



1. The range of $y = \frac{x^2 + 2x + 1}{x^2 - 8x + 12}$ is, for $x \in (2, 6)$

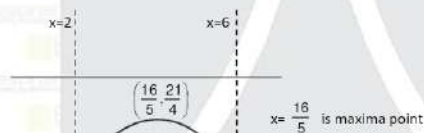
- (1) $(-\infty, \infty)$ (2) $(-\infty, \frac{21}{4}]$ (3) $(1, \infty)$ (4) $[\frac{21}{4}, \infty)$

Ans. (2)

Sol. $y = \frac{x^2 + 2x + 1}{x^2 - 8x + 12} = \frac{(x+1)^2}{(x-2)(x-6)}$... (1)
 $\Rightarrow \frac{dy}{dx} = \frac{-2(x+1)(5x-16)}{(x-2)^2(x-6)^2}$

Number line of $\frac{dy}{dx} =$

So Graph of $y = \frac{(x+1)^2}{(x-2)(x-6)}$ for $x \in (2, 6)$



at $x = \frac{16}{5}$ $y = \frac{21}{4}$ so range = $(-\infty, \frac{21}{4}]$

2. If the foci of hyperbola with eccentricity $\sqrt{2}$ are at $(1 \pm \sqrt{2}, 0)$ then the length of latusrectum is

- (1) $\sqrt{2}$ (2) 2 (3) $2\sqrt{2}$ (4) 4

Ans. (2)

Sol. $S(1 + \sqrt{2}, 0)$ $S'(1 - \sqrt{2}, 0)$
 $SS' = 2ae = 2\sqrt{2} \Rightarrow ae = \sqrt{2} \Rightarrow a\sqrt{2} = \sqrt{2} \Rightarrow a = 1$
 L. R. = $\frac{2b^2}{a} = \frac{2a^2(e^2 - 1)}{a} \Rightarrow 2a(e^2 - 1) = 2$

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3. If $\int_0^a \frac{x}{\sqrt{a+x}-\sqrt{x}} dx = \frac{16+20\sqrt{2}}{15}$, then the value of a is

- (1) 1 (2) 2 (3) 3 (4) 4

Ans. (2)

$$\int_0^a \frac{x(\sqrt{a+x}+\sqrt{x})}{a} dx = \frac{1}{a} \left[\int_0^a x\sqrt{a+x} dx + \int_0^a x^{3/2} dx \right]$$

$$\text{Put } a+x=t^2 \Rightarrow dx=2tdt$$

$$\frac{1}{a} \int_{\sqrt{a}}^{\sqrt{2a}} (t^2-a)2t^2 dt + \frac{2a^{3/2}}{5}$$

$$\frac{1}{a} \left[\frac{2t^5}{5} - \frac{2at^3}{3} \right]_{\sqrt{a}}^{\sqrt{2a}} + \frac{2a^{3/2}}{5}$$

$$\frac{4a\sqrt{2a}+10a\sqrt{a}}{15} = \frac{16+20\sqrt{2}}{15} \Rightarrow a=2$$

4. If a_n is n^{th} term and S_n is sum of n terms of an A.P. such that $a_7 = 6$, $S_n = 0$ and $a_n a_4$ is minimum then the value of $n! + a_n(n+2)$ is

- (1) 140 (2) 139 (3) 145 (4) 141

Ans. (4)

Sol. $a_7 = 6$

$$\Rightarrow a + 6d = 6$$

$$\Rightarrow a = 6 - 6d$$

$$a_n a_4 = a(a + 3d)$$

$$= (6 - 6d)(6 - 6d + 3d)$$

$$= 18(d-1)(d-2)$$

$$= 18(d^2 - 3d + 2)$$

$$\text{Let } f(d) = 18(d^2 - 3d + 2)$$

$$f'(d) = 18(2d - 3)$$

$$\text{at } d = \frac{3}{2}, a_n a_4 \text{ is minimum}$$

$$\text{So, } a = 6 - 6d = -3$$

$$S_n = 0$$

$$\Rightarrow \frac{n}{2} [2a + (n-1)d] = 0$$

$$\Rightarrow \frac{n}{2} [-6 + (n-1)\frac{3}{2}] = 0$$

$$\Rightarrow \frac{n}{2} [-6 + (n-1)\frac{3}{2}] = 0$$

$$\Rightarrow n = 5$$

$$\text{Now, } a_5 = a + 4d = 3$$

$$\text{Now } n! + a_n(n+2) = 5! + 3 \times 7$$

$$= 120 + 21 = 141$$

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5. The coefficient of x^{-5} in the expansion of $\left(\frac{4x}{5} + \frac{5}{2x^2}\right)^9$ is

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5. The coefficient of x^{-6} in the expansion of $\left(\frac{4x}{5} + \frac{5}{2x^2}\right)^9$ is
 (1) 5140 (2) 5240 (3) 5040 (4) 4940
Ans. (3)

Sol. $T_{r+1} = {}^9C_r \left(\frac{5}{2x^2}\right)^r \left(\frac{4x}{5}\right)^{9-r}$
 $= {}^9C_r \frac{2^{18-3r}}{5^{9-2r}} x^{3-3r}$
 for coefficient of $x^{-6} \Rightarrow 9 - 3r = -6 \Rightarrow r = 5$
 coff. of $x^{-6} = \frac{{}^9C_5 \cdot 2^3}{5^{-1}}$
 $= \frac{9 \cdot 8 \cdot 7 \cdot 5}{4 \cdot 3 \cdot 2 \cdot 1} \cdot (8 \times 5)$
 $= 5040$

6. If $\frac{{}^{2n+1}P_{n-1}}{{}^{2n-1}P_n} = \frac{11}{21}$ then the value of $n^2 + n + 15$ is.
 (1) 45 (2) 50 (3) 35 (4) 57
Ans. (1)

Sol. $\frac{(2n+1)!}{(n-2)!} = \frac{11}{21} \frac{(2n-1)!}{(n-1)!}$
 $\Rightarrow \frac{(2n+1)(2n)}{(n+2)(n+1)n} = \frac{11}{21}$
 $\Rightarrow 42(2n+1) = 11(n+1)(n+2)$
 $\Rightarrow 11n^2 - 51n - 20 = 0$
 $\Rightarrow (n-5)(11n+4) = 0$
 $\Rightarrow n = 5$
 $\Rightarrow n^2 + n + 15 = 45$

7. If $z = \frac{i-1}{\cos \pi/6 + i \sin \pi/6}$, then z is equal to

(1) $\sqrt{2} \left(\cos \frac{7\pi}{12} + i \sin \frac{7\pi}{12} \right)$ (2) $\sqrt{2} \left(\cos \frac{5\pi}{12} + i \sin \frac{5\pi}{12} \right)$
 (3) $\sqrt{2} \left(\cos \frac{7\pi}{12} - i \sin \frac{7\pi}{12} \right)$ (4) $\left(\cos \frac{7\pi}{12} + i \sin \frac{7\pi}{12} \right)$

Ans. (1)

Sol. $Z = \frac{i-1}{\cos \pi/6 + i \sin \pi/6} = \frac{\sqrt{2} e^{i3\pi/4}}{e^{i\pi/6}} = \sqrt{2} e^{i5\pi/12}$
 $= \sqrt{2} \left(\cos \frac{7\pi}{12} + i \sin \frac{7\pi}{12} \right)$

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8. Sum of series $1^2 - 2 \cdot 3^2 + 3 \cdot 5^2 - 4 \cdot 7^2 + \dots + 15 \cdot 29^2$ is

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8. Sum of series $1^2 - 2 \cdot 3^2 + 3 \cdot 5^2 - 4 \cdot 7^2 + \dots + 15 \cdot 29^2$ is

Ans. (6952)

Sol. $1^2 - 2 \cdot 3^2 + 3 \cdot 5^2 - 4 \cdot 7^2 + \dots + 15 \cdot 29^2 = ?$

$$\sum_{r=1}^{15} (2r-1)^2 - \sum_{r=1}^{15} 2r(4r-1)^2$$

$$1 + \sum_{r=1}^{15} (2r+1)(4r+1)^2 - 2r(4r-1)^2$$

$$1 + \sum_{r=1}^{15} 2r(16r + (4r+1)^2)$$

$$1 + 48 \sum_{r=1}^{15} r^2 + 8 \sum_{r=1}^{15} r + \sum_{r=1}^{15} 1$$

$$1 + 48 \times \frac{7 \times 8 \times 15}{6} + 8 \times \frac{7 \times 8}{2} + 7$$

$$1 + 56 \times 120 + 56 \times 4 + 7$$

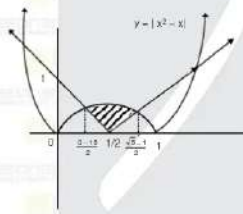
$$8 + 56 \times 124 = 6944 + 8 = 6952$$

9. If area of curve $|2x-1| \leq y \leq |x^2-x|$ is A then value of $(6A+11)^2$ is.

Ans. 125

Sol. $y \geq |2x-1|$

$y \leq |x^2-x|$



Both curve are symmetric about $x = \frac{1}{2}$. Hence

$$A = 2 \int_{\frac{3-\sqrt{5}}{2}}^{\frac{1}{2}} (x-x^2) - (1-2x) dx$$

$$A = 2 \int_{\frac{3-\sqrt{5}}{2}}^{\frac{1}{2}} (x^2 + 3x - 1) dx = 2 \left(\frac{x^3}{3} + \frac{3}{2}x^2 - x \right) \Big|_{\frac{3-\sqrt{5}}{2}}^{\frac{1}{2}}$$

on solving $6A + 11 = 125$ Ans.

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10. The equation $e^{2x} + 3e^{3x} + 13e^{2x} - 8e^x + 1 = 0$ has

(1) Two real root both are positive (2) No real roots

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10. The equation $e^{4x} + 3e^{3x} + 13e^{2x} - 8e^x + 1 = 0$ has

- (1) Two real roots both are positive (2) No real roots
 (3) Four real roots of which two are negative (4) Two real roots both are negative

Ans. (4)

Sol. Let $e^x = t$

$$f(t) = t^4 + 3t^3 + 13t^2 - 8t + 1$$

$$f'(t) = 4t^3 + 9t^2 + 26t - 8$$

$$f''(t) = 12t^2 + 18t + 26 > 0 \forall t$$

$\Rightarrow f'(t) = 0$ has at most one real root

$$\therefore f'(0) < 0 \text{ and } f'\left(\frac{1}{2}\right) > 0$$

then real root of $f'(t) = 0$ lies between 0 and $\frac{1}{2}$

$$\therefore f\left(\frac{1}{4}\right) < 0 \text{ and } f\left(\frac{1}{2}\right) > 0 \text{ and } f(0) > 0$$

$\Rightarrow f(t) = 0$ has at most two real roots

Let α, β be real roots of $f(t) = 0$

for roots of given equation $\Rightarrow e^x = \alpha, \beta$

$$\Rightarrow x = \ln \alpha, \ln \beta < 0$$

given equation has two negative real roots

11. If $a, b \in \mathbb{I}$ and relation R_1 is defined as $a^2 - b^2 \in \mathbb{I}$ and relation R_2 is defined as $2 + \frac{a}{b} > 0$ then,

- (1) R_1 is symmetric but R_2 is not (2) R_2 is symmetric but R_1 is not
 (3) R_1 and R_2 are both symmetric (4) R_1 and R_2 are both transitive

Ans. (1)

Sol. a R_1 $b \Rightarrow a^2 - b^2 \in \mathbb{I}$ always true Hence equivalence

$$a R_2 b \Rightarrow 2 + \frac{a}{b} > 0 \text{ not symmetric when } a = 2, b = 1$$

$$\text{When } a = -8, b = 6, c = 3$$

$$\text{Clearly } (-8, 6) \in R_2, (6, 3) \in R_2 \text{ but } (-8, 3) \notin R_2$$

Hence not transitive.

12. Let A be an event that the absolute difference of two real number lying between 0 and 60 is less than a.

If the probability of happening of event A is $\frac{11}{36}$ then a is equal to

Ans. 10

Sol. $|x - y| < a \Rightarrow -a < x - y < a$

$$\Rightarrow x - y < a \text{ and } x - y > -a$$

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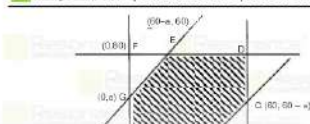
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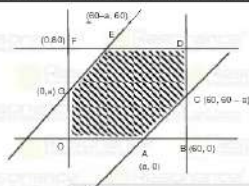


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$$\begin{aligned}
 P(A) &= \frac{\text{ar}(OACDEG)}{\text{(OBDF)}} \\
 &= \frac{\text{ar}(OBDF) - \text{ar}(ABC) - \text{ar}(EFG)}{\text{ar}(OBDF)} \\
 \Rightarrow \frac{11}{36} &= \frac{(60)^2 - \frac{1}{2}(60-a)^2 - \frac{1}{2}(60-a)^2}{3600} \\
 \Rightarrow 1100 &= 3600 - (60-a)^2 \\
 \Rightarrow (60-a)^2 &= 2500 \Rightarrow 60-a=50 \\
 \Rightarrow a &= 10
 \end{aligned}$$

13. If $\vec{a} = \hat{i} + 2\hat{j} - 3\hat{k}$, $\vec{b} = \hat{i} - \hat{j} + 3\hat{k}$, $\vec{c} = \hat{i} + 2\hat{j} + 2\hat{k}$ and \vec{r} is a vector such that $\vec{r} \times \vec{b} = \vec{b} \times \vec{c}$ & $\vec{r} \cdot \vec{a} = 0$ then the value of $25 \cdot |\vec{r}|^2$

Ans. 202.75

Sol. $\vec{r} \times \vec{b} = \vec{b} \times \vec{c} = -\vec{c} \times \vec{b}$

$$\Rightarrow (\vec{r} + \vec{c}) \times \vec{b} = 0 \Rightarrow \vec{r} + \vec{c} = \lambda \vec{b} \Rightarrow \vec{r} = \lambda \vec{b} - \vec{c}$$

$$\vec{r} \cdot \vec{a} = \lambda(\vec{b} \cdot \vec{a}) - \vec{c} \cdot \vec{a} = 0$$

$$\lambda = \frac{\vec{c} \cdot \vec{a}}{\vec{b} \cdot \vec{a}} = \frac{-1}{-10} = \frac{1}{10}$$

$$\vec{r} = \frac{1}{10} \vec{b} - \vec{c} = \frac{1}{10}(\hat{i} - \hat{j} + 3\hat{k}) - (\hat{i} + 2\hat{j} + 2\hat{k})$$

$$\vec{r} = \frac{-9}{10} \hat{i} - \frac{21}{10} \hat{j} - \frac{17}{10} \hat{k}$$

$$10\vec{r} = -9\hat{i} - 21\hat{j} - 17\hat{k}$$

$$100 |\vec{r}|^2 = 811$$

$$25 |\vec{r}|^2 = \frac{811}{4} = 202.75$$

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