

CBSE Class 12 Maths Question Paper 2020

Set 2

General Instructions:

Read the following instructions very carefully and strictly follow them:

- (i) This question paper comprises **four** Sections A, B, C and D. This question paper carries **36** questions. **All** questions are compulsory.
- (ii) **Section A** – Questions no. **1 to 20** comprises of **20** questions of **1** mark each.
- (iii) **Section B** – Questions no. **21 to 26** comprises of **6** questions of **2** mark each.
- (iv) **Section C** – Questions no. **27 to 32** comprises of **6** questions of **4** mark each.
- (v) **Section D** – Questions no. **33 to 36** comprises of **4** questions of **6** mark each.
- (vi) There is no overall choice in the question paper. However, an internal choice has been provided in 3 questions of one mark, 2 questions of two marks, 2 questions of four marks and 2 questions of six marks. Only one of the choices in such questions have to be attempted.
- (vii) In addition to this, separate instructions are given with each section and question, wherever necessary.
- (viii) Use of calculators is **not** permitted.

SECTION - A

Question numbers 1 to 20 carry 1 mark each.

Question numbers 1 to 10 are multiple choice type questions. Select the correct option.

1. If f and g are two functions from R to R defined as $f(x) = |x| + x$ and $g(x) = |x| - x$, then $f \circ g(x)$ for $x < 0$ is
 - (a) $4x$
 - (b) $2x$
 - (c) 0
 - (d) $-4x$
2. The principal value of $\cot^{-1}(-\sqrt{3})$ is
 - (a) $-\frac{\pi}{6}$
 - (b) $\frac{\pi}{6}$
 - (c) $\frac{2\pi}{3}$
 - (d) $\frac{5\pi}{6}$
3. If $A = \begin{bmatrix} -2 & 0 & 0 \\ 0 & -2 & 0 \\ 0 & 0 & -2 \end{bmatrix}$, then the value of $|\text{adj } A|$ is
 - (a) 64
 - (b) 16
 - (c) 0
 - (d) -8
4. The maximum value of slope of the curve $y = -x^3 + 3x^2 + 12x - 5$ is
 - (a) 15
 - (b) 12
 - (c) 9
 - (d) 0
5. $\int \frac{e^x(1+x)}{\cos^2(xe^x)} dx$ is equal to

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(a) $\tan(xe^x) + c$ (b) $\cot(xe^x) + c$ (c) $\cot(e^x) + c$ (d) $\tan[e^x(1+x)] + c$

6. The degree of the differential equation $x^2 \frac{d^2 y}{dx^2} = \left(x \frac{dy}{dx} - y\right)^3$ is

- (a) 1 (b) 2 (c) 3 (d) 6

7. The value of p for which $p(\hat{i} + \hat{j} + \hat{k})$ is a unit vector is

- (a) 0 (b) $\frac{1}{\sqrt{3}}$ (c) 1 (d) $\sqrt{3}$

8. The coordinates of the foot of the perpendicular drawn from the point $(-2, 8, 7)$ on the ZX-plane is

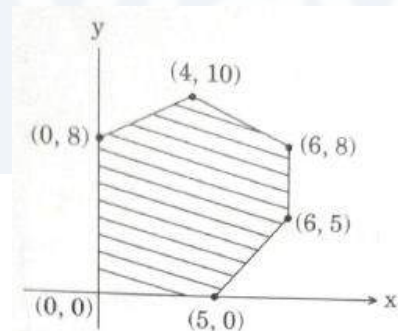
- (a) $(-2, -8, 7)$ (b) $(2, 8, -7)$ (c) $(-2, 0, 7)$ (d) $(0, 8, 0)$

9. The vector equation of XY-plane is

- (a) $\vec{r} \cdot \hat{k} = 0$ (b) $\vec{r} \cdot \hat{j} = 0$ (c) $\vec{r} \cdot \hat{i} = 0$ (d) $\vec{r} \cdot \vec{n} = 1$

10. The feasible region for an LPP is shown below:

Let $z = 3x - 4y$ be the objective function. Minimum of z occurs at



- (a) $(0, 0)$ (b) $(0, 8)$ (c) $(5, 0)$ (d) $(4, 10)$

Fill in the blanks in question numbers 11 to 15.

11. If $y = \tan^{-1} x + \cot^{-1} x$, $x \in R$, then $\frac{dy}{dx}$ is equal to _____.

(OR)

If $\cos(xy) = k$, where k is a constant and $xy \neq n\pi$, $n \in Z$, then $\frac{dy}{dx}$ is equal to _____.

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12. The value of λ so that the function f defined by $f(x) = \begin{cases} \lambda x, & \text{if } x \leq \pi \\ \cos x, & \text{if } x > \pi \end{cases}$ is continuous at $x = \pi$ is _____.

13. The equation of the tangent to the curve $y = \sec x$ at the point $(0, 1)$ is _____.

14. The area of the parallelogram whose diagonals are $2\hat{i}$ and $-3\hat{k}$ is _____ square units.

(OR)

The value of λ for which the vectors $2\hat{i} - \lambda\hat{j} + \hat{k}$ and $i + 2\hat{j} - \hat{k}$ are orthogonal is _____.

15. A bag contains 3 black, 4 red and 2 green balls. If three balls are drawn simultaneously at random, then the probability that the balls are of different colours is _____.

Question numbers 16 to 20 are very short answer type questions.

16. Construct a 2×2 matrix $A = [a_{ij}]$ whose elements are given by $a_{ij} = |(i)^2 - j|$.

17. Differentiate $\sin^2(\sqrt{x})$ with respect to x .

18. Find the interval in which the function f given by $f(x) = 7 - 4x - x^2$ is strictly increasing.

19. Evaluate: $\int_{-2}^2 |x| dx$

(OR)

Find: $\int \frac{dx}{3 + 4x^2}$

20. An unbiased coin is tossed 4 times. Find the probability of getting at least one head.

SECTION - B

Question numbers 21 to 26 carry 2 marks each.

21. Solve for x :

$$\sin^{-1} 4x + \sin^{-1} 3x = -\frac{\pi}{2}$$

(OR)

Express $\tan^{-1}\left(\frac{\cos x}{1 - \sin x}\right)$, $-\frac{3\pi}{2} < x < \frac{\pi}{2}$ in the simplest form.

22. Express $A = \begin{bmatrix} 4 & -3 \\ 2 & -1 \end{bmatrix}$ as a sum of a symmetric and a skew symmetric matrix.

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23. If $y^2 \cos\left(\frac{1}{x}\right) = a^2$, then find $\frac{dy}{dx}$.

24. Show that for any two non-zero vectors \vec{a} and \vec{b} , $|\vec{a} + \vec{b}| = |\vec{a} - \vec{b}|$ if \vec{a} and \vec{b} are perpendicular vectors.

(OR)

Show that the vectors $2\hat{i} - \hat{j} + \hat{k}$, $3\hat{i} + 7\hat{j} + \hat{k}$ and $5\hat{i} + 6\hat{j} + 1\hat{k}$ form the sides of a right-angled triangle.

25. Find the coordinates of the point where the line through $(-1, 1, -8)$ and $(5, -2, 10)$ crosses the ZX-plane.

26. If A and B are two events such that $P(A) = 0.4$, $P(B) = 0.3$ and $P(A \cup B) = 0.6$, then find $P(B' \cap A)$.

SECTION - C

Question numbers 27 to 32 carry 4 marks each.

27. Show that the function $f : (-\infty, 0) \rightarrow (-1, 0)$ defined by $f(x) = \frac{x}{1+|x|}$, $x \in (-\infty, 0)$ is one-one and onto.

(OR)

Show that the relation R in the set $A = \{1, 2, 3, 4, 5, 6\}$ given by $R = \{(a, b) : |a - b| \text{ is divisible by } 2\}$ is an equivalence relation.

28. If $y = x^3 (\cos x)^x + \sin^{-1} \sqrt{x}$, find $\frac{dy}{dx}$.

29. Evaluate: $\int_{-1}^5 (|x| + |x+1| + |x-5|) dx$

30. Find the general solution of the differential equation $x^2 y dx - (x^3 + y^3) dy = 0$.

31. Solve the following LPP graphically:

Minimize $z = 5x + 7y$

subject to the constraints

$$2x + y \geq 8$$

$$x + 2y \geq 10$$

$$x, y \geq 0$$

32. A bag contains two coins, one biased and the other unbiased. When tossed, the biased coin has a 60% chance of showing heads. One of the coin is selected at random and on tossing it shows tails. What is the probability it was an unbiased coin?

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(OR)

The probability distribution of a random variable X , where k is a constant is given below:

$$P(X = x) = \begin{cases} 0.1 & \text{if } x = 0 \\ kx^2, & \text{if } x = 1 \\ kx, & \text{if } x = 2 \text{ or } 3 \\ 0, & \text{otherwise} \end{cases}$$

Determine

(a) the value of k

(b) $P(X \leq 2)$

(c) Mean of the distribution

SECTION - D

Question numbers 33 to 36 carry 6 marks each.

33. Solve the following system of equations by matrix method:

$$x - y + 2z = 7$$

$$2x - y + 3z = 12$$

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

(OR)

Obtain the inverse of the following matrix using elementary operations:

$$A = \begin{bmatrix} 2 & 1 & -3 \\ -1 & -1 & 4 \\ 3 & 0 & 2 \end{bmatrix}$$

34. Find the points on the curve $9y^2 = x^3$, where the normal to the curve makes equal intercepts with both the axes. Also find the equation of the normals.

35. Find the area of the following region using integration: $\{(x, y) : y \leq |x| + 2, y \geq x^2\}$

(OR)

Using integration, find the area of a triangle whose vertices are $(1,0)$, $(2,2)$ and $(3,1)$.

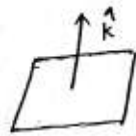
36. Show that the lines $\frac{x-2}{1} = \frac{y-2}{3} = \frac{z-3}{1}$ and $\frac{x-2}{1} = \frac{y-3}{4} = \frac{z-4}{2}$ intersect. Also, find the coordinates of the point of intersection. Find the equation of the plane containing the two lines.

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S.NO	SOLUTION	MARK
1	<p>(D) $f(x) = x + x = \begin{cases} 2x & , x \geq 0 \\ 0 & , x < 0 \end{cases}$</p> <p>$g(x) = x - x = \begin{cases} 0 & , x \geq 0 \\ -2x & , x < 0 \end{cases}$</p> <p>$f[g(x)] = x - x = \begin{cases} 2: g(x) & , g(x) \geq 0 \\ 0 & , g(x) < 0 \end{cases}$</p> <p>$f[g(x)] = -4x & , x < 0$</p>	1
2	<p>(A) $\cot^{-1}(-\sqrt{3}) = \tan^{-1}\left(-\frac{1}{\sqrt{3}}\right) = -\frac{\pi}{6}$</p>	1
3	<p>(A) $A = \begin{bmatrix} -2 & 0 & 0 \\ 0 & -2 & 0 \\ 0 & 0 & -2 \end{bmatrix}$</p> <p>$A = -2(4-0) = -8$</p> <p>$adj A = A ^{3-1} = A ^2 = (-8)^2 = 64$</p>	1
4	<p>(A) $y = -x^3 + 3x^2 + 12x - 5$</p> <p>$\frac{dy}{dx} = -3x^2 + 6x + 12$</p> <p>$= -3(x^2 - 2x - 4)$</p> <p>$= -3((x-1)^2 - 5)$</p> <p>$\frac{dy}{dx} = 15 - 3(x-1)^2$</p> <p>Maximum value = 15</p>	1
5	<p>(A) $\int \frac{e^x(1+x)}{\cos^2(xe^x)} dx$</p> <p>Let $xe^x = t \quad \Rightarrow \quad e^x(1+x).dx = dt$</p> <p>$\int \frac{dt}{\cos^2 t} = \int \sec^2 t = \tan t + c = \tan(xe^x) + c$</p>	1
6	(A)	1

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7	(B) $p\sqrt{3} = 1 \Rightarrow p = \frac{1}{\sqrt{3}}$	1
8	(A) On XZ-plane y-coordinate is zero	1
9	(A) $\vec{r} \cdot \hat{k} = 0$ 	1
10	(B) $z = 3x - 4y$ at $(0,0) \Rightarrow z = 0$ at $(0,8) \Rightarrow z = -32$ at $(5,0) \Rightarrow z = 15$ at $(4,10) \Rightarrow z = -28$ Minimum = -32	1
11	$y = \tan^{-1} x + \cot^{-1} x$ $\frac{dy}{dx} = \frac{1}{1+x^2} - \frac{1}{1+x^2} = 0$	1
	(OR) $y = \tan^{-1} x + \cot^{-1} x$ $y = \pi/2$ $\frac{dy}{dx} = 0$	1
	(OR) $\cos(xy) = k \Rightarrow -\sin(xy) \cdot \left(x \frac{dy}{dx} + y\right) = 0$ $\Rightarrow -\sin(xy) \cdot x \frac{dy}{dx} = y \cdot \sin(xy)$ $\Rightarrow \frac{dy}{dx} = \frac{-y \sin(xy)}{x \sin(xy)} = \frac{-y}{x}$	1
12	$\frac{-1}{\pi}$ $RHL = \cos \pi = -1$ $LHL = \lambda \pi$	1

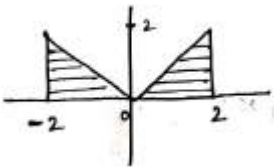
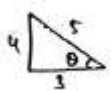
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	$\Rightarrow \lambda\pi = -1 \quad \Rightarrow \lambda = -\frac{1}{\pi}$	
13	$y = \sec x$ $\frac{dy}{dx} = \sec x \cdot \tan x$ at (0,1) $\Rightarrow \frac{dy}{dx} = 0$ Equation of tangent $\rightarrow y - y_1 = m(x - x_1)$ $\rightarrow y - 1 = 0(x - 0)$ $\rightarrow y = 1$	1
14	Area of parallelogram $= \frac{1}{2} d_1 \times d_2 = \frac{1}{2} \times 2 \times 3 = 3$	1
	(OR) $(2\hat{i} - \lambda\hat{j} + \hat{k}) \cdot (\hat{i} + 2\hat{j} - \hat{k}) = 0 \Rightarrow 2 - 2\lambda - 1 = 0 \Rightarrow \lambda = \frac{1}{2}$	1
15	$\frac{2}{7}$ $\frac{4c_1 \times 3c_1 \times 2c_1}{9c_3} = \frac{2}{7}$	1
16	$a_{ij} = (i)^2 - j $ $a_{11} = 1 - 1 = 0$ $a_{21} = 4 - 1 = 3$ $a_{12} = 1 - 2 = 1$ $a_{22} = 4 - 2 = 2$ $\therefore A = \begin{bmatrix} 0 & 1 \\ 3 & 2 \end{bmatrix}$	1
17	$y = \sin^2 \sqrt{x}$ $\frac{dy}{dx} = 2 \sin^2 \sqrt{x} \cdot \cos \sqrt{x} \cdot \frac{1}{2\sqrt{x}}$ $\frac{dy}{dx} = \frac{\sin \sqrt{x} \cdot \cos \sqrt{x}}{\sqrt{x}}$	1
18	$f(x) = 7 - 4x - x^2$ $f'(x) = -4 - 2x$ $f'(x) > 0$	1/2

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	$-4 - 2x > 0 \Rightarrow -4 > 2x \Rightarrow x < -2$	1/2
19	$\int_{-2}^2 x dx$ <p style="text-align: center;">Area = $\left(\frac{1}{2} \times 2 \times 2\right) + \left(\frac{1}{2} \times 2 \times 2\right)$</p> <p style="text-align: center;">= 4 sq. units</p> 	1/2
	<p>(OR) $\int \frac{dx}{9+4x^2} = \frac{1}{4} \int \frac{dx}{\frac{9}{4} + x^2} = \frac{1}{4} \cdot \frac{2}{3} \tan^{-1}\left(\frac{2x}{3}\right)$</p> <p>$\int \frac{dx}{x^2 + a^2} = \frac{1}{a} \tan^{-1}\left(\frac{x}{a}\right) + c = \frac{1}{6} \tan^{-1}\left(\frac{2x}{3}\right)$</p>	1/2
20	<p>Sample space = $\{HH, HT, TH, TT\}$</p> <p style="text-align: center;">Probability of getting at least one head = $\frac{3}{4}$</p>	1
21	$\sin^{-1} 4x + \sin^{-1} (3x) = \frac{-\pi}{2}$ $\sin^{-1} 4x + \frac{\pi}{2} - \cos^{-1} (3x) = \frac{-\pi}{2}$ $\sin^{-1} 4x + \frac{-\pi}{2} - \frac{\pi}{2} + \cos^{-1} (3x)$ $\sin^{-1} (4x) + -\pi + \cos^{-1} (3x)$ $\sin^{-1} (4x) + -[\pi - \cos^{-1} 3x]$ $\sin^{-1} (4x) + -\cos^{-1} (-3x)$ $\sin^{-1} (-4x) + \cos^{-1} (-3x)$  <p style="text-align: center;">Let $\sin^{-1} (-4x) = \theta$ $\cos^{-1} (-3x) = \theta$</p> <p style="text-align: center;">$-4x = \sin \theta$ $-3x = \cos \theta$</p>	1/2

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	$\frac{\sin \theta}{\cos \theta} = \frac{4}{3} \quad \Rightarrow \tan \theta = \frac{4}{3}$ $-4x = \frac{4}{5}$ $x = \frac{-1}{5}$	1/2
	<p>(OR) $\tan^{-1}\left(\frac{\cos x}{1 - \sin x}\right)$</p> $= \tan^{-1}\left(\frac{\cos^2 \frac{x}{2} - \sin^2 \frac{x}{2}}{1 - 2 \sin \frac{x}{2} \cdot \cos \frac{x}{2}}\right)$ $= \tan^{-1}\left(\frac{(\cos \frac{x}{2} + \sin \frac{x}{2})(\cos \frac{x}{2} - \sin \frac{x}{2})}{(\cos \frac{x}{2} - \sin \frac{x}{2})^2}\right)$ $= \tan^{-1}\left(\frac{\cos \frac{x}{2} + \sin \frac{x}{2}}{\cos \frac{x}{2} - \sin \frac{x}{2}}\right)$ $= \tan^{-1}\left(\frac{1 + \tan \frac{x}{2}}{1 - \tan \frac{x}{2}}\right)$ $= \tan^{-1}\left[\tan\left(\frac{\pi}{4} + \frac{x}{2}\right)\right]$ $= \frac{\pi}{4} + \frac{x}{2}$	1/2
22	$A = \begin{bmatrix} 4 & -3 \\ 2 & -1 \end{bmatrix}$ $A^T = \begin{bmatrix} 4 & 2 \\ -3 & -1 \end{bmatrix}$ $\frac{1}{2}(A + A^T) = \frac{1}{2} \begin{bmatrix} 8 & -1 \\ -1 & -2 \end{bmatrix} = \begin{bmatrix} 4 & -1/2 \\ -1/2 & -1 \end{bmatrix}$ $\frac{1}{2}(A - A^T) = \frac{1}{2} \begin{bmatrix} 0 & -5 \\ 5 & 0 \end{bmatrix} = \begin{bmatrix} 0 & -5/2 \\ 5/2 & 0 \end{bmatrix}$	1/2
		1/2

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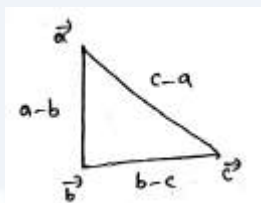
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	<p>Let $P = \frac{1}{2}(A + A^T) = \begin{bmatrix} 4 & -1/2 \\ -1/2 & -1 \end{bmatrix}$</p> <p>$P^T = \begin{bmatrix} 4 & -1/2 \\ -1/2 & -1 \end{bmatrix} = P$</p> <p>Since $P^T = P$ P is symmetric matrix</p> <p>Let $Q = \frac{1}{2}(A - A^T) = \begin{bmatrix} 0 & -5/2 \\ 5/2 & 0 \end{bmatrix}$</p> <p>$Q^T = \begin{bmatrix} 0 & -5/2 \\ 5/2 & 0 \end{bmatrix} = -Q$</p> <p>Since $Q^T = -Q$ Q is skew symmetric matrix</p> <p>Now $P + Q = \frac{1}{2}(A + A^T) + \frac{1}{2}(A - A^T)$ $= A$</p> <p>$\therefore A$ is a sum of symmetric and skew symmetric matrix.</p>	<p>$1/2$</p> <p>$1/2$</p>
23	<p>$y^2 \cdot \cos\left(\frac{1}{x}\right) = a^2$</p> <p>$y^2 \cdot -\sin\left(\frac{1}{x}\right) \cdot \left(\frac{-1}{x^2}\right) + \cos\left(\frac{1}{x}\right) \cdot 2y \cdot \frac{dy}{dx} = 0$</p> <p>$\frac{y^2}{x^2} \cdot \sin\left(\frac{1}{x}\right) = -2y \cos\left(\frac{1}{x}\right) \cdot \frac{dy}{dx}$</p> <p>$\frac{dy}{dx} = -\frac{y^2}{x^2} \cdot \frac{\sin\left(\frac{1}{x}\right)}{\cos\left(\frac{1}{x}\right)} \cdot \frac{1}{2y}$</p> <p>$\frac{dy}{dx} = -\frac{y^2}{2x^2} \cdot \tan\left(\frac{1}{x}\right)$</p>	<p>1</p> <p>1</p>
24	$ a + b = a - b $	

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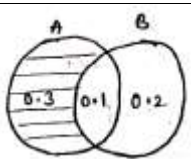
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	$a^2 + b^2 + 2(ab) = a^2 + b^2 - 2(ab)$ $ab = 0$ <p>\therefore a and b are perpendicular</p>	1 1
	<p>(OR) $a - b = -\hat{i} - 8\hat{j}$</p> $ a - b \sqrt{1+64} = \sqrt{65}$ $b - c = -2\hat{i} + \hat{j} - \hat{k}$ $ b - c = \sqrt{4+1+4} = \sqrt{6}$ $c - a = 3\hat{i} + 7\hat{j} + \hat{k}$ $ c - a = \sqrt{9+49+1} = \sqrt{59}$ $ a - b ^2 = b - c ^2 + c - a ^2$ <p>\therefore $\vec{a}, \vec{b}, \vec{c}$ are sides of Right angled Δ.</p>	1/2 1/2 1/2 1/2
25	<p>On ZX plane $y = 0$</p> <p>Dr's of the line $\rightarrow 6, -3, 18$</p> <p>Eqn of the line $\rightarrow \frac{x+1}{6} = \frac{y-1}{-3} = \frac{z+8}{18} = \lambda$</p> $x = 6\lambda - 1, y = -3\lambda + 1, z = 18\lambda - 8$ $y = 0 \Rightarrow -3\lambda + 1 = 0 \Rightarrow \lambda = \frac{1}{3}$ <p>\therefore The point = $(1, 0, -2)$</p>	1/2 1/2 1/2 1/2
26	$P(A) = 0.4$ $P(B) = 0.3$ $P(A \cup B) = 0.6$ $P(B' \cap A) = 0.3$	1



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		1		
27	$f(x) = \frac{x}{1+ x }$ $ x = \begin{cases} x & , x \geq 0 \\ -x & , x < 0 \end{cases}$ $f(x) = \begin{cases} \frac{x}{1+x} & , x \geq 0 \\ \frac{x}{1-x} & , x < 0 \end{cases}$ <p>one-one:</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; padding: 5px;"> <p>For $x \geq 0$</p> $f(x_1) = f(x_2)$ $\frac{x_1}{1+x_1} = \frac{x_2}{1+x_2}$ $x_1 + x_1x_2 = x_2 + x_1x_2$ $x_1 = x_2$ </td> <td style="width: 50%; padding: 5px;"> <p>For $x < 0$</p> $f(x_1) = f(x_2)$ $\frac{x_1}{1-x_1} = \frac{x_2}{1-x_2}$ $x_1 - x_1x_2 = x_2 - x_1x_2$ $x_1 = x_2$ </td> </tr> </table> <p>Hence $f(x_1) = f(x_2) \Rightarrow x_1 = x_2$</p> <p>$\therefore f$ is one-one</p> <p>onto:</p>	<p>For $x \geq 0$</p> $f(x_1) = f(x_2)$ $\frac{x_1}{1+x_1} = \frac{x_2}{1+x_2}$ $x_1 + x_1x_2 = x_2 + x_1x_2$ $x_1 = x_2$	<p>For $x < 0$</p> $f(x_1) = f(x_2)$ $\frac{x_1}{1-x_1} = \frac{x_2}{1-x_2}$ $x_1 - x_1x_2 = x_2 - x_1x_2$ $x_1 = x_2$	1
<p>For $x \geq 0$</p> $f(x_1) = f(x_2)$ $\frac{x_1}{1+x_1} = \frac{x_2}{1+x_2}$ $x_1 + x_1x_2 = x_2 + x_1x_2$ $x_1 = x_2$	<p>For $x < 0$</p> $f(x_1) = f(x_2)$ $\frac{x_1}{1-x_1} = \frac{x_2}{1-x_2}$ $x_1 - x_1x_2 = x_2 - x_1x_2$ $x_1 = x_2$			

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	<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>For $x \geq 0$</p> <p>Let $f(x) = y$</p> $y = \frac{x}{1+x}$ $y + xy = x$ $y = x(1-y)$ $x = \frac{y}{1-y}$ </div> <div style="width: 45%; border-left: 1px solid black; padding-left: 10px;"> <p>For $x < 0$</p> <p>Let $f(x) = y$</p> $y = \frac{x}{1-x}$ $y - xy = x$ $y = x(1+y)$ $x = \frac{y}{1+y}$ </div> </div>	1
	<p>$\therefore f$ is onto.</p> <p>Hence f is both one-one and onto.</p>	1
	(OR)	
28	$y = x^3 (\cos x)^x + \sin^{-1} \sqrt{x}$ <p>Let $u = (\cos x)^x \Rightarrow \log u = x \log (\cos x)$</p> $\Rightarrow \frac{1}{4} \cdot \frac{du}{dx} = x \frac{1}{\cos x} (-\sin x) + \log (\cos x)$ $\Rightarrow \frac{du}{dx} = (\cos x)^x [\log (\cos x) - x \tan x]$ <p>Now, $y = x^3 (\cos x)^x + \sin^{-1} \sqrt{x}$</p>	1
	$\frac{dy}{dx} = x^3 (\cos x)^x [\log (\cos x) - \tan x] + 3x^2 (\cos x)^x + \frac{1}{\sqrt{1-x}} \cdot \frac{1}{2\sqrt{x}}$	2
29	$\int_{-1}^5 (x + x+1 + x-5) dx$ $I_1 = \int_{-1}^5 x = \int_{-1}^0 -x + \int_{-1}^5 x = -\left[\frac{x^2}{2}\right]_{-1}^0 + \left[\frac{x^2}{2}\right]_0^5$ $I_2 = \int_{-1}^5 (x+1) dx \left[\frac{x^2}{2} + x\right]_{-1}^5 = \left(\frac{25}{2} + 5\right) - \left(\frac{1}{2} - 1\right)$ $= \frac{35}{2} + \frac{1}{2} = 18$	1
		1

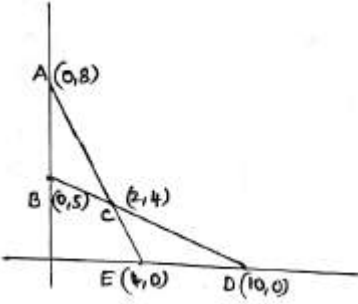
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	$I_3 = \int_{-1}^5 (5-x) dx \left[5x - \frac{x^2}{2} \right]_{-1}^5 = \left(25 - \frac{25}{2} \right) - \left(-5 - \frac{1}{2} \right)$ $= \frac{25}{2} + \frac{11}{2} = 18$ $I = I_1 + I_2 + I_3 = 13 + 18 + 18 = 49$	<p>1</p> <p>1</p>
30	<p>$x^2 y dx - (x^3 + y^3) dy = 0$</p> $\frac{dy}{dx} = \frac{x^2 y}{x^3 + y^3}$ <p>Which is a homogeneous differential equation.</p> <p>Let $y = vx \Rightarrow \frac{dy}{dx} = v + x \frac{dv}{dx}$</p> $v + x \cdot \frac{dv}{dx} = \frac{x^2 (vx)}{x^3 + v^3 x^3}$ $x \cdot \frac{dv}{dx} = \frac{v}{1+v^3} - v$ $x \cdot \frac{dv}{dx} = \frac{v - v - v^4}{1+v^3}$ $\int \frac{1+v^3}{v^4} dv = -\int \frac{dx}{x}$ $\int v^{-4} \cdot dv + \int \frac{1}{v} dv = -\log x + c$ $\frac{v^{-3}}{-3} + \log v + \log x = c$ $\frac{-1}{3} \frac{x^3}{y^3} + \log \frac{y}{x} \cdot x = c$ $\frac{-x^3}{3y^3} + \log y = c.$	<p>1</p> <p>1</p> <p>1</p>
31	<p>$2x + y = 8 \rightarrow (0,8), (4,0)$</p> <p>$2x + y > 8 \rightarrow$ away from origin</p> <p>$x + 2y = 10 \rightarrow (0,5), (10,0)$</p> <p>$x + 2y > 10 \rightarrow$ away from origin</p> <p>$z = 5x + 7y$</p>	<p>1</p> <p>1</p>

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		<p>at $(0, 8) \rightarrow z = 56$</p> <p>at $(2, 4) \rightarrow z = 38$</p> <p>at $(10, 0) \rightarrow z = 50$</p> <p>Minimum value = 38 at $c(2, 4)$</p> 	1									
32		<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 30%;"></th> <th style="width: 30%;">Head</th> <th style="width: 30%;">Tail</th> </tr> </thead> <tbody> <tr> <td>Biased</td> <td style="text-align: center;">0.6</td> <td style="text-align: center;">0.4</td> </tr> <tr> <td>Unbiased</td> <td style="text-align: center;">0.5</td> <td style="text-align: center;">0.5</td> </tr> </tbody> </table>		Head	Tail	Biased	0.6	0.4	Unbiased	0.5	0.5	2
	Head	Tail										
Biased	0.6	0.4										
Unbiased	0.5	0.5										
		<p>(OR) $P\left(\frac{U}{T}\right) = \frac{\frac{1}{2} \times 0.5}{\frac{1}{2} \times 0.4 + \frac{1}{2} \times 0.5} = \frac{\frac{1}{4}}{\frac{1}{5} + \frac{1}{4}} = \frac{\frac{1}{4}}{\frac{9}{20}} = \frac{1}{4} \times \frac{20}{9} = \frac{5}{9}$</p>	2									
33		<p>$x - y + 2z = 7$</p> <p>$2x - y + 3z = 12$</p> <p>$3x + 2y - z = 5$</p> $\begin{bmatrix} 1 & -1 & 2 \\ 2 & -1 & 3 \\ 3 & 2 & -1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 7 \\ 12 \\ 5 \end{bmatrix}$ <p>$A = 1(1-6) + 1(-2-9) + 2(4+3)$</p> <p>$= -5 - 11 + 14 = -2$</p> $adj A = \begin{bmatrix} -5 & 11 & 7 \\ 3 & -7 & -5 \\ -1 & 1 & 1 \end{bmatrix}^{-1} = \begin{bmatrix} -5 & 3 & -1 \\ 11 & -7 & 1 \\ 7 & -5 & 1 \end{bmatrix}$ $A^{-1} = \frac{adj A}{ A } = \frac{-1}{2} \begin{bmatrix} -5 & 3 & -1 \\ 11 & -7 & 1 \\ 7 & -5 & 1 \end{bmatrix}$	1									
			1									

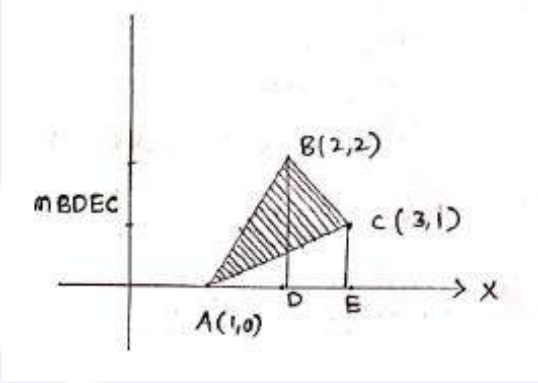
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	$x = A^{-1}.B = \frac{-1}{2} \begin{bmatrix} -5 & 3 & -1 \\ 11 & -7 & 1 \\ 7 & -5 & 1 \end{bmatrix} \begin{bmatrix} 7 \\ 12 \\ 5 \end{bmatrix}$ $= \frac{-1}{2} \begin{bmatrix} -35 + 36 - 5 \\ 77 - 84 + 5 \\ 49 - 60 + 5 \end{bmatrix} = \begin{bmatrix} 2 \\ 1 \\ 3 \end{bmatrix}$ <p>$\therefore x = 2, y = 1, z = 3.$</p>	<p>1</p> <p>1</p> <p>1</p>
	(OR)	
34	<p>$9y^2 = x^3 \quad \rightarrow (i)$</p> <p>$18y \cdot \frac{dy}{dx} = 3x^2$</p> <p>Given $m = \pm 1$</p> <p>$\frac{-6y}{x^2} = \pm 1$</p> <p>$\frac{-6y}{x^2} = 1 \quad \text{or} \quad \frac{-6y}{x^2} = -1$</p> <p>$x^2 = -6y \quad \text{or} \quad x^2 = 6y$</p> <p>Substitute the above in (i)</p> <p>$9\left(\frac{x^4}{36}\right) = x^3 \quad \Rightarrow \quad x = 0 \quad \text{or} \quad 4$</p> <p>If $x = 4 \quad \Rightarrow \quad y = \pm \frac{8}{3}$</p> <p>Equation of normal $\Rightarrow y - y_1 = \frac{-dx}{dy}(x - x_1)$</p> <p>$\Rightarrow y - \frac{8}{3} = \frac{-6\left(\frac{8}{3}\right)}{16}(x - 4)$</p> <p>$\Rightarrow \frac{3y - 8}{3} = -x + 4$</p> <p>$\Rightarrow 3y - 8 = -3x + 12$</p> <p>$\Rightarrow 3x + 3y = 20$</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>2</p>
35	Let $A(1,0), B(2,2), C(3,1)$ be the vertices of triangle ABC	

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	<p style="text-align: center;">Area of $\Delta ABC = \text{Area of } \Delta ABD + \text{Area of Trapezium } BDEC -$ Area of ΔAEC</p> <p>Equation of side $AB \rightarrow y = 2(x-1)$</p> <p>Equation of side $BC \rightarrow y = 4-x$</p> <p>Equation of side $CA \rightarrow y = \frac{1}{2}(x-1)$</p> <p style="text-align: center;">Area of $\Delta ABC = \int_1^2 2(x-1)dx + \int_2^3 (4-x)dx - \int_1^3 \frac{x-1}{2}.dx$</p> $= 2 \left[\frac{x^2}{2} - x \right]_1^2 + \left[4x - \frac{x^2}{2} \right]_2^3 - \frac{1}{2} \left[\frac{x^2}{2} - x \right]_1^3$ $= \frac{3}{2}.$	<p>1</p> <p>1</p> <p>1</p> <p>2</p>
		1
	(OR)	
36	$\frac{x-2}{1} = \frac{y-2}{3} = \frac{z-3}{1} = \lambda \text{ and } \frac{x-2}{1} = \frac{y-3}{4} = \frac{z-4}{2} = \mu$ $x = \lambda + 2 \quad x = \mu + 2$ $y = 3\lambda + 2 \quad y = 4\mu + 3$ $z = \lambda + 3 \quad z = 2\mu + 4$ $\lambda + 2 = \mu + 2 \Rightarrow \lambda = \mu$ $3\lambda + 2 = 4\mu + 3 \Rightarrow \lambda = \mu = -1$ $\lambda + 3 = 2\mu + 4 \Rightarrow 2 = 2$ <p>\therefore The lines intersect at $(1, -1, 2)$</p> <p>Equation of plane is</p>	<p>1</p> <p>1</p> <p>1</p>

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	$\begin{vmatrix} x-x_1 & y-y_1 & z-z_1 \\ x_1 & m_1 & n_1 \\ x_2 & m_2 & n_2 \end{vmatrix} = 0 \Rightarrow \begin{vmatrix} x-2 & y-2 & z-3 \\ 1 & 3 & 1 \\ 1 & 4 & 2 \end{vmatrix} = 0$	2
	$\Rightarrow 2x - y + z = 5$	1



Vidya Champ