केवल मूल्यांकनकर्ता के उपयोग हेतु!

माध्यमिक शिक्षा मण्डल, मध्यप्रदेश, भोपाल

32 पृष्ठीय

केवल परीक्षक द्वारा भरा जावे। प्रश्न क्रमांक के सम्मुख प्राप्तांकों की प्रविष्टी करें।

प्रश्न क्रमांक	पृष्ठ क्रमांक	प्राप्तांक (अंकों में)	प्रश्न क्रमांक	पृष्ठ क्रमांक	प्राप्तांक (अंकों में)
1			17		
2			18		
3			19		
4			20		
5			21		
6			22		
7			23		
8			24		
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परीक्षक एवं उपमुख्य परीक्षक द्वारा भरा जावे

परीक्षक एवं उपमुख्य परीक्षक द्वारा भरा जावे

प्रमाणित किया जाता है कि अन्दर के पृष्ठों के अनुरूप मुख्य पृष्ठ पर अंकों की प्रविष्टी एवं अंकों का योग सही है।

निर्धारित मुद्राः नाम, पदनाम, मोबाईल नम्बर, परीक्षक क्रमांक एवं पदांकित संस्था के नाम की मुद्रा लगाएं।

उप मुख्य परीक्षक के हस्ताक्षर एवं निर्धारित मुद्रा	परीक्षक के हस्ताक्षर एवं निर्धारित मुद्रा
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Question-1

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$\frac{16}{25}$

A square matrix in which diagonal elements are equal to some scalar number K, and off-diagonal elements are zero is called scalar matrix. or,

$[a_{ij}]_{m\times m}$ = Scalar if a_{ij} = K (constant) when $i=j$ & $a_{ij}=0$ when $i\neq j$.

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$\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$

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Question-2

i) f is one-one onto

ii) $\frac{3\pi}{4}$

iii) $\frac{\pi}{3}$

iv) $\pm\sqrt{3}$

v) $\theta = \frac{\pi}{2}$

vi) $\frac{1}{18}$

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Question-3

i) $\frac{1}{x \cdot \log(x)}$

ii) 12π cm

iii) x

iv) 1

v) 2

vi) $\vec{0}$ (zero vector)

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Question-4

i) True

ii) False

iii) True

iv) False

v) False

vi) True

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Question-5

i) $\int \frac{dx}{\sqrt{x^2+a^2}}$ - $\log|x+\sqrt{x^2+a^2}|+C$

ii) $\int \sqrt{x^2+a^2}$ - $\frac{x}{2}\sqrt{x^2+a^2}+\frac{a^2}{2}\log|x+\sqrt{x^2+a^2}|+C$

iii) $\int \tan x$ - $\log|\sec x|+C$

iv) $\int \cot x$ - $\log|\sin x|+C$

v) $\int \sqrt{x^2-9}$ - $\frac{x}{2}\sqrt{x^2-9}-\frac{9}{2}\log|x+\sqrt{x^2-9}|+C$

vi) $\int \frac{1}{\sqrt{x^2-9}}$ - $\log|x+\sqrt{x^2-9}|+C$

vii) $\tan\left(\frac{1}{\sqrt{x^2-1}}\right)$ - $\operatorname{cosec}^{-1}(x)$

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Question - 6

Given,

$\vec{a} = \hat{i} + \hat{j} - \hat{K}$

$\vec{b} = \hat{i} - \hat{j} + \hat{K}$

To find,

$\theta = \cos^{-1}\left(\frac{\vec{a}\cdot\vec{b}}{|\vec{a}|\cdot|\vec{b}|}\right)$

$\Rightarrow \theta = \cos^{-1}\left(\frac{(\hat{i}+\hat{j}-\hat{K})\cdot(\hat{i}-\hat{j}+\hat{K})}{\sqrt{1^2+1^2+1^2}\cdot\sqrt{1^2+1^2+1^2}}\right)$ $\left[|\vec{m}| = \sqrt{x^2+y^2+z^2}\right]$

$\Rightarrow \theta = \cos^{-1}\left(\frac{1-1-1}{\sqrt{3}\cdot\sqrt{3}}\right)$

$\Rightarrow \boxed{\theta = \cos^{-1}\left(-\frac{1}{3}\right)}$, or

$\Rightarrow \boxed{\theta = \pi - \cos^{-1}\left(\frac{1}{3}\right)}$

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Question - 7

Given,

Parallel vector $(\vec{b}) = 3\hat{i} + 2\hat{j} - 8\hat{k}$

A point satisfying equation of line,

$(\vec{a}) = 5\hat{i} + 2\hat{j} - 4\hat{k}$

To find,

Vector equation of line given by-

$l = \vec{a} + \lambda \vec{b}$

$\Rightarrow l = 5\hat{i} + 2\hat{j} - 4\hat{k} + \lambda(3\hat{i} + 2\hat{j} - 8\hat{k})$

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Question – 8

Given,

Set $A = \{1, 2, 3\}$

$R \subset A \times A = \{(1,2)\ (2,1)\}$

To be reflexive,

$(a,a) \in R \quad \forall \ a \in A$

but, $(1,1)\ (2,2)\ (3,3) \notin R$

$\therefore$ R is not reflexive

To be symmetric,

if $(a,b) \in R \Rightarrow (b,a) \in R$

and, $(1,2), (2,1) \in R$

$\therefore$ R is symmetric

To be transitive

if $(a,b)\ \&\ (b,c) \in R \Rightarrow (a,c) \in R$

~~but~~ but, $(1,2)\ (2,1) \in R$ and $(1,1) \notin R$

$\therefore$ R is not transitive.

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Question - 9

To prove,

$3\cos^{-1}x = \cos^{-1}(4x^3 - 3x)$

$LHS = 3\cos^{-1}x$

$RHS = \cos^{-1}(4x^3 - 3x)$ [Let, $x = \cos\theta$ — (i)]

$= \cos^{-1}(4\cos^3\theta - 3\cos\theta)$

$= \cos^{-1}(\cos 3\theta)$ [$\cos 3x = 4\cos^3 x - 3\cos x$]

$= 3\theta$ [In suitable domain, $\cos^{-1}(\cos(x)) = x$]

$\Rightarrow RHS = 3\cos^{-1}x$ [from (i) $x = \cos\theta \Rightarrow \theta = \cos^{-1}x$]

Hence, LHS = RHS

$2x - y = 10$
$3x + y = 5$

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Question - 10

$x\begin{bmatrix}2\\3\end{bmatrix} + y\begin{bmatrix}-1\\1\end{bmatrix} = \begin{bmatrix}10\\5\end{bmatrix}$

$\Rightarrow \begin{bmatrix}2x\\3x\end{bmatrix} + \begin{bmatrix}-y\\y\end{bmatrix} = \begin{bmatrix}10\\5\end{bmatrix}$ $\left(K[a_{ij}] = [Ka_{ij}]\right)$

~~On compari~~

$\Rightarrow \begin{bmatrix}2x-y\\3x+y\end{bmatrix} = \begin{bmatrix}10\\5\end{bmatrix}$ (By addition of matrices)

On comparing elements

$\Rightarrow$ $2x - y = 10$ — (i)

and, $3x + y = 5$ — (ii)

Adding (i) & (ii)

$\Rightarrow 2x - y + 3x + y = 10 + 5$

$\Rightarrow 5x = 15$

$\Rightarrow x = 3$ — (iii) (Substitute (iii) in (i))

$\Rightarrow 2(3) - y = 10$

$\Rightarrow y = -4$

$\therefore$, $x = 3$ & $y = -4$

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Question-11 OR

Given,
$(x_1, y_1) = (1,0)$; $(x_2, y_2) = (6,0)$; $(x_3, y_3) = (4,3)$

We know that,
Area of triangle $= \frac{1}{2}\begin{vmatrix} 1 & x_1 & y_1 \\ 1 & x_2 & y_2 \\ 1 & x_3 & y_3 \end{vmatrix}$

$\Rightarrow$ Ar. $\Delta = \frac{1}{2}\begin{vmatrix} 1 & 1 & 0 \\ 1 & 6 & 0 \\ 1 & 4 & 3 \end{vmatrix}$

Now opening determinant along column 3

$\Rightarrow \begin{vmatrix} 1 & 1 & 0 \\ 1 & 6 & 0 \\ 1 & 4 & 3 \end{vmatrix} = 0\begin{vmatrix} 1 & 6 \\ 1 & 4 \end{vmatrix} - 0\begin{vmatrix} 1 & 1 \\ 1 & 4 \end{vmatrix} + 3\begin{vmatrix} 1 & 1 \\ 1 & 6 \end{vmatrix}$

$\Rightarrow$ Det ( ) $= 3(6 \times 1 - 1 \times 1)$
$= 3 \times 5$

$\Rightarrow$ Det ( ) $= 15$

$\therefore$, Ar. $\Delta = \frac{1}{2} \times 15$

$\Rightarrow$ Ar. $\Delta = \frac{15}{2}$ sq. units

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Question - 12

Given,

$$2x + 3y = \sin y$$

$$\Rightarrow \frac{d}{dx}(2x+3y) = \frac{d}{dx}(\sin y) \quad \left(\text{Differentiating both sides w.r.t. } x\right)$$

$$\Rightarrow \frac{d\,2x}{dx} + \frac{d\,3y}{dx} = \frac{d(\sin y)}{dx} \quad \left(\frac{d(f(x)+g(x))}{dx} = \frac{d f(x)}{dx} + \frac{d\,g(x)}{dx}\right)$$

$$\Rightarrow 2\frac{dx}{dx} + 3\frac{dy}{dx} = \cos y \cdot \frac{dy}{dx} \quad \left(\frac{d\,K(f(x))}{dx} = K\frac{d f(x)}{dx},\ \frac{d \sin\theta}{d\theta} = \cos\theta\right)$$

$$\Rightarrow 2 = \cos y \cdot \frac{dy}{dx} - 3\frac{dy}{dx}$$

$$\Rightarrow \frac{dy}{dx}(\cos y - 3) = 2$$

$$\Rightarrow \boxed{\frac{dy}{dx} = \frac{2}{\cos(y) - 3}}$$

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Question-13

Given,

$$I = \int \cos^2 x \, dx$$

WKT, $\cos 2x = 2\cos^2 x - 1$

$\Rightarrow \cos^2 x = \dfrac{\cos 2x + 1}{2}$

$$\Rightarrow I = \int \frac{\cos 2x + 1}{2} dx$$

$$= \int \frac{\cos 2x}{2} dx + \int \frac{dx}{2} \quad \left(\int f(x) + g(x) = \int f(x) + \int g(x)\right)$$

$$= \frac{1}{2} \int \cos 2x \, dx + \frac{1}{2} \int dx$$

$$= \frac{1}{2} \times \frac{\sin 2x}{2} + \frac{x}{2} \quad \left(\begin{array}{l} \int \cos\theta = \sin\theta \\ \int dx = x \end{array}\right)$$

$$\Rightarrow \boxed{I = \frac{\sin 2x}{4} + \frac{x}{2}}$$

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Question - 14 - OR

Given, $\frac{dy}{dx} = -4xy^2$

$\Rightarrow \frac{dy}{y^2} = -4x\,dx$

$\Rightarrow \int \frac{dy}{y^2} = \int -4x\,dx$ (Integrate both sides)

$\Rightarrow \frac{y^{-2+1}}{-2+1} = -4\int x\,dx$ $\left(\int w^n\,dw = \frac{w^{n+1}}{n+1}\right)$

$\Rightarrow \frac{y^{-1}}{+1} = +\frac{4x^2}{2} + C$ $\left(\int x\,dx = \frac{x^2}{2}\right)$

$\Rightarrow +\frac{1}{y} = +\frac{4x^2}{2} + C$

$\Rightarrow \boxed{\frac{1}{y} = 2x^2 + C}$

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Question-15 - OR

Given,

$\vec{a} = 2\hat{i} + 3\hat{j} + 2\hat{k}$

$\vec{b} = \hat{i} + 2\hat{j} + \hat{k}$

To find,
projection of $\vec{a}$ on $\vec{b}$

$\Rightarrow \vec{a} \cdot \hat{b} = \dfrac{\vec{a} \cdot \vec{b}}{|\vec{b}|}$ $\left(\hat{x} = \dfrac{\vec{x}}{|\vec{x}|} \right)$

$= \dfrac{(2\hat{i} + 3\hat{j} + 2\hat{k})(\hat{i} + 2\hat{j} + \hat{k})}{\sqrt{1^2 + 2^2 + 1^2}}$

$= \dfrac{2 + 6 + 2}{\sqrt{6}}$ $\left(|\vec{v}| = \sqrt{x^2 + y^2 + z^2} \right)$

$\Rightarrow \vec{a} \cdot \hat{b} = \dfrac{10}{\sqrt{6}} \times \dfrac{\sqrt{6}}{\sqrt{6}}$ (Rationalize)

or, $\boxed{\vec{a} \cdot \hat{b} = \dfrac{5\sqrt{6}}{3}}$

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Question - 16

Given, Bag A or I[st] — 3R, 3B
Bag B or 2[nd] — 4R, 5B

Let, E_1 = ~~Red~~ ball is from bag I[st]
E_2 = ~~Red~~ ball is from Bag 2[nd]
A = Ball drawn is Red.

Using Baye's theorem,

$$\Rightarrow P\left(\frac{E_1}{A}\right) = \frac{P\left(\frac{A}{E_1}\right) \times P(E_1)}{P\left(\frac{A}{E_1}\right) \times P(E_1) + P\left(\frac{A}{E_2}\right) \times P(E_2)}$$

$$= \frac{\frac{3}{6} \times \frac{1}{2}}{\frac{3}{6} \times \frac{1}{2} + \frac{4}{9} \times \frac{1}{2}}$$

[P(choosing a bag) = $\frac{1}{2}$
P(Red ball) = $\frac{\text{No. of Red balls}}{\text{Total no. of balls}}$]

$$= \frac{3/6}{9+8/18}$$

$$= \frac{3 \times 3}{17}$$

$$\Rightarrow \boxed{P\left(\frac{E_1}{A}\right) = \frac{9}{17}}$$

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Question - 17

Given, $\frac{dR}{dt} = 4\ cm/s$

$R = 10\ cm$

To find, $\frac{dA}{dt}$

Calculation,

$$\frac{dA}{dt} = \frac{d(\pi r^2)}{dt} \quad [Area = \pi r^2]$$

$$= \pi \frac{dr^2}{dt} \quad \left[\frac{d\,K f(x)}{dx} = K \frac{d f(x)}{dx}\right]$$

$$= \pi\, 2r \frac{dr}{dt} \quad \left(\frac{dx^n}{dx} = n x^{n-1}\right)$$

$$= \pi . 2 . (10) . (4) \quad [Given]$$

$$\Rightarrow \boxed{\frac{dA}{dt} = 80\pi \ \frac{cm^2}{s}}$$

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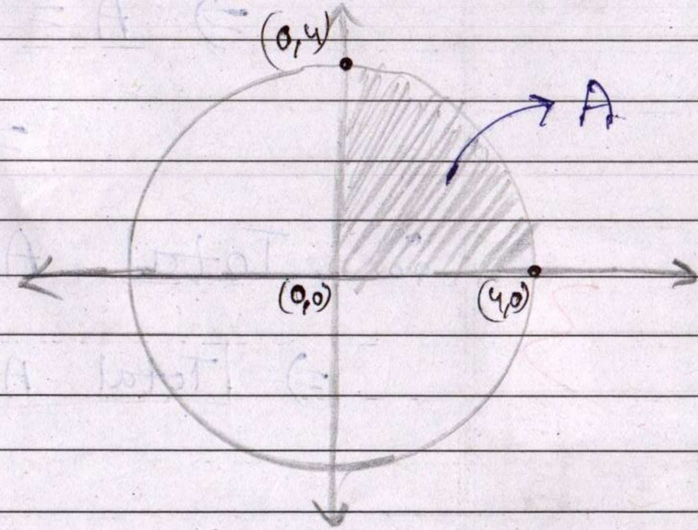
[Question - 18]



Given,

eq^n $x^2+y^2=16$

$\Rightarrow y = \pm\sqrt{16-x^2}$

To find,

Total Area = 4 A (A is shown in diagram)

Calculation,

$$A = \int_0^4 \sqrt{4^2-x^2}\, dx$$

Using formula

$$\int\sqrt{a^2-x^2} = \frac{x}{2}\sqrt{a^2-x^2} + \frac{a^2}{2}\sin^{-1}\left(\frac{x}{a}\right)$$

$$\Rightarrow A = \left[\frac{x}{2}\sqrt{16-x^2} + \frac{16}{2}\sin^{-1}\left(\frac{x}{4}\right)\right]_0^4$$

$$= \left[\frac{4}{2}\sqrt{16-16} + 8\sin^{-1}\left(\frac{4}{4}\right)\right] - \left[\frac{0}{2}\sqrt{16-0} + 8\sin^{-1}(0)\right]$$

$$\Rightarrow A = 8\sin^{-1}(1) \quad \left(\sin^{-1}(1) = \frac{\pi}{2}\right)$$

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$\Rightarrow A = 8 \times \frac{\pi}{2}$

$= 4\pi$ sq. units

$\therefore$, Total Area $= 4 \cdot A$

$= 4 \cdot 4\pi$

$\Rightarrow$ Total Area $= 16\pi$ sq. units

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Question-20

Given,

$$\vec{r_1} = \hat{i} + 2\hat{j} + \hat{k} + \lambda(\hat{i} - \hat{j} + \hat{k})$$

$$\vec{r_2} = 2\hat{i} - \hat{j} - \hat{k} + \mu(2\hat{i} + \hat{j} + 2\hat{k})$$

On comparing with, $l = \vec{a} + \lambda\vec{b}$

$\Rightarrow \vec{a_1} = \hat{i} + 2\hat{j} + \hat{k}$, $\vec{a_2} = 2\hat{i} - \hat{j} + \hat{k}$

$\vec{b_1} = \hat{i} - \hat{j} + \hat{k}$, $\vec{b_2} = 2\hat{i} + \hat{j} + 2\hat{k}$

To find,

Shortest distance b/w lines

Calculation,

$$\text{Shortest distance} = \left| \frac{(\vec{a_2} - \vec{a_1}) \cdot (\vec{b_1} \times \vec{b_2})}{|\vec{b_1} \times \vec{b_2}|} \right| \quad \text{—(i)}$$

Now, $\vec{a_2} - \vec{a_1} = (2\hat{i} - \hat{j} + \hat{k}) - (\hat{i} + 2\hat{j} + \hat{k})$

$$\vec{a_2} - \vec{a_1} = \hat{i} - 3\hat{j} \quad \text{—(ii)}$$

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$$\vec{b_1} \times \vec{b_2} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & -1 & 1 \\ 2 & 1 & 2 \end{vmatrix}$$

$$= \hat{i}(-3) - \hat{j}(0) + \hat{k}(3)$$

$$\Rightarrow \boxed{\vec{b_1} \times \vec{b_2} = -3\hat{i} + 3\hat{k}} \quad \text{(iii)}$$

Substituting (ii) & (iii) in (i)

$$\Rightarrow D = \left| \frac{(\hat{i} - 3\hat{j}) \cdot (-3\hat{i} + 3\hat{k})}{|-3\hat{i} + 3\hat{k}|} \right|$$

$$= \left| \frac{-3}{\sqrt{3^2 + 3^2}} \right| \quad \left(|x\hat{i} + y\hat{j} + z\hat{k}| = \sqrt{x^2 + y^2 + z^2} \right)$$

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

$$\Rightarrow D = \frac{1}{\sqrt{2}} \text{ units.}$$

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[Question-21] OR

Given,
$$f(x) = \begin{cases} \frac{K\cos x}{\pi - 2x} & \text{if } x \neq \frac{\pi}{2} \\ 3 & \text{if } x = \frac{\pi}{2} \end{cases}$$

To, find, K if f(x) is continuous at $\frac{\pi}{2}$

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Calculation,
To be continuous at $\frac{\pi}{2}$

LHL = f(x) = RHL

Taking LHL & f(x) into consideration

$$\Rightarrow \lim_{x \to \frac{\pi}{2}^{-}} f(x) = f\left(\frac{\pi}{2}\right)$$

$$\Rightarrow \lim_{h \to 0^{+}} f\left(\frac{\pi}{2} - h\right) = f\left(\frac{\pi}{2}\right)$$

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$$\Rightarrow \lim_{h\to 0^{+}} \left(\frac{K\cos(x-h)}{\pi - 2x}\right)_{x=\frac{\pi}{2}} = 3$$

$$\Rightarrow \lim_{h\to 0^{+}} \frac{K\cos\left(\frac{\pi}{2}-h\right)}{\pi - 2\left(\frac{\pi}{2}-h\right)} = 3$$

$$\Rightarrow \lim_{h\to 0^{+}} \frac{K\sin h}{2h+\pi-\pi} = 3 \quad \left[\cos\left(\frac{\pi}{2}-h\right) = \sin h\right]$$

$$\Rightarrow \lim_{h\to 0^{+}} \frac{K}{2}\left(\frac{\sin h}{h}\right) = 3$$

$$\Rightarrow \frac{K}{2}\cdot 1 = 3 \quad \left[\lim_{x\to 0} \frac{\sin(x)}{x} = 1\right]$$

$$\Rightarrow K = 2\times 3$$

$$\Rightarrow \boxed{K=6}$$

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Question - 22

Given,

$$I = \int_0^{\pi} \frac{x \sin x \, dx}{1+\cos^2 x} \quad \text{--- (i)}$$

Using property,

$$\int_a^b f(x) = \int_a^b f(a+b-x)$$

$$\Rightarrow I = \int_0^{\pi} \frac{(\pi - x)\sin(\pi - x)\,dx}{1+\cos^2(\pi - x)} \quad \text{--- (ii)}$$

$$\Rightarrow I = \int_0^{\pi} \frac{(\pi - x)\sin x}{1+\cos^2 x}\,dx \quad \left[\begin{array}{l}\sin(\pi - h) = \sin h \\ \cos(\pi - h) = -\cos h\end{array}\right]$$

Adding (i) & (ii)

$$\Rightarrow 2I = \int_0^{\pi} \frac{(\pi - x)\sin x + x \sin x \, dx}{1+\cos^2 x}$$

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$$\Rightarrow 2I = \int_0^{\pi} \frac{\pi \sin x \, dx}{1+\cos^2 x} \quad \text{(iii)}$$

Let $\cos x = t$ (iv)

$\Rightarrow -\sin x \, dx = dt$ (v) (substitute in (iii))

$$\Rightarrow 2I = \int_{1}^{-1} \frac{-\pi \, dt}{1+t^2} \quad \begin{bmatrix} \text{If } \cos x \to t \\ \Rightarrow \pi \to -1 \\ \Rightarrow 0 \to 1 \end{bmatrix}$$

$$= -\pi \int_{1}^{-1} \frac{dt}{1+t^2}$$

$$= -\pi \left[\tan^{-1}(t)\right]_{1}^{-1} \quad \left[\int \frac{dx}{a^2+x^2} = \frac{1}{a}\tan^{-1}\left(\frac{x}{a}\right)\right]$$

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

$$= -\pi \left(-\frac{\pi}{4} - \frac{\pi}{4}\right)$$

$$= +\pi \left(+\frac{\pi}{2}\right)$$

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$\Rightarrow \quad 2I = \frac{\pi^2}{2}$

$\Rightarrow \quad \boxed{I = \frac{\pi^2}{4}}$

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Question -23

Given, differential equation

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

$$\Rightarrow \frac{dy}{dx} + \frac{2y}{x} = x$$ [Divide whole equation by x]

On comparing with,

$$\frac{dy}{dx} + p \cdot y = q$$

$$\Rightarrow \boxed{p = \frac{2}{x}} \quad \& \quad \boxed{q = x}$$

$\therefore$, $IF = e^{\int p \cdot dx}$

$= e^{\int \frac{2}{x} \cdot dx}$

$= e^{2 \log x}$ $\left[\int \frac{1}{x} dx = \log(x)\right]$

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$\Rightarrow \boxed{IF = x^2}$ $\quad [e^{\log x} = x^{\log(e)} = x]$

now,

We know that,

$$IF \cdot y = \int IF \cdot q$$

$$\Rightarrow x^2 \cdot y = \int x^2 \cdot x$$

$$\Rightarrow x^2 y = \int x^3 \qquad \left[\int x^n dx = \frac{x^{n+1}}{n+1}\right]$$

$$\Rightarrow x^2 y = \frac{x^4}{4} + C$$

$$\Rightarrow 4x^2 y = x^4 + 4C \qquad [\text{Multiply whole equation with } 4]$$

$$\Rightarrow \boxed{y = \frac{x^2}{4} + \frac{K}{4x^2}} \qquad [\text{Divide whole equation by } 4x^2]$$

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Question - 19

Given, $Z = 3x + 4y$

$x + y \leq 4$, $x \geq 0, y \geq 0$.

To do,

Maximise Z

Calculation,

$x + y \leq 4$

$\Rightarrow$ $y \leq 4 - x$

finding y - intercept (Putting $x = 0$)

$\Rightarrow$ $y = 4 - 0$

$\Rightarrow$ $y = 4$ at $x = 0$

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find x- intercept (Putting $y=0$)

$\Rightarrow \quad 0 = 4 - x$

$\Rightarrow \quad \boxed{x=4.}$ at $\boxed{y=0}$

Now,
Feasible region OAB has been shown in graph in next page.

Calculation table

S.No.	Corner Points	x	y	$Z = 3x+4y$
1	O	0	0	$3(0)+4(0) = 0$
2	A	0	4	$3(0)+4(4) = 16$
3	B	4	0	$3(4)+4(0) = 12$

[Maximum]

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∴, Z is maximum at A(0,4)

and, Maximum value of Z = 16

BSE

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