

Mathematics Section A

Section Id :	864351239
Section Number :	5
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	20
Number of Questions to be attempted :	20
Section Marks :	80
Mark As Answered Required? :	Yes



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Sub-Section Number : 1
Sub-Section Id : 864351239
Question Shuffling Allowed : Yes

Question Number : 61 Question Id : 8643513571 Question Type : MCQ Option Shuffling : Yes Is
Question Mandatory : No
Correct Marks : 4 Wrong Marks : 1

The number of solutions of the equation $\sin^{-1}\left[x^2 + \frac{1}{3}\right] + \cos^{-1}\left[x^2 - \frac{2}{3}\right] = x^2$, for $x \in [-1, 1]$, and $[x]$ denotes the greatest integer less than or equal to x , is :

Options :

86435110711. 0
86435110712. 2
86435110713. 4
86435110714. Infinite

Question Number : 62 Question Id : 8643513572 Question Type : MCQ Option Shuffling : Yes Is
Question Mandatory : No
Correct Marks : 4 Wrong Marks : 1

If the Boolean expression $(p \wedge q) \oplus (p \otimes q)$ is a tautology, then \oplus and \otimes are respectively given by :

Options :

86435110715. \wedge, \vee
86435110716. \vee, \rightarrow
86435110717. \rightarrow, \rightarrow
86435110718. \wedge, \rightarrow

Question Number : 63 Question Id : 8643513573 Question Type : MCQ Option Shuffling : Yes Is
Question Mandatory : No
Correct Marks : 4 Wrong Marks : 1

Let O be the origin. Let $\vec{OP} = x\hat{i} + y\hat{j} - \hat{k}$ and $\vec{OQ} = -\hat{i} + 2\hat{j} + 3x\hat{k}$, $x, y \in \mathbf{R}$, $x > 0$, be such that $|\vec{PQ}| = \sqrt{20}$ and the vector \vec{OP} is perpendicular to \vec{OQ} . If $\vec{OR} = 3\hat{i} + z\hat{j} - 7\hat{k}$, $z \in \mathbf{R}$, is coplanar with \vec{OP} and \vec{OQ} , then the value of $x^2 + y^2 + z^2$ is equal to :

Options :

86435110719. 1

86435110720. 2

86435110721. 7

86435110722. 9

Question Number : 64 Question Id : 8643513574 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

If x, y, z are in arithmetic progression with common difference d , $x \neq 3d$, and the determinant

of the matrix $\begin{bmatrix} 3 & 4\sqrt{2} & x \\ 4 & 5\sqrt{2} & y \\ 5 & k & z \end{bmatrix}$ is zero, then the value of k^2 is :

Options :

86435110723. 6

86435110724. 12

86435110725. 36

86435110726. 72

Question Number : 65 Question Id : 8643513575 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

The value of the limit $\lim_{\theta \rightarrow 0} \frac{\tan(\pi \cos^2 \theta)}{\sin(2\pi \sin^2 \theta)}$ is equal to :

Options :

86435110727. $\frac{1}{4}$

86435110728. $-\frac{1}{2}$

86435110729. $-\frac{1}{4}$

86435110730. 0

Question Number : 66 Question Id : 8643513576 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

If the integral $\int_0^{10} \frac{[\sin 2\pi x]}{e^x - [x]} dx = \alpha e^{-1} + \beta e^{-\frac{1}{2}} + \gamma$, where α, β, γ are integers and $[x]$ denotes

the greatest integer less than or equal to x , then the value of $\alpha + \beta + \gamma$ is equal to :

Options :

86435110731. 0

86435110732. 10

86435110733. 20

86435110734. 25

Question Number : 67 Question Id : 8643513577 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

If the curve $y=y(x)$ is the solution of the differential equation

$$2(x^2 + x^{5/4}) dy - y(x + x^{1/4}) dx = 2x^{9/4} dx, \quad x > 0 \text{ which passes through the point}$$

$\left(1, 1 - \frac{4}{3} \log_e 2\right)$, then the value of $y(16)$ is equal to :

Options :

86435110735. $4\left(\frac{31}{3} - \frac{8}{3} \log_e 3\right)$

86435110736. $\left(\frac{31}{3} - \frac{8}{3} \log_e 3\right)$

86435110737. $\left(\frac{31}{3} + \frac{8}{3} \log_e 3\right)$

86435110738. $4\left(\frac{31}{3} + \frac{8}{3} \log_e 3\right)$

Question Number : 68 Question Id : 8643513578 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

Let $y=y(x)$ be the solution of the differential equation

$$\cos x(3\sin x + \cos x + 3) dy = (1 + y \sin x(3\sin x + \cos x + 3))dx, \quad 0 \leq x \leq \frac{\pi}{2}, \quad y(0) = 0. \text{ Then, } y\left(\frac{\pi}{3}\right) \text{ is}$$

equal to :

Options :

86435110739. $2 \log_e \left(\frac{3\sqrt{3} - 8}{4}\right)$

86435110740. $2 \log_e \left(\frac{\sqrt{3} + 7}{2}\right)$

$$2 \log_e \left(\frac{2\sqrt{3} + 9}{6} \right)$$

86435110741.

$$2 \log_e \left(\frac{2\sqrt{3} + 10}{11} \right)$$

86435110742.

Question Number : 69 Question Id : 8643513579 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1

Consider the function $f: \mathbb{R} \rightarrow \mathbb{R}$ defined by $f(x) = \begin{cases} \left(2 - \sin\left(\frac{1}{x}\right)\right) |x|, & x \neq 0 \\ 0, & x = 0 \end{cases}$. Then f is :

Options :

86435110743. monotonic on $(0, \infty)$ only

86435110744. monotonic on $(-\infty, 0)$ only

86435110745. monotonic on $(-\infty, 0) \cup (0, \infty)$

86435110746. not monotonic on $(-\infty, 0)$ and $(0, \infty)$

Question Number : 70 Question Id : 8643513580 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Correct Marks : 4 Wrong Marks : 1

The value of

$$\lim_{n \rightarrow \infty} \frac{[r] + [2r] + \dots + [nr]}{n^2},$$

where r is a non-zero real number and $[r]$ denotes the greatest integer less than or equal to r , is equal to :

Options :

86435110747. r

$$86435110748. \frac{r}{2}$$

$$86435110749. 2r$$

$$86435110750. 0$$

Question Number : 71 Question Id : 8643513581 Question Type : MCQ Option Shuffling : Yes Is

Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

Let a computer program generate only the digits 0 and 1 to form a string of binary numbers with probability of occurrence of 0 at even places be $\frac{1}{2}$ and probability of occurrence of 0 at the odd place be $\frac{1}{3}$. Then the probability that '10' is followed by '01' is equal to :

Options :

$$86435110751. \frac{1}{9}$$

$$86435110752. \frac{1}{6}$$

$$86435110753. \frac{1}{3}$$

$$86435110754. \frac{1}{18}$$

Question Number : 72 Question Id : 8643513582 Question Type : MCQ Option Shuffling : Yes Is

Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

If the sides AB, BC and CA of a triangle ABC have 3, 5 and 6 interior points respectively, then the total number of triangles that can be constructed using these points as vertices, is equal to :

Options :

$$86435110755. 360$$

86435110756. 364

86435110757. 333

86435110758. 240

Question Number : 73 Question Id : 8643513583 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

Let the tangent to the circle $x^2 + y^2 = 25$ at the point $R(3, 4)$ meet x -axis and y -axis at points P and Q , respectively. If r is the radius of the circle passing through the origin O and having centre at the incentre of the triangle OPQ , then r^2 is equal to :

Options :

86435110759. $\frac{125}{72}$ 86435110760. $\frac{625}{72}$ 86435110761. $\frac{529}{64}$ 86435110762. $\frac{585}{66}$

Question Number : 74 Question Id : 8643513584 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

Let S_1, S_2 and S_3 be three sets defined as

$$S_1 = \{z \in \mathbb{C} : |z - 1| \leq \sqrt{2}\}$$

$$S_2 = \{z \in \mathbb{C} : \operatorname{Re}((1 - i)z) \geq 1\}$$

$$S_3 = \{z \in \mathbb{C} : \operatorname{Im}(z) \leq 1\}$$

Then the set $S_1 \cap S_2 \cap S_3$

Options :

86435110763. has exactly two elements

86435110764. has exactly three elements

86435110765. is a singleton

86435110766. has infinitely many elements

Question Number : 75 Question Id : 8643513585 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No**Correct Marks : 4 Wrong Marks : 1**Let $f: \mathbb{R} \rightarrow \mathbb{R}$ be defined as $f(x) = e^{-x} \sin x$. If $F: [0, 1] \rightarrow \mathbb{R}$ is a differentiable function suchthat $F(x) = \int_0^x f(t) dt$, then the value of $\int_0^1 (F'(x) + f(x))e^x dx$ lies in the interval**Options :**86435110767. $\left[\frac{330}{360}, \frac{331}{360} \right]$ 86435110768. $\left[\frac{327}{360}, \frac{329}{360} \right]$ 86435110769. $\left[\frac{331}{360}, \frac{334}{360} \right]$ 86435110770. $\left[\frac{335}{360}, \frac{336}{360} \right]$ **Question Number : 76 Question Id : 8643513586 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No****Correct Marks : 4 Wrong Marks : 1**The value of $\sum_{r=0}^6 \binom{6}{r} \cdot \binom{6}{6-r}$ is equal to :**Options :**

86435110771. 924

86435110772. 1024

86435110773. 1124

86435110774. 1324

Question Number : 77 Question Id : 8643513587 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

If the equation of plane passing through the mirror image of a point $(2, 3, 1)$ with respect to

line $\frac{x+1}{2} = \frac{y-3}{1} = \frac{z+2}{-1}$ and containing the line $\frac{x-2}{3} = \frac{1-y}{2} = \frac{z+1}{1}$ is

$\alpha x + \beta y + \gamma z = 24$, then $\alpha + \beta + \gamma$ is equal to :

Options :

86435110775. 21

86435110776. 20

86435110777. 19

86435110778. 18

Question Number : 78 Question Id : 8643513588 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

Two tangents are drawn from a point P to the circle $x^2 + y^2 - 2x - 4y + 4 = 0$, such that the

angle between these tangents is $\tan^{-1}\left(\frac{12}{5}\right)$, where $\tan^{-1}\left(\frac{12}{5}\right) \in (0, \pi)$. If the centre of the

circle is denoted by C and these tangents touch the circle at points A and B, then the ratio of

the areas of ΔPAB and ΔCAB is :

Options :

86435110779. 9 : 4

86435110780. 3 : 1

86435110781. 2 : 1

86435110782. 11 : 4

Question Number : 79 Question Id : 8643513589 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

The number of solutions of the equation $x + 2 \tan x = \frac{\pi}{2}$ in the interval $[0, 2\pi]$ is :

Options :

86435110783. 2

86435110784. 3

86435110785. 4

86435110786. 5

Question Number : 80 Question Id : 8643513590 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No

Correct Marks : 4 Wrong Marks : 1

Let L be a tangent line to the parabola $y^2 = 4x - 20$ at $(6, 2)$. If L is also a tangent to the ellipse

$\frac{x^2}{2} + \frac{y^2}{b} = 1$, then the value of b is equal to :

Options :

86435110787. 11

86435110788. 14

86435110789. 16

86435110790. 20

Mathematics Section B

Section Id :	864351240
Section Number :	6
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	10
Number of Questions to be attempted :	5
Section Marks :	20
Mark As Answered Required? :	Yes
Sub-Section Number :	1
Sub-Section Id :	864351240
Question Shuffling Allowed :	Yes

Question Number : 81 Question Id : 8643513591 Question Type : SA
Correct Marks : 4 Wrong Marks : 0

Let $I_n = \int_1^e x^{19} (\log|x|)^n dx$, where $n \in \mathbb{N}$. If $(20)I_{10} = \alpha I_9 + \beta I_8$, for natural numbers α and β , then $\alpha - \beta$ equals to _____.

Response Type : Numeric
Evaluation Required For SA : Yes
Show Word Count : Yes
Answers Type : Equal
Text Areas : PlainText
Possible Answers :

100

Question Number : 82 Question Id : 8643513592 Question Type : SA
Correct Marks : 4 Wrong Marks : 0

Let $\tan\alpha$, $\tan\beta$ and $\tan\gamma$; $\alpha, \beta, \gamma \neq \frac{(2n-1)\pi}{2}$, $n \in \mathbb{N}$ be the slopes of three line segments OA, OB and OC, respectively, where O is origin. If circumcentre of ΔABC coincides with origin and its orthocentre lies on y-axis, then the value of $\left(\frac{\cos 3\alpha + \cos 3\beta + \cos 3\gamma}{\cos \alpha \cos \beta \cos \gamma} \right)^2$ is equal to _____.

Response Type : Numeric
Evaluation Required For SA : Yes

Show Word Count : Yes**Answers Type :** Equal**Text Areas :** PlainText**Possible Answers :**

100

Question Number : 83 **Question Id :** 8643513593 **Question Type :** SA**Correct Marks :** 4 **Wrong Marks :** 0

If 1, $\log_{10}(4^x - 2)$ and $\log_{10}\left(4^x + \frac{18}{5}\right)$ are in arithmetic progression for a real number x , then

the value of the determinant $\begin{vmatrix} 2\left(x - \frac{1}{2}\right) & x - 1 & x^2 \\ 1 & 0 & x \\ x & 1 & 0 \end{vmatrix}$ is equal to :

Response Type : Numeric**Evaluation Required For SA :** Yes**Show Word Count :** Yes**Answers Type :** Equal**Text Areas :** PlainText**Possible Answers :**

100

Question Number : 84 **Question Id :** 8643513594 **Question Type :** SA**Correct Marks :** 4 **Wrong Marks :** 0

Consider a set of $3n$ numbers having variance 4. In this set, the mean of first $2n$ numbers is 6 and the mean of the remaining n numbers is 3. A new set is constructed by adding 1 into each of first $2n$ numbers, and subtracting 1 from each of the remaining n numbers. If the variance of the new set is k , then $9k$ is equal to _____.

Response Type : Numeric**Evaluation Required For SA :** Yes**Show Word Count :** Yes**Answers Type :** Equal**Text Areas :** PlainText**Possible Answers :**

100

Question Number : 85 **Question Id :** 8643513595 **Question Type :** SA**Correct Marks :** 4 **Wrong Marks :** 0

Let $f: [-1, 1] \rightarrow \mathbb{R}$ be defined as $f(x) = ax^2 + bx + c$ for all $x \in [-1, 1]$, where $a, b, c \in \mathbb{R}$ such that $f(-1) = 2, f'(-1) = 1$ and for $x \in (-1, 1)$ the maximum value of $f''(x)$ is $\frac{1}{2}$. If $f(x) \leq \alpha, x \in [-1, 1]$, then the least value of α is equal to _____.

Response Type : Numeric

Evaluation Required For SA : Yes

Show Word Count : Yes

Answers Type : Equal

Text Areas : PlainText

Possible Answers :

100

Question Number : 86 **Question Id :** 8643513596 **Question Type :** SA

Correct Marks : 4 **Wrong Marks :** 0

Let the coefficients of third, fourth and fifth terms in the expansion of $\left(x + \frac{a}{x^2}\right)^n, x \neq 0$, be

in the ratio 12 : 8 : 3. Then the term independent of x in the expansion, is equal to _____.

Response Type : Numeric

Evaluation Required For SA : Yes

Show Word Count : Yes

Answers Type : Equal

Text Areas : PlainText

Possible Answers :

100

Question Number : 87 **Question Id :** 8643513597 **Question Type :** SA

Correct Marks : 4 **Wrong Marks :** 0

Let $f: [-3, 1] \rightarrow \mathbb{R}$ be given as

$$f(x) = \begin{cases} \min \{(x+6), x^2\}, & -3 \leq x \leq 0 \\ \max \{\sqrt{x}, x^2\}, & 0 \leq x \leq 1. \end{cases}$$

If the area bounded by $y=f(x)$ and x -axis is A , then the value of $6A$ is equal to _____.

Response Type : Numeric

Evaluation Required For SA : Yes

Show Word Count : Yes

Answers Type : Equal

Text Areas : PlainText

Possible Answers :

100

Question Number : 88 Question Id : 8643513598 Question Type : SA

Correct Marks : 4 Wrong Marks : 0

Let P be an arbitrary point having sum of the squares of the distances from the planes $x + y + z = 0$, $lx - nz = 0$ and $x - 2y + z = 0$, equal to 9. If the locus of the point P is $x^2 + y^2 + z^2 = 9$, then the value of $l - n$ is equal to _____.

Response Type : Numeric

Evaluation Required For SA : Yes

Show Word Count : Yes

Answers Type : Equal

Text Areas : PlainText

Possible Answers :

100

Question Number : 89 Question Id : 8643513599 Question Type : SA

Correct Marks : 4 Wrong Marks : 0

Let \vec{x} be a vector in the plane containing vectors $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}$ and $\vec{b} = \hat{i} + 2\hat{j} - \hat{k}$. If the vector \vec{x} is perpendicular to $(3\hat{i} + 2\hat{j} - \hat{k})$ and its projection on \vec{a} is $\frac{17\sqrt{6}}{2}$, then the value of

$|\vec{x}|^2$ is equal to _____.

Response Type : Numeric

Evaluation Required For SA : Yes

Show Word Count : Yes

Answers Type : Equal

Text Areas : PlainText

Possible Answers :

100

Question Number : 90 Question Id : 8643513600 Question Type : SA

Correct Marks : 4 Wrong Marks : 0

Let $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ and $B = \begin{bmatrix} \alpha \\ \beta \end{bmatrix} \neq \begin{bmatrix} 0 \\ 0 \end{bmatrix}$ such that $AB = B$ and $a + d = 2021$, then the value of $ad - bc$ is equal to _____.

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Response Type : Numeric

Evaluation Required For SA : Yes

Show Word Count : Yes

Answers Type : Equal

Text Areas : PlainText

Possible Answers :

100