec{b})\vec{a}|\vec{a}|^2+|\vec{a}|^4\vec{b}$

$= |\vec{a}|^4\vec{b}\quad(\because \vec{a}\cdot\vec{b}=0)$

Topic :- S & P
Subtopic:- (M17)
Level :- Medium

6. In an increasing, geometric series, the sum of the second and the sixth term is $\frac{25}{2}$ and the product of the third and fifth term is 25. Then, the sum of 4^{th}, 6^{th} and 8^{th} terms is equal to:
(1) 35
(2) 30
(3) 26
(4) 32

एक वर्धमान गुणोत्तर श्रेणी में, दूसरे तथा छठे पदों का योगफल $\frac{25}{2}$ है और तीसरे तथा पाँचवें पदों का गुणनफल 25 है, तो चौथे, छठे तथा आठवें पदों का योगफल है :
(1) 35
(2) 30
(3) 26
(4) 32

Ans (1)

Sol. $ar + ar^5 = \frac{25}{2}$

$ar^2 \times ar^4 = 25$

$a^2r^6 = 25$

$ar^3 = 5$

$\boxed{a = \frac{5}{r^3}}$ ....(1)

$\frac{5r}{r^3} + \frac{5r^5}{r^3} = \frac{25}{2}$

$\frac{1}{r^2} + r^2 = \frac{5}{2}$

Put $r^2 = t$

$\frac{t^2+1}{t} = \frac{5}{2}$

$2t^2 - 5t + 2 = 0$

$2t^2 - 4t - t + 2 = 0$

$(2t - 1)(t - 2) = 0$

$t = \frac{1}{2}, 2 \Rightarrow \boxed{r^2 = \frac{1}{2}, 2}$

$\boxed{r = \sqrt{2}}$

$= ar^3 + ar^5 + ar^7$

$= ar^3 (1 + r^2 + r^4)$

$= 5[1 + 2 + 4] = 35$

Topic :- 3D
Subtopic:- (M178)
Level :- Easy

7. Consider the three planes

$P_1: 3x + 15y + 21z = 9,$

$P_2: x - 3y - z = 5,$ and

$P_3: 2x + 10y + 14z = 5$

Then, which one of the following is true?

(1) P_1 and P_3 are parallel.

(2) P_2 and P_3 are parallel.

(3) P_1 and P_2 are parallel.

(4) P_1, P_2 and P_3 all are parallel.

तीन समतलों

$P_1: 3x + 15y + 21z = 9,$

$P_2: x - 3y - z = 5$ तथा

$P_3: 2x + 10y + 14z = 5$

का विचार कीजिए। तब, निम्न में से कौन सा एक सत्य है ?

(1) P_1 तथा P_3 समांतर है

(2) P_2 तथा P_3 समांतर है

(3) P_1 तथा P_2 समांतर है

(4) P_1, P_2 तथा P_3 तीनों समांतर है

Ans. (1)

Sol. $P_1 = x + 5y + 7z = 3$

$P_2 = x - 3y - z = 5$

$P_3 = x + 5y + 7z = 5/2$

$\Rightarrow P_1 || P_3$

Topic :- S & P
Subtopic:- (M18)
Level :- Easy

8. The sum of the infinite series $1+\frac{2}{3}+\frac{7}{3^2}+\frac{12}{3^3}+\frac{17}{3^4}+\frac{22}{3^5}+...$ is equal to

(1) $\frac{9}{4}$

(2) $\frac{15}{4}$

(3) $\frac{13}{4}$

(4) $\frac{11}{4}$

अनन्त श्रेणी $1+\frac{2}{3}+\frac{7}{3^2}+\frac{12}{3^3}+\frac{17}{3^4}+\frac{22}{3^5}+...$ को योग बराबर है :

(1) $\frac{9}{4}$

(2) $\frac{15}{4}$

(3) $\frac{13}{4}$

(4) $\frac{11}{4}$

Ans. (3)

Sol. $s=1+\frac{2}{3}+\frac{7}{3^2}+\frac{12}{3^3}+\frac{17}{3^4}+\frac{22}{3^5}+....$

$\frac{s}{3}= \quad \frac{1}{3}+\frac{2}{3^2}+\frac{7}{3^3}+.....\infty$

$\frac{2s}{3}=1+\frac{1}{3}+\frac{5}{3^2}+\frac{5}{3^3}+.....\infty$

$\frac{2s}{3}=\frac{4}{3}+\frac{5}{3}\left\{\frac{1/3}{1-\frac{1}{3}}\right\}=\frac{5}{6}+\frac{4}{3}=\frac{13}{6}$

$\boxed{s=\frac{13}{4}}$

Topic :- Determinant
Subtopic:- (M186)
Level :- Easy

9. The value of $\begin{vmatrix}(a+1)(a+2) & a+2 & 1\\ (a+2)(a+3) & a+3 & 1\\ (a+3)(a+4) & a+4 & 1\end{vmatrix}$ is

(1) –2
(2) (a+1) (a+2) (a+3)
(3) 0
(4) (a+2) (a+3) (a+4)

$\begin{vmatrix}(a+1)(a+2) & a+2 & 1\\ (a+2)(a+3) & a+3 & 1\\ (a+3)(a+4) & a+4 & 1\end{vmatrix}$ का मान है :

(1) –2
(2) (a+1) (a+2) (a+3)
(3) 0
(4) (a+2) (a+3) (a+4)

Ans. (1)

Sol. $C_1 \to C_1 - C_2,\ C_2 \to C_2 - C_3$

$$= \begin{vmatrix}(a+2)a & a+1 & 1\\ (a+3)(a+1) & a+2 & 1\\ (a+4)(a+2) & a+3 & 1\end{vmatrix}$$

$R_2 \to R_2 - R_1$ & $R_3 \to R_3 - R_1$

$$= \begin{vmatrix}a^2+2a & a+1 & 1\\ 2a+3 & 1 & 0\\ 4a+8 & 2 & 0\end{vmatrix}$$

$= 6 - 8 = -2$

Topic :- ITF
Subtopic:- (M128)
Level :- Easy

10. If $\frac{\sin^{-1}x}{a}=\frac{\cos^{-1}x}{b}=\frac{\tan^{-1}y}{c};0<x<1,$ then the value of $\cos\left(\frac{\pi c}{a+b}\right)$ is:

(1) $\frac{1-y^2}{2y}$

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

(3) $1-y^2$

(4) $\frac{1-y^2}{y\sqrt{y}}$

यदि $\frac{\sin^{-1}x}{a}=\frac{\cos^{-1}x}{b}=\frac{\tan^{-1}y}{c};0<x<1,$ तो $\cos\left(\frac{\pi c}{a+b}\right)$ का मान है :

(1) $\frac{1-y^2}{2y}$

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

(3) $1-y^2$

(4) $\frac{1-y^2}{y\sqrt{y}}$

Ans. (2)

Sol. $\frac{\sin^{-1}x}{a}=\frac{\cos^{-1}x}{b}=\frac{\tan^{-1}y}{c}$

$\frac{\sin^{-1}x}{a}=\frac{\cos^{-1}x}{b}=\frac{\sin^{-1}x+\cos^{-1}x}{a+b}=\frac{\pi}{2(a+b)}$

Now, $\frac{\tan^{-1}y}{c}=\frac{\pi}{2(a+b)}$

$2\tan^{-1}y=\frac{\pi c}{a+b}$

$\Rightarrow\cos\left(\frac{\pi c}{a+b}\right)=\cos\left(2\tan^{-1}y\right)=\frac{1-y^2}{1+y^2}$

Topic :- matrix
Subtopic:- (M185)
Level :- Easy

11. Let A be a symmetric matrix of order 2 with integer entries. If the sum of the diagonal elements of A^2 is 1, then the possible number of such matrices is:

(1) 6
(2) 1
(3) 4
(4) 12

माना A एक 2 कोटि का सममित आव्यूह है, जिसके अवयव पूर्णांक हैं। यदि A^2 के विकर्ण के अवयवों का योगफल 1 है, तो ऐसे आव्यूहों की संभावित संख्या है :

(1) 6
(2) 1
(3) 4
(4) 12

Ans. (3)

Sol. Let $A = \begin{bmatrix} a & b \\ b & c \end{bmatrix}$

$$A^2 = \begin{bmatrix} a & b \\ b & c \end{bmatrix}\begin{bmatrix} a & b \\ b & c \end{bmatrix} = \begin{bmatrix} a^2+b^2 & ab+bc \\ ab+bc & c^2+b^2 \end{bmatrix}$$

$= a^2 + 2b^2 + c^2 = 1$

$a = 1, b = 0, c = 0$

$a = 0, b = 0, c = 1$

$a = -1, b = 0, c = 0$

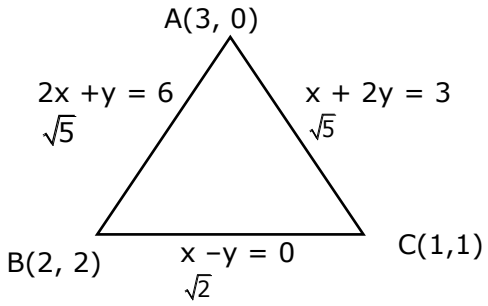
$c = -1, b = 0, a = 0$

Topic :- St. Line
Subtopic:- (M79)
Level :- Easy

12. The intersection of three lines $x-y = 0$, $x + 2y = 3$ and $2x + y = 6$ is a:
(1) Equilateral triangle
(2) None of the above
(3) Isosceles triangle
(4) Right angled triangle
तीन रेखाओं $x-y = 0$, $x + 2y = 3$ तथा $2x + y = 6$ का प्रतिच्छेदन :
(1) एक समबाहु त्रिभुज है
(2) इनमें से कोई नहीं है
(3) एक समद्विबाहु त्रिभुज है
(4) एक समकोण त्रिभुज है

Ans. (3)

Sol.



Topic :- Maxima & minima
Subtopic:- (M306)
Level :- Medium

13. The maximum slope of the curve $y = \frac{1}{2}x^4 - 5x^3 + 18x^2 - 19x$ occurs at the point:

(1) (2, 9)
(2) (2,2)
(3) $\left(3, \frac{21}{2}\right)$
(4) (0, 0)

वक्र $y = \frac{1}{2}x^4 - 5x^3 + 18x^2 - 19x$ की अधिकतम प्रवणता निम्न में से किस बिंदु पर है ?

(1) (2, 9)
(2) (2,2)
(3) $\left(3, \frac{21}{2}\right)$
(4) (0, 0)

Ans. **(2)**

Sol. $\frac{dy}{dx} = 2x^3 - 15x^2 + 36x - 19$

Let $f(x) = 2x^3 - 15x^2 + 36x - 19$

$f'(x) = 6x^2 - 30x + 36 = 0$

$x^2 - 5x + 6 = 0$

$\boxed{x = 2, 3}$

$f''(x) = 12x - 30$

$f''(x) < 0$ for $\boxed{x = 2}$

At $\boxed{x = 2}$

$y = 8 - 40 + 72 - 38$

$y = 72 - 70 = 2$

$\Rightarrow (2,2)$

Topic :- Differentiability
Subtopic:- (M74)
Level :- Medium

14. Let *f* be any function defined on R and let it satisfy the condition:

$(|f(x)-f(y)| \le |(x-y)^2|, \forall (x,y) \in R$

If f(0) = 1, then:

(1) f(x) < 0, $\forall x \in R$

(2) f(x) can take any value in R

(3) f(x) = 0, $\forall\ x \in R$

(4) f(x) >0, $\forall\ x \in R$

माना R पर परिभाषित कोई फलन *f* है तथा माना यह $|f(x)-f(y)| \le |(x-y)^2|, \forall (x,y) \in R$ को संतुष्ट करता है। यदि *f*(0) = 1 है, तो :

(1) f(x) < 0, $\forall x \in R$

(2) f(x), R में कोई भी मान ले सकता है

(3) f(x) = 0, $\forall\ x \in R$

(4) f(x) >0, $\forall\ x \in R$

Ans. (4)

Sol. $|f(x)-f(y)| \le |(x-y)^2|, \forall (x,y) \in R$

$$\left|\frac{f(x)-f(y)}{x-y}\right| \le |x-y|$$

$$\lim_{x \to y} \left|\frac{f(x)-f(y)}{x-y}\right| \le 0$$

$$|f'(y)| \le 0 \Rightarrow f'(y) = 0$$

$$f(y) = C$$

$$\Rightarrow \boxed{c = 1} \because f(0) = 1$$

$$\Rightarrow f(x) = 1$$

Topic :- D.I.
Subtopic:- (M111)
Level :- Easy

15. The value of $\int_{-\pi/2}^{\pi/2} \frac{\cos^2 x}{1+3^x}\,dx$ is:

(1) 2π
(2) 4π
(3) $\frac{\pi}{2}$
(4) $\frac{\pi}{4}$

$\int_{-\pi/2}^{\pi/2} \frac{\cos^2 x}{1+3^x}\,dx$ का मान है :

(1) 2π
(2) 4π
(3) $\frac{\pi}{2}$
(4) $\frac{\pi}{4}$

Ans. (4)

Sol. Let $I = \int_{-\pi/2}^{\pi/2} \frac{\cos^2 x}{1+3^x}\,dx$

$$I = \int_{-\pi/2}^{\pi/2} \frac{3^x \cos^2 x}{1+3^x}\,dx$$

$$2I = \int_{-\pi/2}^{\pi/2} \cos^2 x\,dx$$

$$I = \int_{0}^{\pi/2} \cos^2 x\,dx = \frac{\pi}{4}$$

Topic :- Limit
Subtopic:- (M49)
Level :- Medium

16. The value of $\lim\limits_{h\to 0}\left\{\dfrac{\sqrt{3}\sin\left(\frac{\pi}{6}+h\right)-\cos\left(\frac{\pi}{6}+h\right)}{\sqrt{3}h\left(\sqrt{3}\cosh-\sinh\right)}\right\}$ is:

(1) $\frac{3}{4}$

(2) $\frac{2}{\sqrt{3}}$

(3) $\frac{4}{3}$

(4) $\frac{2}{3}$

$\lim\limits_{h\to 0}\left\{\dfrac{\sqrt{3}\sin\left(\frac{\pi}{6}+h\right)-\cos\left(\frac{\pi}{6}+h\right)}{\sqrt{3}h\left(\sqrt{3}\cosh-\sinh\right)}\right\}$ का मान है :

(1) $\frac{3}{4}$

(2) $\frac{2}{\sqrt{3}}$

(3) $\frac{4}{3}$

(4) $\frac{2}{3}$

Ans. (3)

Sol. $\lim\limits_{h\to 0} 2\times 2\left\{\dfrac{\sin\left(\frac{\pi}{6}+h-\frac{\pi}{6}\right)}{2\sqrt{3}h\left(\cos(h+\frac{\pi}{6})\right)}\right\}$

$= \frac{2}{\sqrt{3}}\times\frac{2}{\sqrt{3}} = \frac{4}{3}$

Topic :- Probability
Subtopic:- (M232)
Level :- Medium

17. A fair coin is tossed fixed number of times. If the probability of getting 7 heads is equal to probability of getting 9 heads, then the probability of getting 2 heads is:

(1) $\frac{15}{2^{12}}$

(2) $\frac{15}{2^{13}}$

(3) $\frac{15}{2^{14}}$

(4) $\frac{15}{2^{8}}$

एक निष्पक्ष सिक्के को एक निश्चित बार उछाला जाता है। यदि 7 चित आने की प्रायिकता, 9 चित आने की प्रायिकता के बराबर है, तो 2 चित आने की प्रायिकता है :

(1) $\frac{15}{2^{12}}$

(2) $\frac{15}{2^{13}}$

(3) $\frac{15}{2^{14}}$

(4) $\frac{15}{2^{8}}$

Ans. (2)

Sol. $p(x=9)=p(x=7)$

$${}^{n}C_{9}\left(\frac{1}{2}\right)^{n-9}\times\left(\frac{1}{2}\right)^{9}={}^{n}C_{7}\left(\frac{1}{2}\right)^{n-7}\times\left(\frac{1}{2}\right)^{7}$$

$${}^{n}C_{9}\times\left(\frac{1}{2}\right)^{2}=\left(\frac{1}{2}\right)^{2}\times{}^{n}C_{7}$$

$x+y=n\Rightarrow\ n=16$

$$p(x=2)={}^{16}C_{2}\times\left(\frac{1}{2}\right)^{14}\times\left(\frac{1}{2}\right)^{2}$$

$$={}^{16}C_{2}\times\left(\frac{1}{2}\right)^{16}=\frac{15}{2^{13}}$$

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Topic :- Vector
Subtopic:- (M159)
Level :- Easy

18. If (1, 5, 35), (7, 5, 5), (1, λ, 7) and (2λ, 1, 2) are coplanar, then the sum of all possible values of λ is:

(1) $-\frac{44}{5}$

(2) $\frac{39}{5}$

(3) $-\frac{39}{5}$

(4) $\frac{44}{5}$

यदि (1, 5, 35), (7, 5, 5), (1, λ, 7) तथा (2λ, 1, 2) समतलीय हैं, तो λ के सभी संभव मानों का योगफल है :

(1) $-\frac{44}{5}$

(2) $\frac{39}{5}$

(3) $-\frac{39}{5}$

(4) $\frac{44}{5}$

Ans. (4)

Sol. Let P(1, 5, 35), Q(7, 5, 5), R(1, λ, 7), S(2λ, 1, 2)

$$\left[\vec{PQ}\ \ \vec{PR}\ \ \vec{PS}\right] = 0$$

$$\begin{vmatrix} 6 & 0 & -30 \\ 0 & \lambda-5 & -28 \\ 2\lambda-1 & -4 & -33 \end{vmatrix} = 0$$

$$\begin{vmatrix} 1 & 0 & -5 \\ 0 & \lambda-5 & -28 \\ 2\lambda-1 & -4 & -33 \end{vmatrix} = 0$$

$$\{-33\lambda+165-112\}+5(\lambda-5)(2\lambda-1)=0$$

$$53-33\lambda+5\{2\lambda^2-11\lambda+5\}=0$$

$$16\lambda^2-88\lambda+78=0$$

$$5\lambda^2-44\lambda+39=0 \quad \lambda_1, \lambda_2$$

$$\Rightarrow \lambda_1+\lambda_2 = 44/5$$

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Topic :- Set & Relation
Subtopic:- Set & Relation
Level :- Medium

19. Let R = {(P,Q)|P and Q are at the same distance from the origin} be a relation, then the equivalence class of (1,–1) is the set:

(1) S = $\{(x,y)|x^2+y^2=1\}$

(2) S = $\{(x,y)|x^2+y^2=4\}$

(3) S = $\{(x,y)|x^2+y^2=\sqrt{2}\}$

(4) S = $\{(x,y)|x^2+y^2=2\}$

माना R = {(P,Q)|P तथा Q, मूलबिंदु से समान दूरी पर} एक संबंध है। तो (1,–1) का तुल्यता–वर्ग निम्न में से कौन सा समुच्चय है ?

(1) S = $\{(x,y)|x^2+y^2=1\}$

(2) S = $\{(x,y)|x^2+y^2=4\}$

(3) S = $\{(x,y)|x^2+y^2=\sqrt{2}\}$

(4) S = $\{(x,y)|x^2+y^2=2\}$

Ans. **(4)**

Sol. P(a, b) , Q(c, d), PO = QO

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

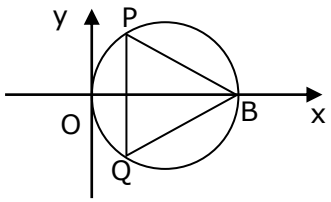
R(x,y) s = (1, –1) $\Rightarrow$RO = SO

($\because$ equivalence class)

$x^2 + y^2 = 2$

Topic :- Circle
Subtopic:- (M92)
Level :- Easy

20. In the circle given below, let OA = 1 unit, OB = 13 unit and PQ $\perp$ OB. Then, the area of the triangle PQB (in square units) is:



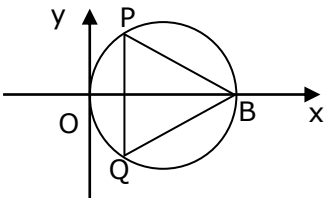
(1) $26\sqrt{3}$

(2) $24\sqrt{2}$

(3) $24\sqrt{3}$

(4) $26\sqrt{2}$

नीचे दिए वृत में, माना OA = 1 इकाई, OB = 13 इकाई तथा PQ ⊥ OB है। तो त्रिभुज PQB का क्षेत्रफल (वर्ग इकाईयों में) है :



(1) $26\sqrt{3}$

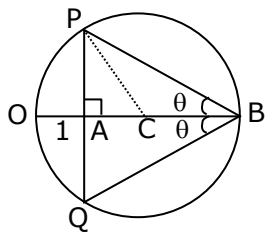
(2) $24\sqrt{2}$

(3) $24\sqrt{3}$

(4) $26\sqrt{2}$

Ans. (3)

Sol.



$OC = \frac{13}{2} = 6.5$

$AC = CO - AO$

$= 6.5 - 1$

$= 5.5$

In ΔPAC

$PA = \sqrt{6.5^2 - 5.5^2}$

$PA = \sqrt{12}$

$\Rightarrow PQ = 2PA = 2\sqrt{12}$

Now, area of $\Delta PQB = \frac{1}{2} \times PQ \times AB$

$= \frac{1}{2} \times 2\sqrt{12} \times 12$

$= 12\sqrt{12}$

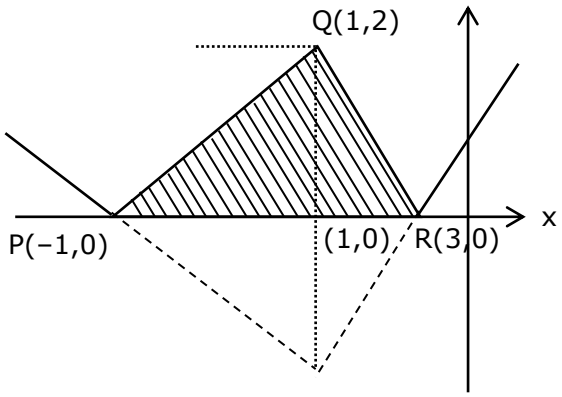
$= 24\sqrt{3}$

Section-B

Topic :- AUC
Subtopic:- (M144)
Level :- Easy

1. The area bounded by the lines $y = ||x-1|-2|$ is.....
रेखाओं $y = ||x-1|-2|$ द्वारा घिरे क्षेत्र का क्षेत्रफल है .....।

Ans. **Bonus**
NTA Ans. (8)
Sol.



Topic :- Trigo Phase - 1
Subtopic:- (M249)
Level :- Medium

2. The number of integral values of 'k' for which the equation $3\sin x + 4\cos x = k + 1$ has a solution, $k \in R$ is _____.
'k' के पूर्णांकीय मानों, जिनके लिए समीकरण $3\sin x + 4\cos x = k + 1$ का एक हल है, $k \in R$ है, की संख्या है _____।

Ans. **(11)**

Sol. $3\sin x + 4\cos x = k+1$

$-5 \le k+1 \le 5$

$-6 \le k \le 4$

$\boxed{-6,-5,-4,-3,-2,-1,0,1,2,3,4} \Rightarrow$ 11 integral values

Topic :- B.T.
Subtopic:- (M28)
Level :- Tough

3. Let $m, n \in N$ and gcd (2, n) = 1. If $30\binom{30}{0}+29\binom{30}{1}+....+2\binom{30}{28}+1\binom{30}{29}=n\cdot 2^m$,

then n + m is equal to_____.

माना $m, n \in N$ and gcd (2, n) = 1 है। यदि $30\binom{30}{0}+29\binom{30}{1}+....+2\binom{30}{28}+1\binom{30}{29}=n\cdot 2^m$ है,

तो n + m बराबर है_____।

Ans. (45)

Sol. Let $S=\sum_{r=0}^{30}(30-r)\ {}^{30}C_r$

$=30\sum_{r=0}^{30}{}^{30}C_r-\sum_{r=0}^{30}r\ {}^{30}C_r$

$=20\times 2^{30}-\sum_{r=1}^{30}r.\frac{30}{4}.{}^{29}C_{r-1}$

$=30\times 2^{30}-30.2^{29}$

$= (30\times 2 - 30).2^{29} = 30.2^{29} \Rightarrow 15.2^{30}$

$= n = 15,\ m = 30$

$n + m = 45$

Topic :- D.E.
Subtopic:- (M137)
Level :- Medium

4. If y = y(x) is the solution of the equation $e^{siny}\ cosy\ \frac{dy}{dx}+e^{siny}\cos x=\cos x, y(0)=0$; then

$1+y\left(\frac{\pi}{6}\right)+\frac{\sqrt{3}}{2}y\left(\frac{\pi}{3}\right)+\frac{1}{\sqrt{2}}y\left(\frac{\pi}{4}\right)$ is equal to _____.

यदि समीकरण $e^{siny}\ cosy\ \frac{dy}{dx}+e^{siny}\cos x=\cos x, y(0)=0$ का हल y = y(x) है, तो

$1+y\left(\frac{\pi}{6}\right)+\frac{\sqrt{3}}{2}y\left(\frac{\pi}{3}\right)+\frac{1}{\sqrt{2}}y\left(\frac{\pi}{4}\right)$ बराबर है_____।

Ans. (1)

Sol. $e^{siny}\cos y\frac{dy}{dx}+e^{siny}\cos x=\cos x$

Put $e^{siny}=t$

$e^{\sin y} \times \cos y \frac{dy}{dx} = \frac{dt}{dx}$

$\Rightarrow \frac{dt}{dx} + t\cos x = \cos x$

I.F. = $e^{\int \cos x dx} = e^{\sin x}$

Solution of diff equation:

$t.e^{\sin x} = \int e^{\sin x}.\cos x dx$

$e^{\sin y}.e^{\sin x} = e^{\sin x} + c$

at x = 0, y = 0

1 = 1 + c $\Rightarrow$c = 0

$e^{\sin x + \sin y} = e^{\sin x}$

sinx + siny = sin x

y = 0

$\Rightarrow y\left(\frac{\pi}{6}\right) = 0, \quad y\left(\frac{\pi}{3}\right) = 0, \quad y\left(\frac{\pi}{4}\right) = 0$

$\Rightarrow$ 1 + 0 + 0 + 0 = 1

Topic :- Basic log

Subtopic:- (M3)

Level :- Easy

5. The number of solutions of the equation $\log_4(x-1) = \log_2(x-3)$ is _____.

समीकरण $\log_4(x-1) = \log_2(x-3)$ के हलों की संख्या है _____।

Ans. **(1)**

Sol. $\frac{1}{2}\log_2(x-1) = \log_2(x-3)$

$x - 1 = (x-3)^2$

$x^2 - 6x + 9 = x - 1$

$x^2 - 7x + 10 = 0$

$x = 2, 5$

X = 2 Not possible as $\log_2(x-3)$ is not defined

$\Rightarrow$ No. of solution = 1

Topic :- Trigo. Phase - II
Subtopic:- (M32)
Level :- Medium

6. If $\sqrt{3}(\cos^2 x) = (\sqrt{3}-1)\cos x + 1$, the number of solutions of the given equation when $x \in \left[0, \frac{\pi}{2}\right]$ is _____.

समीकरण $\sqrt{3}(\cos^2 x) = (\sqrt{3}-1)\cos x + 1$, जबकि $x \in \left[0, \frac{\pi}{2}\right]$, के हलों की संख्या है_____।

Ans. (1)

Sol. $\sqrt{3}t^2 - \left(\sqrt{3}-1\right)t - 1 = 0$ (where t = cosx)

Now, $t = \frac{\left(\sqrt{3}-1\right) \pm \sqrt{4+2\sqrt{3}}}{2\sqrt{3}}$

t = cos x = 1 or $-\frac{1}{\sqrt{3}} \rightarrow$ rejected as $x \in \left[0, \frac{\pi}{2}\right]$

$\Rightarrow$ cos x = 1

$\Rightarrow$No. of solution = 1

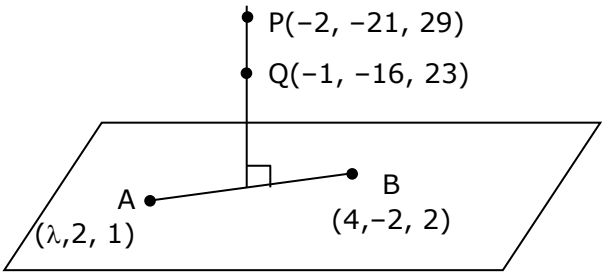
Topic :- 3D
Subtopic:- (M174)
Level :- Easy

7. Let (λ, 2, 1) be a point on the plane which passes through the point (4, –2, 2). If the plane is perpendicular to the line joining the point (–2, –21, 29) and (–1, –16, 23), then $\left(\frac{\lambda}{11}\right)^2 - \frac{4\lambda}{11} - 4$ is equal to _____.

माना बिंदु (4, –2, 2) से होकर जाने वाले एक समतल पर एक बिंदु (λ, 2, 1) है। यदि यह समतल, बिंदुओं (–2, –21, 29) तथा (–1, –16, 23) को मिलाने वाली रेखा के लंबवत है, तो $\left(\frac{\lambda}{11}\right)^2 - \frac{4\lambda}{11} - 4$ बराबर है_____।

Ans. (8)

Sol.



$\vec{AB} \perp \vec{PQ}$

$\left[(4-\lambda)\hat{i}-4\hat{j}+\hat{k}\right].\left[+\hat{i}+5\hat{j}-6\hat{k}\right]=0$

$4-\lambda-20-6=0$

$\boxed{\lambda=-22}$

Now , $\frac{\lambda}{11}=-2$

$\Rightarrow\left(\frac{\lambda}{11}\right)^2-\frac{4\lambda}{11}-4$

$\Rightarrow 4+8-4=8$

Topic :- D.E.
Subtopic:- (M133)
Level :- Easy

8. The difference between degree and order of differential equation that represents the family of curves given by $y^2=a\left(x+\frac{\sqrt{a}}{2}\right), a>0$ is _____.

$y^2=a\left(x+\frac{\sqrt{a}}{2}\right), a>0$ द्वारा दिए गए वक्र–कुल के अवकल समीकरण की घात तथा कोटि का अंतर है _____।

Ans. **(2)**

Sol. $y^2=a\left(x+\frac{\sqrt{a}}{2}\right)$

$2yy' = a$

$y^2 = 2yy'\left(x+\frac{\sqrt{2yy'}}{2}\right)$

$y = 2y'\left(x+\frac{\sqrt{yy'}}{\sqrt{2}}\right)$

$y - 2xy' = \sqrt{2}y'\sqrt{yy'}$

$\left(y-2x\frac{dy}{dx}\right)^2=2y\left(\frac{dy}{dx}\right)^3$

D = 3 & O = 1

D– O = 3 – 1 = 2

Topic :- Complex Number
Subtopic:- (M263)
Level :- Easy

9. The sum of 162^{th} power of the roots of the equation $x^3 - 2x^2 + 2x - 1 = 0$ is_____.
समीकरण $x^3 - 2x^2 + 2x - 1 = 0$ के मूलों की $162^{वीं}$ घातों का योगफल है_____।

Ans. (3)

Sol. Let roots of $x^3 - 2x^2 + 2x - 1 = 0$ are α, β, γ

$(x - 1)(x^2 - x + 1) = 0$

$x = \underset{\alpha}{1}, \underset{\beta}{-\omega}, \underset{\gamma}{-\omega^2}$

Now $\alpha^{162} + \beta^{162} + \gamma^{162}$

$= 1 + \omega^{162} + (\omega^2)^{162}$

$= 1 + (\omega^3)^{54} + (\omega^3)^{108}$

$= 3$

Topic :- D.I.
Subtopic:- (M112)
Level :- Easy

10. The value of the integeral $\int_0^{\pi} |\sin 2x|\, dx$ is _____

समाकलन $\int_0^{\pi} |\sin 2x|\, dx$ का मान बराबर है_____।

Ans. (2)

Sol. $I = \int_0^{\pi} |\sin 2x|\, dx$

$I = 2\int_0^{\pi/2} |\sin 2x|\, dx = 2\int_0^{\pi/2} \sin 2x\, dx$

$I = 2\left[\frac{-\cos(2x)}{2}\right]_0^{\pi/2} = 2$

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