Class XII Session 2026-27
Subject - Mathematics
Sample Question Paper - 10

Time Allowed: 3 hours **Maximum Marks: 80**

General Instructions:

1. This Question paper contains - five sections A, B, C, D and E. Each section is compulsory. However, there are internal choices in some questions.
2. Section A has 18 MCQ's and 02 Assertion-Reason based questions of 1 mark each.
3. Section B has 5 Very Short Answer (VSA)-type questions of 2 marks each.
4. Section C has 6 Short Answer (SA)-type questions of 3 marks each.
5. Section D has 4 Long Answer (LA)-type questions of 5 marks each.
6. Section E has 3 source based/case based/passage based/integrated units of assessment (4 marks each) with sub parts.

Section A

1. If $[x\ 1]\begin{bmatrix} 1 & 0 \\ -2 & 0 \end{bmatrix} = 0$, then x equals **[1]**

   a) -1 b) 2

   c) -2 d) 0

2. For what value of λ the following system of equations does not have a solution x + y + z = 6, 4x + λy - λz = 0, 3x + 2y – 4z = - 5 ? **[1]**

   a) -3 b) 1

   c) 3 d) 0

3. If A is a 3×3 matrix and |A| = -2, then value of |A (adj A)| is **[1]**

   a) 2 b) 8

   c) -2 d) -8

4. If $y = \log(\sin e^x)$, then $\frac{dy}{dx}$ is: **[1]**

   a) cosec e^x b) e^x cot e^x

   c) cot e^x d) e^x cosec e^x

5. The Cartesian equation of a line passing through the point with position vector $\vec{a} = \hat{i} - \hat{j}$ and parallel to the line $\vec{r} = \hat{i} + \hat{k} + \mu(2\hat{i} - \hat{j})$, is **[1]**

   a) $\frac{x-1}{2} = \frac{y+1}{-1} = \frac{z}{0}$ b) $\frac{x-1}{2} = \frac{y}{-1} = \frac{z-1}{0}$

   c) $\frac{x-2}{1} = \frac{y+1}{0} = \frac{z}{1}$ d) $\frac{x+1}{2} = \frac{y+1}{-1} = \frac{z}{0}$

6. The solution of the DE xdy + ydx = 0 is **[1]**

a) xy = C

b) log (x + y) = C

c) log (x - y) = C

d) x + y = C

7. The objective function Z = 4 x + 3 y can be maximised subjected to the constraints 3x + 4y $\leq$ 24, 8x + 6y $\leq$ 48 , x $\leq$ 5 , y $\leq$ 6 ; x, y $\geq$ 0 **[1]**

a) at a finite number of points

b) at only one point

c) at an infinite number of points

d) at two points only

8. $\sin^{-1}\left(\frac{1}{\sqrt{5}}\right) + \cot^{-1}(3) =$ **[1]**

a) $\frac{\pi}{2}$

b) $\frac{\pi}{6}$

c) $\frac{\pi}{4}$

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

9. $\int \frac{dx}{\sin^2 x \cos^2 x}$ is equal to **[1]**

a) $\tan x + \cot x + C$

b) $(\tan x + \cot x)^2 + C$

c) $\tan x - \cot x + C$

d) $(\tan x - \cot x)^2 + C$

10. If $A = \begin{bmatrix} -1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$, then A^{-1} is **[1]**

a) $\begin{bmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -1 \end{bmatrix}$

b) $\begin{bmatrix} -1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -1 \end{bmatrix}$

c) $\begin{bmatrix} -1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

d) $\begin{bmatrix} -1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

11. A feasible region of a system of linear inequalities is said to be ..., if it can be enclosed within a circle. **[1]**

a) In squared form

b) bounded

c) unbounded

d) in circled form

12. The direction cosines of vector $\overrightarrow{BA}$, where coordinates of A and B are (1, 2, -1) and (3, 4, 0) respectively, are: **[1]**

a) 2, 2, 1

b) $\frac{2}{3}, \frac{2}{3}, \frac{1}{3}$

c) $-\frac{2}{3}, -\frac{2}{3}, -\frac{1}{3}$

d) -2, -2, -1

13. If A = $\begin{vmatrix} 5a & -b \\ 3 & 2 \end{vmatrix}$ and A adj A = A A', then 5a + b is equal to **[1]**

a) 4 b) -1

c) 5 d) 13

14. A box contains 3 orange balls, 3 green balls and 2 blue balls. Three balls are drawn at random from the box without replacement. The probability of drawing 2 green balls and one blue ball is **[1]**

a) $\frac{2}{21}$ b) $\frac{167}{168}$

c) $\frac{1}{28}$ d) $\frac{3}{28}$

15. The sum of the order and degree of the differential equation $\left[1+\left(\frac{dy}{dx}\right)^2\right]^3 = \frac{d^2y}{dx^2}$ is: **[1]**

a) 4 b) 2

c) 3 d) $\frac{5}{2}$

16. What is the value of $\frac{\text{projection of } \vec{a} \text{ on } \vec{b}}{\text{projection of } \vec{b} \text{ on } \vec{a}}$ for vectors $\vec{a} = 2\hat{i} - 3\hat{j} - 6\hat{k}$ and $\vec{b} = 2\hat{i} - 2\hat{j} + \hat{k}$? **[1]**

a) $\frac{4}{3}$ b) $\frac{7}{3}$

c) $\frac{3}{7}$ d) $\frac{4}{7}$

17. $\frac{d}{dx}(\tan^{-1}(\sec x + \tan x)$ is equal to **[1]**

a) $\frac{1}{2}$ b) $-\frac{1}{2}$

c) $\frac{1}{2\sec x(\sec x + \tan x)}$ d) $\frac{1}{4}$

18. The Cartesian equation of the line passing through the point $(1, -3, 2)$ and parallel to the line $\vec{r} = 2\hat{i} - \hat{k} + \lambda(\hat{i} + \hat{j} + 2\hat{k})$ is: **[1]**

a) $\frac{x+1}{2} = \frac{y-3}{0} = \frac{z+2}{-1}$ b) $\frac{x+1}{1} = \frac{y-3}{1} = \frac{z+2}{2}$

c) $\frac{x-1}{2} = \frac{y+3}{0} = \frac{z-2}{-1}$ d) $\frac{x-1}{1} = \frac{y+3}{1} = \frac{2-z}{-2}$

19. **Assertion (A):** If manufacturer can sell x items at a price of ₹$(5 - \frac{x}{100})$ each. The cost price of x items is ₹$(\frac{x}{5} + 500)$. Then, the number of items he should sell to earn maximum profit is 240 items. **[1]**

Reason (R): The profit for selling x items is given by $\frac{24}{5}x - \frac{x^2}{100}$ - 300.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

20. **Assertion (A):** If R is the relation defined in set {1, 2, 3, 4, 5, 6} as R = {{a, b) : b = a + 1), then R is reflexive. **[1]**

Reason (R): The relation R in the set {1, 2, 3} given by R = {(1, 2), (2, 1)} is symmetric.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

Section B

21. Simplify $\sin^{-1}\left(\frac{x}{\sqrt{1+x^2}}\right)$. **[2]**

OR

Write the interval for the principal value of function and draw its graph: $\sin^{-1}x$....

22. Find the local maxima and local minima, of function. Find also the local maximum and the local minimum value, as the case may be: $f(x) = x^3 - 3x$. **[2]**

23. A spherical ball of salt is dissolving in water in such a manner that the rate of decrease of the volume at any instant is proportional to the surface. Prove that the radius is decreasing at a constant rate. **[2]**

OR

Find the intervals of function $f(x) = x^3 - 6x^2 + 9x + 10$ is

a. increasing

b. decreasing.

24. Evaluate: $\int \frac{x+2}{(x^2+3x+3)\sqrt{x+1}}dx$ **[2]**

25. If $A = \begin{bmatrix} 2 & 3 \\ 5 & -2 \end{bmatrix}$ be such that $A^{-1} = kA$, then find the value of k. **[2]**

Section C

26. Evaluate: $\int \frac{1}{\sqrt{3}\sin x+\cos x}dx$ **[3]**

27. A and B appear for an interview for two posts. The probability of A's selection is (1/3) and that of B's selection is (2/5). Find the probability that only one of them will be selected. **[3]**

28. Evaluate: $\int_0^{\pi/2} \frac{1}{1+\cot x}dx$ **[3]**

OR

Evaluate: $\int_0^1 \frac{x\tan^{-1}x}{(1+x^2)^{3/2}}dx$

29. Solve the initial value problem: $(x + y + 1)^2 dy = dx$, $y(-1) = 0$ **[3]**

OR

Find the particular solution of the differential equation $(1 - y^2)(1 + \log|x|)dx + 2xy\,dy = 0$ given that $y = 0$, when $x = 1$.

30. Find the sine of the angle between the vectors. $\vec{a} = 2\hat{i} - \hat{j} + 3\hat{k}, \vec{b} = \hat{i} + 3\hat{j} + 2\hat{k}$ **[3]**

OR

If the vertices A, B, C of $\triangle ABC$ have position vectors (1,2,3), (-1,0,0), (0,1,2) respectively, what is the magnitude of $\angle ABC$?

31. Differentiate $\tan^{-1}\left(\frac{\sqrt{1-x^2}}{x}\right)$ w.r.t $\cos^{-1}\left(2x\sqrt{1-x^2}\right)$, when $x \neq 0$. **[3]**

Section D

32. Using integration, find the area of the region: $\{(x, y) : 9x^2 + 4y^2 \leq 36, 3x + y \geq 6\}$. **[5]**

33. Check whether the relation S in the set $\mathbb{R}$ of real numbers, defined as $S = \{(a, b) : a \leq b^2\}$ is reflexive, symmetric or transitive. Also, determine all $x \in R$ such that $(x, x) \in S$. **[5]**

OR

If A = {1, 2, 3, 4}, define relations on A which have properties of being:

a. reflexive, transitive but not symmetric

b. symmetric but neither reflexive nor transitive

c. reflexive, symmetric and transitive.

34. An amount of ₹ 10,000 is put into three investments at the rate of 10%, 12% and 15% per annum. The combined annual income of all three investments is ₹ 1,310 , however the combined annual income of the first and the second investments is ₹ 190 short of the income from the third. Use matrix method and find the investment amount in each at the beginning of the year. **[5]**

35. Show that the right triangle of maximum area that can be inscribed in a circle is an isosceles triangle. **[5]**

OR

Show that of all the rectangles with a given perimeter, the square has the largest area.

Section E

36. A shop selling electronic items sells smartphones of only three reputed companies A, B and C because chances of their manufacturing a defective smartphone are only $5\%, 4\%$ and 2% respectively. In his inventory he has 25% smartphones from company A, 35% smartphones from company B and 40% smartphones from company C. **[4]**

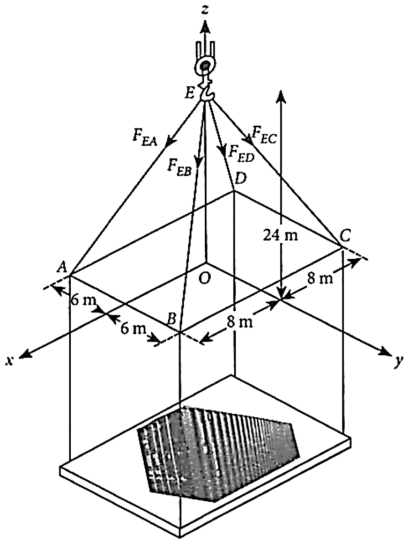
A person buys a smartphone from this shop.

i. Find the probability that it was defective. **(2)**

ii. What is the probability that this defective smartphone was manufactured by company B? **(2)**

37. **Read the following text carefully and answer the questions that follow:** **[4]**

Consider the following diagram, where the forces in the cable are given.



i. What is the cartesian equation of line along EA? (1)

ii. The vector $\overrightarrow{ED}$ is (1)

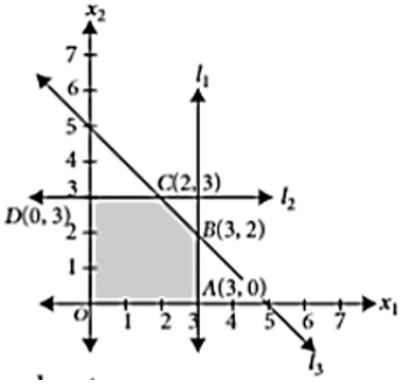
iii. The length of the cable EB is (2)

OR

What is the result of adding up all the vectors along the cables? (2)

38. **Read the following text carefully and answer the questions that follow:** **[4]**

Corner points of the feasible region for an LPP are (0, 3), (5, 0), (6, 8), (0, 8). Let Z = 4x - 6y be the objective function.



i. At which corner point the minimum value of Z occurs? (1)

ii. At which corner point the maximum value of Z occurs? (1)

iii. What is the value of (maximum of Z - minimum of Z)? (2)

OR

The corner points of the feasible region determined by the system of linear inequalities are (2)

Solution

Section A

1.

(b) 2

Explanation:

$\begin{bmatrix} x & 1 \end{bmatrix}\begin{bmatrix} 1 & 0 \\ -2 & 0 \end{bmatrix} = \begin{bmatrix} 0 & 0 \end{bmatrix}$

$\Rightarrow \begin{bmatrix} x-2 & 0 \end{bmatrix} = \begin{bmatrix} 0 & 0 \end{bmatrix}$

$\Rightarrow$ x - 2 = 0 [By def. of equality]

$\Rightarrow$ x = 2

2.

(c) 3

Explanation:

The given system of equations does not have solution if $\begin{vmatrix} 1 & 1 & 1 \\ 4 & \lambda & -\lambda \\ 3 & 2 & -4 \end{vmatrix} = 0 \Rightarrow \begin{vmatrix} 0 & 0 & 1 \\ 4+\lambda & 2\lambda & -\lambda \\ 7 & 6 & 4 \end{vmatrix} = 0 \Rightarrow (24+6\lambda-14\lambda) = 0 \Rightarrow \lambda = 3$

3.

(d) -8

Explanation:

-8

4.

(b) e^x cot e^x

Explanation:

e^x cot e^x

y = log (sin e^x)

$\frac{dy}{dx} = \frac{d}{dx}$log (sin e^x)

= $\frac{1}{sine^x}\frac{d}{dx}$sin e^x

=$\frac{1}{sine^x}$cos $e^x\frac{d}{dx}e^x$

= cot $e^x(e^x)$

= e^x cot e^x

5. **(a)** $\frac{x-1}{2} = \frac{y+1}{-1} = \frac{z}{0}$

Explanation:

$\frac{x-1}{2} = \frac{y+1}{-1} = \frac{z}{0}$

6. **(a)** xy = C

Explanation:

Given, xdy + ydx = 0

xdy = -ydx

$-\frac{dy}{y} = \frac{dx}{x}$

On integrating on both sides ,we obtain
-log y = log x +log c
log x + log y =log c
log xy =log c
xy = C

7.

(c) at an infinite number of points

Explanation:

First, we will convert the given inequations into equations, we obtain the following equations:
3x + 4y = 24, 8x + 6y = 48, x = 5, y = 6, x = 0 and y = 0
The line 3x + 4y = 24 meets the coordinate axis at A(8, 0) and B(0, 6). Join these points to obtain the line 3x + 4y = 24 Clearly, (0, 0) satisfies the inequation 3x + 4y $\leq$ 24 . So, the region in x y -plane that contains the origin represents the solution set of the given equation. The line 8x + 6y = 48 meets the coordinate axis at C(6, 0) and D(0, 8) . Join these points to obtain the line 8x + 6y = 48 Clearly, (0, 0) satisfies the inequation 8x + 6y $\leq$ 48 . So, the region in x y -plane that contains the origin represents the solution set of the given equation.
x = 5 is the line passing through x = 5 parallel to the Y axis.
y = 6 is the line passing through y = 6 parallel to the X axis.
The region represented by x $\geq$ 0 and y $\geq$ 0 :
since, every point in the first quadrant satisfies these inequations. So, the first quadrant is the region represented by the inequations.
These lines are drawn using a suitable scale.
The corner points of the feasible region are O(0, 0), G(5, 0), $F\left(5, \frac{4}{3}\right)$, $E\left(\frac{24}{7}, \frac{24}{7}\right)$ and B(0, 6)
The values of Z at these corner points are as follows:
Corner point : Z = 4x + 3y
O(0, 0) : $4 \times 0 + 3 \times 0 = 0$
G(5, 0) : $4 \times 5 + 3 \times 0 = 20$
$F\left(5, \frac{4}{3}\right) : 4 \times 5 + 3 \times \frac{4}{3} = 24$
$E\left(\frac{24}{7}, \frac{24}{7}\right) : 4 \times \frac{24}{7} + 3 \times \frac{24}{7} = \frac{196}{7} = 28$
B(0, 6) : $4 \times 0 + 3 \times 6 = 18$
We see that the maximum value of the objective function z is 24 which is at $F\left(5, \frac{4}{3}\right)$ and $E\left(\frac{24}{7}, \frac{24}{7}\right)$ Thus, the optimal value of Z is 24
As, we know that if an LPP has two optimal solutions, then there are an infinite number of optimal solutions. Therefore, the given objective function can be subjected at an infinite number of points.

8.

(c) $\frac{\pi}{4}$

Explanation:

$sin^{-1}\left(\frac{1}{\sqrt{5}}\right) + cot^{-1}(3)$
$\Rightarrow \tan^{-1}\left(\frac{1}{2}\right) + tan^{-1}\left(\frac{1}{3}\right)$ because $\frac{1}{2} . \frac{1}{3} < 1$
$\Rightarrow \tan^{-1}\left(\frac{\left(\frac{1}{2}\right)+\left(\frac{1}{3}\right)}{1-\left(\frac{1}{2}\right)\left(\frac{1}{3}\right)}\right)$
$\Rightarrow \tan^{-1}(1) = \frac{\pi}{4}$

9.

(c) $\tan x - \cot x + C$

Explanation:
$\tan x - \cot x + C$

10.

(d) $\begin{bmatrix} -1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

Explanation:
$\begin{bmatrix} -1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

11.

(b) bounded

Explanation:
A feasible region of a system of linear inequalities is said to be bounded, if it can be enclosed within a circle.

12.

(c) $-\frac{2}{3}, -\frac{2}{3}, -\frac{1}{3}$

Explanation:
$-\frac{2}{3}, -\frac{2}{3}, -\frac{1}{3}$

13.

(c) 5

Explanation:
5

14.

(d) $\frac{3}{28}$

Explanation:
Probability of drawing 2 green balls and one blue ball
$= P_G \cdot P_G \cdot P_B + P_B \cdot P_G \cdot P_G + P_G \cdot P_B \cdot P_G$
$= \frac{3}{8} \cdot \frac{2}{7} \cdot \frac{2}{7} + \frac{2}{8} \cdot \frac{3}{7} \cdot \frac{2}{6} + \frac{3}{8} \cdot \frac{2}{7} \cdot \frac{2}{6}$
$= \frac{1}{28} + \frac{1}{28} + \frac{1}{28} = \frac{3}{28}$

15.

(c) 3

Explanation:
3

16.

(b) $\frac{7}{3}$

Explanation:
$\frac{7}{3}$

17. **(a)** $\frac{1}{2}$

Explanation:

$\frac{d}{dx}(\tan^{-1}(\sec x + \tan x)) = \frac{\sec x \tan x + \sec^2 x}{1+(\sec x + \tan x)^2} = \frac{\sec x(\sec x + \tan x)}{2\sec x(\sec x + \tan x)} = \frac{1}{2}$.

Which is the required solution.

18.

(d) $\frac{x-1}{1} = \frac{y+3}{1} = \frac{2-z}{-2}$

Explanation:

$\frac{x-1}{1} = \frac{y+3}{1} = \frac{2-z}{-2}$

19.

(c) A is true but R is false.

Explanation:

Let S(x) be the selling price of x items and let C(x) be the cost price of x items.

Then, we have

S(x) = (5 - $\frac{x}{100}$)x = 5x - $\frac{x^2}{100}$

and C(x) = $\frac{x}{5}$ + 500

Thus, the profit function P(x) is given by

P(x) = S(x) - C(x) = 5x - $\frac{x^2}{100} - \frac{x}{5}$ - 500

i.e. P(x) = $\frac{24}{5}x - \frac{x^2}{100}$ - 500

On differentiating both sides w.r.t. x, we get

P'(x) = $\frac{24}{5} - \frac{x}{50}$

Now, P'(x) = 0 gives x = 240.

Also, P'(x) = $\frac{-1}{50}$.

So, P'(240) = $\frac{-1}{50}$ < 0

Thus, x = 240 is a point of maxima.

Hence, the manufacturer can earn maximum profit, if he sells 240 items.

20.

(d) A is false but R is true.

Explanation:

Assertion: Let A = {1, 2, 3, 4, 5, 6}

A relation R is defined on set A is

R = {(a, b) : b = a + 1}

$\therefore$ R = {(1, 2), (2, 3), (3, 4), (4, 5), (5, 6)}

Now, 6 $\in$ A but (6, 6) $\notin$ R

$\therefore$ R is not reflexive.

Reason: Given set A = {1, 2, 3}

A relation R on A is defined as

R = {(1, 2), (2, 1)}

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

So, R is symmetric.

Section B

21. Put $x = \tan\theta \Rightarrow \theta = \tan^{-1} x$

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

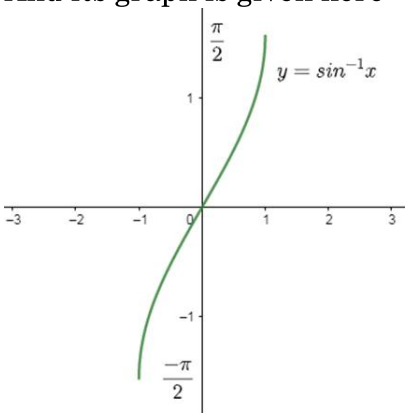
$= \sin^{-1}\left(\frac{\tan\theta}{\sec\theta}\right) = \sin^{-1}(\sin\theta)$

$= \theta = \tan^{-1} x$

OR

Principal value branch of $\sin^1$ x is $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$

And its graph is given here



22. Given: f(x) = x^3 - 3x

$\because$ f'(x) = $3x^2$ -3

and

f''(x) = 0 $\Rightarrow$ $3x^2$ =3 $\Rightarrow$ x = $\pm$ 1

f''(x) = 6x

f''(1) = 6 > 0

f''(-1) = -6 < 0

by second derivative test, x = 1 is a point of local minima and local minimum value of f at x = 1 is

f(1) = 1^3 - 3 = 1 - 3 = - 2.

but, x = -1 is a point of local maxima and local maximum value of f at

x = -1 is

f(1) = $(-1)^3$ - 3 (-1) = -1 + 3 = 2

23. We have, rate of decrease of the volume of spherical ball of salt at any instant is proportional to surface area. Let the radius of the spherical ball of the salt be r.

$\therefore$ Volume of the ball (V) = $\frac{4}{3}\pi r^3$

and surface area (s) = $4\pi r^2$

$\because \frac{dV}{dT} \propto s$

$\Rightarrow \frac{d}{dt}\left(\frac{4}{3}\pi r^3\right) \propto 4\pi r^2$

$\Rightarrow \frac{4}{3}\pi 3r^2 \frac{dr}{dt} \propto 4\pi r^2$

$\Rightarrow \frac{dr}{dt} \propto \frac{4\pi r^2}{4\pi r^2}$

$\Rightarrow \frac{dr}{dt} = k.1$ [where, k is the proportionality constant]

$\Rightarrow \frac{dr}{dt} = k$

Hence, the radius of ball is decreasing at a constant rate.

OR

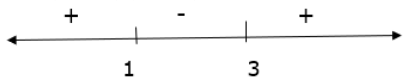
The given function

f(x) = x^3 - $6x^2$ + 9x + 10

f'(x) = $3x^2$ - 12x + 9

f'(x) = 3(x^2 - 4x + 3)

= 3(x - 3)(x - 1)



Function f(x) is decreasing for x $\in$ [1, 3] and increasing in x $\in (-\infty, 1) \cup (3, \infty)$

24. Let I = $\int \frac{x+2}{(x^2+3x+3)\sqrt{x+1}}dx$

Putting x + 1 = t^2, and dx = 2t, we get

I = $\int \frac{\left(t^2+1\right)2t}{\left\{\left(t^2-1\right)^2+3\left(t^2-1\right)+3\right\}\sqrt{t^2}}dt$

$\Rightarrow$ I = $2\int \frac{\left(t^2+1\right)}{t^4+t^2+1}dt = 2\frac{1+\frac{1}{t^2}}{t^2+\frac{1}{t^2}+1}dt$ [Dividing $N^r$and D^r by t^2]

$\Rightarrow$ I = $2\int \frac{1+\frac{1}{t^2}}{\left(t-\frac{1}{t}\right)^2+(\sqrt{3})^2}$dt = $2\int \frac{du}{u^2+(\sqrt{3})^2}$, where t - $\frac{1}{t}$ = u

$\Rightarrow$ I = $\frac{2}{\sqrt{3}}$ $\tan^{-1}\left(\frac{u}{\sqrt{3}}\right)$ + C = $\frac{2}{\sqrt{3}}$ $\tan^{-1}\left\{\frac{t-\frac{1}{t}}{\sqrt{3}}\right\}+C$

$\Rightarrow$ I = $\frac{2}{\sqrt{3}}$ $\tan^{-1}\left(\frac{t^2-1}{\sqrt{3}t}\right)$ + C = $\frac{2}{\sqrt{3}}$ $\tan^{-1}\left\{\frac{x}{\sqrt{3(x+1)}}\right\}+C$.

25. According to question,

A^{-1} = kA

$\frac{1}{A} = kA$

$k = \frac{1}{A^2} = \frac{1}{\begin{bmatrix}2 & 3\\ 5 & -2\end{bmatrix}\begin{bmatrix}2 & 3\\ 5 & -2\end{bmatrix}} = \frac{1}{19\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}}$

Also. $|k| = \frac{1}{|A|^2}$

$= \frac{1}{|A^2|}$

$= \frac{1}{|19\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}}$

$= \frac{1}{19\times 1} = \frac{1}{19}$

Hence, k = $\frac{1}{19}$

Section C

26. Let the given integral be,

I = $\int \frac{1}{\sqrt{3}\sin x+\cos x}dx$

Putting sin x = $\frac{2\tan\frac{x}{2}}{1+\tan^2\frac{x}{2}}$ and cos x = $\frac{1-\tan^2\frac{x}{2}}{1+\tan^2\frac{x}{2}}$

$\Rightarrow I = \int \frac{1}{\sqrt{3}\frac{2\tan\frac{x}{2}}{1+\tan^2\frac{x}{2}}+\frac{1-\tan^2\frac{x}{2}}{1+\tan^2\frac{x}{2}}}dx$

$= \int \frac{1+\tan^2\frac{x}{2}}{2\sqrt{3}\tan\frac{x}{2}+1-\tan^2\frac{x}{2}}dx$

$= \int \frac{\sec^2\frac{x}{2}}{-\tan^2\frac{x}{2}+2\sqrt{3}\tan\frac{x}{2}+1}dx$

Let $\tan\frac{x}{2}$ = t

$\Rightarrow \frac{1}{2}\sec^2\frac{x}{2}$ dx = dt

$\Rightarrow \sec^2\frac{x}{2}$ dx = 2dt

$\therefore I = 2\int \frac{dt}{-t^2+2\sqrt{3}t+1}$

$= -2\int \frac{dt}{t^2-2\sqrt{3}t-1}$

$= -2\int \frac{dt}{t^2-2\sqrt{3}t+(\sqrt{3})^2-(\sqrt{3})^2-1}$

$= -2\int \frac{dt}{(t-\sqrt{3})^2-(2)^2}$

$= -\frac{2}{2\times 2}\log\left|\frac{t-\sqrt{3}-2}{t-\sqrt{3}+2}\right| + C$

$= -\frac{1}{2}\log\left|\frac{\tan\frac{x}{2}-2-\sqrt{3}}{\tan\frac{x}{2}+2-\sqrt{3}}\right| + C$

$= \frac{1}{2}\log\left|\frac{\tan\frac{x}{2}+2-\sqrt{3}}{|\tan\frac{x}{2}+2-\sqrt{3}}\right| + C$

27. Let E_1 = event that A is selected, and E_2 = event that B is selected.

Therefore,we have,

$P(E_1) = \frac{1}{3}$ and $P(E_2) = \frac{2}{5}$

$\Rightarrow P\left(\bar{E}_1\right) = \left(1-\frac{1}{3}\right) = \frac{2}{3}$ and $P\left(\bar{E}_2\right) = \left(1-\frac{2}{5}\right) = \frac{3}{5}$

$\therefore$ P(event that only one of them is selected)

= P[(E_1 and not E_2) or (E_2 and not E_1)]

$= P\left[\left(E_1 \cap \bar{E}_2\right) \text{ or } \left(E_2 \cap \bar{E}_1\right)\right]$

$= P\left(E_1 \cap \bar{E}_2\right) + P\left(E_2 \cap \bar{E}_1\right)$ $\left[\because \left(E_1 \cap \bar{E}_2\right) \cap \left(E_2 \cap \bar{E}_1\right) = \phi\right]$

$= P\left(E_1\right) \cdot P\left(\bar{E}_2\right) + P\left(E_2\right) \cdot P\left(\bar{E}_1\right)$ [$\because$ E_1 and $\bar{E}_2$ are independent, and E_2 and $\bar{E}_1$ are independent]

$= \left(\frac{1}{3}\times\frac{3}{5}\right) + \left(\frac{2}{5}\times\frac{2}{3}\right) = \left(\frac{1}{5}+\frac{4}{15}\right) = \frac{7}{15}$

This is the required probability

28. We have,

$\frac{1}{1+\cot x} = \frac{1}{1+\frac{\cos x}{\sin x}} = \frac{\sin x}{\sin x+\cos x}$

$\therefore \int_0^{\frac{\pi}{2}} \frac{1}{1+\cot x}dx = \int_0^{\frac{\pi}{2}} \frac{\sin x}{\sin x+\cos x}dx$

Let

$I = \int_0^{\frac{\pi}{2}} \frac{\sin x}{\sin x+\cos x}dx$..(i)

so, using property of defnite integrals we have

$I = \int_0^{\frac{\pi}{2}} \frac{\sin\left(\frac{\pi}{2}-x\right)}{\sin\left(\frac{\pi}{2}-x\right)+\cos\left(\frac{\pi}{2}-x\right)}dx$ $\left[\because \int_0^a f(x)dx = \int_0^a f(a-x)dx\right]$

$= \int_0^{\frac{\pi}{2}} \frac{\cos x}{\sin x+\cos x}dx$..(ii)

Adding (i) & (ii), we get

$2I = \int_0^{\frac{\pi}{2}} \frac{\sin x}{\sin x+\cos x}dx + \int_0^{\frac{\pi}{2}} \frac{\cos x}{\sin x+\cos x}dx$

$= \int_0^{\frac{\pi}{2}} \frac{\sin x+\cos x}{\sin x+\cos x}dx$

$= \int_0^{\frac{\pi}{2}} dx$

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

$= \left[\frac{\pi}{2}-0\right]$

$\Rightarrow \ I = \frac{\pi}{4}$

OR

Let $\tan^{-1}x = \theta$ or, $x = \tan\theta$. Then, $dx = \sec^2\theta d\theta$

Also, $x = 0 \Rightarrow \tan\theta = 0 \Rightarrow \theta = 0$ and $x = 1 \Rightarrow \tan\theta = 1 \Rightarrow \theta = \frac{\pi}{4}$

$\Rightarrow \quad I = \int_0^{\pi/4} \frac{\theta\tan\theta}{\sec^3\theta}\sec^2\theta d\theta$

$\Rightarrow \quad I = \int_0^{\pi/4} \theta\sin\theta d\theta$

Using integration by parts

$\Rightarrow \quad I = \left[-\theta\cos\theta\right]_0^{\pi/4} - \int_0^{\pi/4}(-\cos\theta)d\theta$

$= [-\theta\cos\theta]_0^{\pi/4} + [\sin\theta]_0^{\pi/4}$

$\Rightarrow \quad I = \left(-\frac{\pi}{4\sqrt{2}} - 0\right) + \left(\frac{1}{\sqrt{2}} - 0\right) = \frac{4-\pi}{4\sqrt{2}}$

29. We have,

$(x + y + 1)^2\, dy = dx$

$\Rightarrow \frac{dy}{dx} = \frac{1}{(x+y+1)^2}$ ...(i)

Let x + y + 1 = v. Then, $1 + \frac{dy}{dx} = \frac{dv}{dx} \Rightarrow \frac{dy}{dx} = \frac{dv}{dx} - 1$

Putting x + y + 1 = v and $\frac{dy}{dx} = \frac{dv}{dx}$ - 1 in (i), we have,

$\therefore \frac{dv}{dx} - 1 = \frac{1}{v^2}$

$\Rightarrow \frac{dv}{dx} = \frac{1+v^2}{v^2}$

$\Rightarrow \frac{v^2}{v^2+1}\, dv = dx$

$\Rightarrow \int \frac{v^2}{v^2+1} dv = \int dx$

$\Rightarrow \int \frac{v^2+1-1}{v^2+1} dv = \int dx$

$\Rightarrow \int \left(1 - \frac{1}{v^2+1}\right) dv = \int dx$

$\Rightarrow v - \tan^{-1} v = x + C$

$\Rightarrow (x + y + 1) - \tan^{-1}(x + y + 1) = x + C$

$\Rightarrow y + 1 - \tan^{-1}(x + y + 1) = C$ ...(ii)

It is given that y(-1) = 0 i.e. y = 0 when x = -1 . Putting x = -1 and y = 0 in (ii), we get

$1 - \tan^{-1} 0 = C \Rightarrow C = 1$

Putting C = 1 in (ii), we get

$y = \tan(x + y + 1) \Rightarrow x + y + 1 = \tan y$, which is the required solution.

OR

We have,

$(1 - y^2)(1 + \log|x|)\, dx + 2xy\, dy = 0.$

On separating the variables, we get

$\frac{(1+\log|x|)}{x} dx + \frac{2y}{1-y^2} dy = 0$ [dividing both sides by $x(1 - y^2)$]

On integrating, we get

$\int \left(\frac{1}{x} + \frac{\log|x|}{x}\right) dx + \int \frac{2y}{1-y^2} dy = 0$

$\Rightarrow \log|x| + \frac{(\log|x|)^2}{2} - \log|1 - y^2| = \log C$ ...(i)

Also, given y = 0 and x = 1

$\therefore \log 1 + \frac{(\log 1)^2}{2} - \log|1 - 0| = \log C$

$\Rightarrow 0 + 0 - 0 = \log C \Rightarrow \log C = 0$

On putting log C = 0 in Eq. (i), we get

$\log|x| + \frac{(\log|x|)^2}{2} - \log|1 - y^2| = 0$

Which is the required solution of given differential equation.

30. $\vec{a} = \sqrt{4+1+9} = \sqrt{14}$

$\vec{b} = \sqrt{1+9+4} = \sqrt{14}$

$$\vec{a} \times \vec{b} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & -1 & 3 \\ 1 & 3 & 2 \end{vmatrix}$$

$= -11\hat{i} - \hat{j} + 7\hat{k}$

$\left|\vec{a}\times\vec{b}\right| = \sqrt{(-11)^2+(-1)^2+(7)^2}$

$= \sqrt{171} = 3\sqrt{19}$

$\sin\theta = \frac{\left|\vec{a}\times\vec{b}\right|}{\left|\vec{a}\right|\left|\vec{b}\right|} = \frac{3\sqrt{19}}{\sqrt{14}.\sqrt{14}} = \frac{3}{14}\sqrt{19}$

OR

We are given that,

A =(1,2,3)

B =(-1,0,0)

c = (0,1,2)

Position vector A $= \hat{i}+2\hat{j}+3\hat{k}$

Position vector of B $= -\hat{i}+0\hat{j}+0\hat{k}$

position vector of C $= 0\hat{i}+\hat{j}+2\hat{k}$

$\overrightarrow{AB}$ = position vector of B -position vector of A

$= (-\hat{i}+0\hat{j}+0\hat{k}) - (\hat{i}+2\hat{j}+3\hat{k})$

$= -2\hat{i}-2\hat{j}-3\hat{k}$

$\overrightarrow{BC} = (0\hat{i}+\hat{j}+2\hat{k}) - (-\hat{i}+0\hat{j}+0\hat{k})$

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

$\overrightarrow{AB}\cdot\overrightarrow{BC} = (-2\hat{i}-2\hat{j}-3\hat{k})\cdot(\hat{i}+\hat{j}+2\hat{k})$

= -2 -2 -6

=-10

$\angle ABC = \frac{\overrightarrow{AB}\cdot\overrightarrow{BC}}{\left|\overrightarrow{AB}\right|\left|\overrightarrow{BC}\right|}$

$= \frac{-10}{\sqrt{(-2)^2+(-2)^2+(-3)^2}.\sqrt{1^2+1^2+2^2}}$

$= \frac{-10}{\sqrt{17}\sqrt{6}}$

$\angle ABC = \cos^{-1}\left(\frac{-10}{\sqrt{102}}\right)$

31. Let u =$\tan^{-1}\left[\frac{\sqrt{1-x^2}}{x}\right]$

Put x =$\cos\theta \Rightarrow \theta = \cos^{-1}x$

Then, u = $\tan^{-1}\left[\frac{\sqrt{1-\cos^2\theta}}{\cos\theta}\right]$

= $\tan^{-1}\left[\frac{\sqrt{\sin^2\theta}}{\cos\theta}\right]$ $\left[\because \cos^2\theta+\sin^2\theta = 1 \Rightarrow \sin^2\theta = 1-\cos^2\theta\right]$

= $\tan^{-1}\left[\frac{\sin\theta}{\cos\theta}\right]$

= $\tan^{-1}[\tan\theta] = \theta$

$\Rightarrow \quad u = \cos^{-1}x$

On differentiating both sides w.r.t x, we get

$\frac{du}{dx} = -\frac{1}{\sqrt{1-x^2}}$

Again , let v =$\cos^{-1}\left(2x\sqrt{1-x^2}\right)$

Put x =$\cos\theta \Rightarrow \theta = \cos^{-1}x$

Then, v = $\cos^{-1}\left[2\cos\theta\sqrt{1-\cos^2\theta}\right]$

$= \cos^{-1}[2\cos\theta\sin\theta]\begin{bmatrix}\because \sin\theta = \sqrt{1-\cos^2\theta}\\ \Rightarrow \sin^2\theta = 1-\cos^2\theta\end{bmatrix}$

$= \cos^{-1}[\sin 2\theta]$

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

$\Rightarrow v = \frac{\pi}{2} - 2\cos^{-1}x\left[\because \theta = \cos^{-1}x\right]$

On differentiating both sides w.r.t x, we get

$\frac{dv}{dx} = \frac{2}{\sqrt{1-x^2}}$

Now, $\frac{du}{dv} = \frac{du}{dx} \times \frac{dx}{dv} = -\frac{1}{\sqrt{1-x^2}} \times \frac{\sqrt{1-x^2}}{2}$

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

Section D

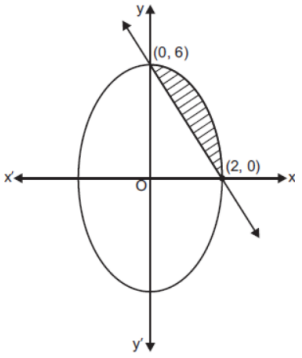
32. Given region is {(x, y): $9x^2 + 4y^2 \leq 36$ and $3x + y \geq 6$}

We draw the curves corresponding to equations

$9x^2 + 4y^2 = 36$ or $\frac{x^2}{4} + \frac{y^2}{9} = 1$ and $3x + y = 6$

The curves intersect at (2, 0) and (0, 6)

Shaded area is the area enclosed by the two curves and is given as,



$= \int_0^2 \sqrt{9\left(1 - \frac{x^2}{4}\right)}dx - \int_0^2 (6 - 3x)dx$

$= 3\left[\frac{x}{4}\sqrt{4-x^2} + \frac{4}{2}\sin^{-1}\frac{x}{2} - 2x + \frac{x^2}{2}\right]_0^2$

$= 3\left[\frac{2}{4}\sqrt{4-4} + \frac{4}{2}\sin^{-1}\frac{2}{2} - 4 + \frac{4}{2} - 0\right]$

$= 3\left[2\frac{\pi}{2} - 2\right]$ = 3(π - 2) square units.

33. Reflexive: Let $\frac{1}{2} \not\leq \left(\frac{1}{2}\right)^2$,

$\therefore S$ is not reflexive.

Symmetric: $1 \not\leq 2^2 \Rightarrow (1,2) \notin S$ but $2 \leq 1^2 \Rightarrow (2,1) \in S$.

$\therefore S$ is not symmetric.

Transitive: $10 \leq 6^2 \Rightarrow (10,6) \in S \& 6 \not\leq 3^2$

$\Rightarrow (6,3) \notin S$ but $10 \leq 3^2 \Rightarrow (10,3) \in S$

$\therefore S$ is not Transitive.

Let $(x,x) \in S \Leftrightarrow x \leq x^2 \Leftrightarrow x \in R - (0,1)$

OR

Given that A = {1, 2, 3, 4},

a. Let R_1 = {(1,1), (1,2), (2,3), (2,2), (1,3), (3,3)}

R_1 is reflexive, since, (1,1) (2,2) (3,3) lie is R_1

Now, (1,2) $\in R_1$ (2,3) $\in R_1 \Rightarrow$ (1, 3) $\in R_1$

Hence, R_1 is also transitive but (1,2), $\in R_1 \Rightarrow (2,1) \notin R_1$

So, it is not symmetric.

b. Let R_2 = {(1,2),(2,1)}. Here,1,2,3 ∈ {1,2,3} but (1,1),(2,2),(3,3) are not in R.

Therefore, R is not reflexive.Now, (1,2) ∈ R_2, (2,1) ∈ R_2

So, it is symmetric.

Now (1,2) ∈ R (2,1) ∈ R, but (1,1) ∉ R,

therefore, R is not transitive.

c. Let R3 = {(1,2), (2,1),(1,1)(2,2),(3,3),(1,3),(3,1),(2,3)}

Clearly, R_3 is reflexive, symmetric and transitive.

34. Let the numbers are x,y,z

x + y + z = 10,000 ...(i)

Also,

0.1x + 0.12y + 0.15z = 1310 ...(ii)

Again,

0.1x + 0.12y – 0.15z = – 190 ...(iii)

$$\begin{bmatrix} 1 & 1 & 1 \\ 0.1 & 0.12 & 0.15 \\ 0.1 & 0.12 & -0.15 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 10000 \\ 1310 \\ -190 \end{bmatrix}$$

A X = B

|A| = 1(– 0.036) – 1(– 0.03) + 1(0)

= – 0.006

Hence, the unique solution given by $x = A^{-1}B$

C_{11} = – 0.036

C_{12} = 0.27

C_{13} = 0

C_{21} = 0.27

C_{22} = – 0.25

C_{23} = – 0.02

C_{31} = 0.03

C_{32} = – 0.05

C_{33} = 0.02

$$X = A^{-1}B = \frac{1}{|A|}(\text{ adj } A)B$$

$$\text{Adj A} = \begin{bmatrix} -0.036 & 0.27 & 0.03 \\ 0.27 & -0.25 & -0.05 \\ 0.03 & -0.02 & 0.02 \end{bmatrix}^{T} = \begin{bmatrix} -0.036 & 0.27 & 0.03 \\ 0.03 & -0.25 & -0.05 \\ 0 & -0.02 & 0.02 \end{bmatrix}$$

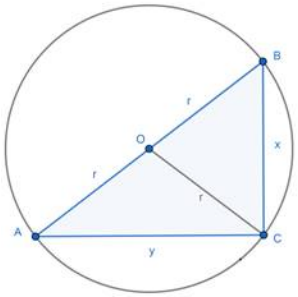
$$X = \frac{1}{-0.006} \begin{bmatrix} -0.036 & 0.27 & 0.03 \\ 0.03 & -0.25 & -0.05 \\ 0 & -0.02 & 0.02 \end{bmatrix} \begin{bmatrix} 10000 \\ 1310 \\ -190 \end{bmatrix}$$

$$X = \frac{1}{-0.006} \begin{bmatrix} -12 \\ -18 \\ -30 \end{bmatrix}$$

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 2000 \\ 3000 \\ 5000 \end{bmatrix}$$

Hence, x = ₹ 2000, y = ₹ 3000 and z = ₹ 5000

35. Given, A right angle triangle is inscribed inside the circle. The radius of the circle is given.



Let us consider, 'r' is the radius of the circle.
'x' and 'y' be the base and height of the right-angle triangle.

The hypotenuse of the $\triangle$ABC = $AB^2 = AC^2 + BC^2$
AB = 2r, AC = y and BC = x
Hence,
$4r^2 = x^2 + y^2$
$y^2 = 4r^2 - x^2$
$y = \sqrt{4r^2 - x^2}$ ... (i)
Now, Area of the $\triangle$ABC is
$A = \frac{1}{2} \times \text{ base } \times \text{ height}$
$A = \frac{1}{2} \times x \times y$
Now substituting equation(i) in the area of the triangle,
$A = \frac{1}{2} x(\sqrt{4r^2 - x^2})$
[Squaring both sides]
$Z = A^2 = \frac{1}{4} x^2 \left(4r^2 - x^2\right)$ ... (ii)
For finding the maximum/ minimum of a given function, we can find it by differentiating it with x and then equating it to zero.
This is because if the function f(x) has a maximum/minimum at a point c then f'(c) = 0.
Differentiating both sides the equation (ii) with respect to x:
$\frac{dZ}{dx} = \frac{d}{dx}\left[\frac{1}{4} x^2 \left(4r^2 - x^2\right)\right]$
$\frac{dZ}{dx} = \frac{1}{4}\left[\left(4r^2 - x^2\right) \frac{d}{dx}\left(x^2\right) + x^2 \frac{d}{dx}\left(4r^2 - x^2\right)\right]$
$\frac{dZ}{dx} = \frac{1}{4}\left[\left(4r^2 - x^2\right) \times (2x) + x^2(0 - 2x)\right]$
[Since $\frac{d}{dx}(x^n) = nx^{n-1}$ and if u and v are two functions of x, then $\frac{\mathrm{d}}{\mathrm{dx}}(\mathrm{u} \cdot \mathrm{v}) = \mathrm{v}\frac{\mathrm{du}}{\mathrm{dx}} + \mathrm{u}\frac{\mathrm{dv}}{\mathrm{dx}}$]
$\frac{dZ}{dx} = \frac{1}{4}\left[8r^2 x - 2x^3 - 2x^3\right]$
$\frac{dZ}{dx} = \frac{1}{4}\left[8r^2 x - 4x^3\right] = \frac{4x}{4}\left[2r^2 - x^2\right]$
$\frac{dZ}{dx} = 2r^2 x - x^3$ ... (iii)
To find the critical point, we need to equate equation (iii) to zero.
$\frac{dz}{dx} = 2r^2 x - x^3 = 0$
$2r^2 x = x^3$
$x^2 = 2r^2$
$x = \pm\sqrt{2r^2}$
$x = r\sqrt{2}$
[as the base of the triangle cannot be negative.]
Now to check if this critical point will determine the maximum area of the triangle, we need to check with the second differential which needs to be negative.
Consider differentiating both sides the equation (iii) with x:
$\frac{d^2 Z}{dx^2} = \frac{d}{dx}\left[2r^2 x - x^3\right]$

$\frac{d^2Z}{dx^2} = \frac{d}{dx}\left(2r^2x\right) - \frac{d}{dx}\left(x^3\right)$

$\frac{d^2z}{dx^2} = 2r^2 - 3x^2$ ... (iv)

[Since $\frac{d}{dx}(x^n) = nx^{n-1}$]

Now, consider the value of $\left(\frac{d^2z}{dx^2}\right)_{x=r\sqrt{2}}$

$\left(\frac{d^2Z}{dx^2}\right)_{x=r\sqrt{2}}$ = $2r^2 - 3(r\sqrt{2})^2$ = $2r^2$ - $6r^2$ = $-4r^2$

As $\left(\frac{d^2Z}{dx^2}\right)_{x=r\sqrt{2}} = -4r^2 < 0$, so function A is maximum at x = $r\sqrt{2}$

Now substituting x = $r\sqrt{2}$ in equation (i):

$y = \sqrt{4r^2 - (r\sqrt{2})^2}$

$y = \sqrt{4r^2 - 2r^2}$

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

As x = y = $r\sqrt{2}$, the base and height of the triangle are equal, which means that two sides of a right-angled triangle are equal,

Hence the given triangle, which is inscribed in a circle, is an isosceles triangle with sides AC and BC equal.

OR

Let x and y be the lengths of two sides of a rectangle. Again, let P denotes its perimeter and 'A' be the area of rectangle

Then, P = 2 (x + y) [$\because$ perimeter of rectangle = 2 (l + b)]

$\Rightarrow \quad P = 2x + 2y$

$\Rightarrow \quad y = \frac{P-2x}{2}$ ...(i)

We know that, area of rectangle is given by

A = xy

$\Rightarrow A = x\left(\frac{P-2x}{2}\right)$ [by using Eq. (i)]

On differentiating both sides w.r.t. x, we get

$\frac{dA}{dx} = \frac{P-4x}{2}$

For maxima or minima put $\frac{dA}{dx} = 0$

$\Rightarrow \quad \frac{P-4x}{2} = 0 \Rightarrow P = 4x$

$\Rightarrow \quad 2x + 2y = 4x \quad [\because P = 2x + 2y]$

$\Rightarrow \quad x = y$

So, the rectangle is a square.

Also, $\frac{d^2A}{dx^2} = \frac{d}{dx}\left(\frac{P-4x}{2}\right)$

$= -\frac{4}{2} = -2 < 0$

$\Rightarrow$ A is maximum.

Hence, the area is maximum, when the rectangle is a square.

Section E

36. i. $P(\text{defective smartphone}) = 0.25 \times 0.05 + 0.35 \times 0.04 + 0.40 \times 0.02$
$= 0.0345$

ii. $P(\ B/\ \text{Defective}) = \frac{0.35 \times 0.04}{0.25 \times 0.05 + 0.35 \times 0.04 + 0.40 \times 0.02}$
$= \frac{140}{345}$ or $\frac{28}{69}$

37. i. Clearly, the coordinates of A are (8, -6, 0) and that of E are (0, 0, 24).
Also, cartesian equation of line along EA is given by

$\frac{x-0}{8-0} = \frac{y-0}{-6-0} = \frac{z-24}{0-24}$

$\Rightarrow \frac{x}{8} = \frac{y}{-6} = \frac{z-24}{-24} \Rightarrow \frac{x}{-4} = \frac{y}{3} = \frac{z-24}{12}$

ii. Clearly, the coordinates of D are (-8, -6, 0) and that of E are (0, 0, 24)

$\therefore$ Vector $\overrightarrow{ED}$ is (-8 - 0)$\hat{i}$ + (-6 - 0)$\hat{j}$ + (0 - 24)$\hat{k}$, i.e., -8$\hat{i}$ - 6$\hat{j}$ - 24$\hat{k}$.

iii. Since, the coordinates of B are (8, 6, 0) and that of E are (0, 0, 24), therefore length of cable EB = $\sqrt{(8-0)^2 + (6-0)^2 + (0-24)^2}$

$= \sqrt{64 + 36 + 576} = \sqrt{676}$ = 26 units

OR

Sum of all vectors along the cables

$= \overrightarrow{EA} + \overrightarrow{EB} + \overrightarrow{EC} + \overrightarrow{ED}$

= (8$\hat{i}$ - 6$\hat{j}$ - 24$\hat{k}$) + (8$\hat{i}$ + 6$\hat{j}$ - 24$\hat{k}$) + (-8$\hat{i}$ + 6$\hat{j}$ - 24$\hat{k}$) + (-8$\hat{i}$ - 6$\hat{j}$ - 24$\hat{k}$)

= -96$\hat{k}$

38. i.

Corner Points	**Value of Z = 4x - 6y**
(0, 3)	$4 \times 0 - 6 \times 3 = -18$
(5, 0)	$4 \times 5 - 6 \times 0 = 20$
(6, 8)	$4 \times 6 - 6 \times 8 = -24$
(0, 8)	$4 \times 0 - 6 \times 8 = -48$

Minimum value of Z is - 48 which occurs at (0, 8).

ii.

Corner Points	**Value of Z = 4x - 6y**
(0, 3)	$4 \times 0 - 6 \times 3 = -18$
(5, 0)	$4 \times 5 - 6 \times 0 = 20$
(6, 8)	$4 \times 6 - 6 \times 8 = -24$
(0, 8)	$4 \times 0 - 6 \times 8 = -48$

Maximum value of Z is 20, which occurs at (5, 0).

iii.

Corner Points	**Value of Z = 4x - 6y**
(0, 3)	$4 \times 0 - 6 \times 3 = -18$
(5, 0)	$4 \times 5 - 6 \times 0 = 20$
(6, 8)	$4 \times 6 - 6 \times 8 = -24$
(0, 8)	$4 \times 0 - 6 \times 8 = -48$

Maximum of Z - Minimum of Z = 20 - (-48) = 20 + 48 = 68

OR

The corner points of the feasible region are O(0, 0), A(3, 0), B(3, 2), C(2, 3), D(0, 3).