EXPECTED ANSWER/VALUE POINTS

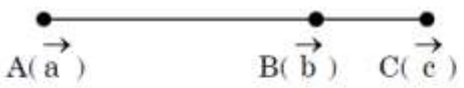
SECTION A

Q.No.	EXPECTED ANSWER / VALUE POINTS	Marks
	SECTION-A **(Question nos. 1 to 18 are Multiple Choice Questions carrying 1 mark each)**	
1	**1.** If for a square matrix A, $A^2 - 3A + I = O$ and $A^{-1} = xA + yI$, then the value of x + y is : (a) -2 (b) 2 (c) 3 (d) -3	
Ans	(b) 2	**1**
2.	**2.** If $\|A\| = 2$, where A is a 2×2 matrix, then $\|4A^{-1}\|$ equals : (a) 4 (b) 2 (c) 8 (d) $\frac{1}{32}$	
Ans	(c) 8	**1**
3.	**3.** Let A be a 3×3 matrix such that $\|\text{adj } A\| = 64$. Then $\|A\|$ is equal to : (a) 8 only (b) -8 only (c) 64 (d) 8 or -8	
Ans	(d) 8 or – 8	**1**
4.	**4.** If $A = \begin{bmatrix} 3 & 4 \\ 5 & 2 \end{bmatrix}$ and 2A + B is a null matrix, then B is equal to : (a) $\begin{bmatrix} 6 & 8 \\ 10 & 4 \end{bmatrix}$ (b) $\begin{bmatrix} -6 & -8 \\ -10 & -4 \end{bmatrix}$ (c) $\begin{bmatrix} 5 & 8 \\ 10 & 3 \end{bmatrix}$ (d) $\begin{bmatrix} -5 & -8 \\ -10 & -3 \end{bmatrix}$	
Ans	(b)$\begin{bmatrix} -6 & -8 \\ -10 & -4 \end{bmatrix}$	**1**
5.	**5.** If $\frac{d}{dx}(f(x)) = \log x$, then f(x) equals : (a) $-\frac{1}{x} + C$ (b) $x(\log x - 1) + C$ (c) $x(\log x + x) + C$ (d) $\frac{1}{x} + C$	
Ans	(b) x(logx – 1) + C	**1**

6.	**6.** $\int_0^{\frac{\pi}{6}} \sec^2(x - \frac{\pi}{6})\, dx$ is equal to : (a) $\frac{1}{\sqrt{3}}$ (b) $-\frac{1}{\sqrt{3}}$ (c) $\sqrt{3}$ (d) $-\sqrt{3}$	
Ans	(a) $\frac{1}{\sqrt{3}}$	**1**
7.	**7.** The sum of the order and the degree of the differential equat $\frac{d^2y}{dx^2} + \left(\frac{dy}{dx}\right)^3 = \sin y$ is : (a) 5 (b) 2 (c) 3 (d) 4	
Ans	(c) 3	**1**
8.	**8.** The value of p for which the vectors $2\hat{i} + p\hat{j} + \hat{k}$ and $-4\hat{i} - 6\hat{j} + 26\hat{k}$ are perpendicular to each other, is : (a) 3 (b) -3 (c) $-\frac{17}{3}$ (d) $\frac{17}{3}$	
Ans	(a) 3	**1**
9.	**9.** The value of $(\hat{i} \times \hat{j}) . \hat{j} + (\hat{j} \times \hat{i}) . \hat{k}$ is : (a) 2 (b) 0 (c) 1 (d) -1	
Ans	(d) *-1*	**1**
10.	**10.** If $\vec{a} + \vec{b} = \hat{i}$ and $\vec{a} = 2\hat{i} - 2\hat{j} + 2\hat{k}$, then $\lvert \vec{b} \rvert$ equals : (a) $\sqrt{14}$ (b) 3 (c) $\sqrt{12}$ (d) $\sqrt{17}$	
Ans	(b) 3	**1**
11.	**11.** Direction cosines of the line $\frac{x-1}{2} = \frac{1-y}{3} = \frac{2z-1}{12}$ are : (a) $\frac{2}{7}, \frac{3}{7}, \frac{6}{7}$ (b) $\frac{2}{\sqrt{157}}, -\frac{3}{\sqrt{157}}, \frac{12}{\sqrt{157}}$ (c) $\frac{2}{7}, -\frac{3}{7}, -\frac{6}{7}$ (d) $\frac{2}{7}, -\frac{3}{7}, \frac{6}{7}$	
Ans	(d) $\frac{2}{7}, \frac{-3}{7}, \frac{6}{7}$	**1**

12.	**12.** If $P\left(\frac{A}{B}\right) = 0{\cdot}3$, $P(A) = 0{\cdot}4$ and $P(B) = 0{\cdot}8$, then $P\left(\frac{B}{A}\right)$ is equal to : (a) 0·6 (b) 0·3 (c) 0·06 (d) 0·4	
Ans	(a) 0.6	**1**
13.	**13.** The value of k for which $f(x) = \begin{cases} 3x + 5, & x \geq 2 \\ kx^2, & x < 2 \end{cases}$ is a continuous function, is : (a) $-\frac{11}{4}$ (b) $\frac{4}{11}$ (c) 11 (d) $\frac{11}{4}$	
Ans	(d) $\frac{11}{4}$	**1**
14.	**14.** If $A = \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$ and $(3I + 4A)(3I - 4A) = x^2I$, then the value(s) x is/are : (a) $\pm\sqrt{7}$ (b) 0 (c) ± 5 (d) 25	
Ans	(c) $\pm$ 5	**1**
15.	**15.** The general solution of the differential equation $x\,dy - (1 + x^2)\,dx = dx$ is : (a) $y = 2x + \frac{x^3}{3} + C$ (b) $y = 2\log x + \frac{x^3}{3} + C$ (c) $y = \frac{x^2}{2} + C$ (d) $y = 2\log x + \frac{x^2}{2} + C$	
Ans	(d) $y = 2\log x + \frac{x^2}{2} + C$	**1**
16.	**16.** If $f(x) = a(x - \cos x)$ is strictly decreasing in $\mathbb{R}$, then 'a' belongs to (a) {0} (b) $(0, \infty)$ (c) $(-\infty, 0)$ (d) $(-\infty, \infty)$	
Ans	(c) $(-\infty, 0)$	**1**

17.	**17.** The corner points of the feasible region in the graphical representation of a linear programming problem are (2, 72), (15, 20) and (40, 15). If z = 18x + 9y be the objective function, then : (a) z is maximum at (2, 72), minimum at (15, 20) (b) z is maximum at (15, 20), minimum at (40, 15) (c) z is maximum at (40, 15), minimum at (15, 20) (d) z is maximum at (40, 15), minimum at (2, 72)	
Ans	(c) z is maximum at (40, 15) and minimum at (15, 20)	**1**
18.	**18.** The number of corner points of the feasible region determined by the constraints $x - y \geq 0,\ 2y \leq x + 2,\ x \geq 0,\ y \geq 0$ is : (a) 2 (b) 3 (c) 4 (d) 5	
Ans	(a) *2*	**1**
(Question Nos. 19 & 20 are Assertion-Reason based questions of 1 mark each)		
19.	**19.** *Assertion (A) :* The range of the function $f(x) = 2\sin^{-1}x + \frac{3\pi}{2}$, where $x \in [-1, 1]$, is $\left[\frac{\pi}{2}, \frac{5\pi}{2}\right]$. *Reason (R) :* The range of the principal value branch of $\sin^{-1}(x)$ is $[0, \pi]$.	
Ans	(c) Assertion is True, Reason is False	**1**
20.	**20.** *Assertion (A) :* Equation of a line passing through the points (1, 2, 3) and (3, – 1, 3) is $\frac{x-3}{2} = \frac{y+1}{3} = \frac{z-3}{0}$. *Reason (R) :* Equation of a line passing through points (x_1, y_1, z_1), (x_2, y_2, z_2) is given by $\frac{x-x_1}{x_2-x_1} = \frac{y-y_1}{y_2-y_1} = \frac{z-z_1}{z_2-z_1}$.	
Ans	(d) Assertion is False, Reason is True	**1**
SECTION-B **(Question nos. 21 to 25 are very short Answer type questions carrying 2 marks each)**		
21.	**21.** (a) A function $f : A \to B$ defined as $f(x) = 2x$ is both one-one and onto. If A = {1, 2, 3, 4}, then find the set B. **OR** (b) Evaluate : $\sin^{-1}\left(\sin\frac{3\pi}{4}\right) + \cos^{-1}\left(\cos\frac{3\pi}{4}\right) + \tan^{-1}(1)$	
Ans	(a) f(1) = 2, f(2) = 4, f(3) = 6, f(4) = 8 $\therefore$ B = {2, 4, 6, 8} **OR** (b) Required value = $\frac{\pi}{4} + \frac{3\pi}{4} + \frac{\pi}{4}$	$1\frac{1}{2}$ ½ $1\frac{1}{2}$

	$= \frac{5\pi}{4}$	$\frac{1}{2}$
22.	**22.** Find all the vectors of magnitude $3\sqrt{3}$ which are collinear to vector $\hat{i} + \hat{j} + \hat{k}$.	
Ans	Unit vector along $\hat{i} + \hat{j} + \hat{k}$ is $\frac{\hat{i}}{\sqrt{3}} + \frac{\hat{j}}{\sqrt{3}} + \frac{\hat{k}}{\sqrt{3}}$ Required vectors are $3\hat{i} + 3\hat{j} + 3\hat{k}$ and $-3\hat{i} - 3\hat{j} - 3\hat{k}$	1 $\frac{1}{2}+\frac{1}{2}$
23.	**23.** (a) Position vectors of the points A, B and C as shown in the figure below are $\vec{a}$, $\vec{b}$ and $\vec{c}$ respectively.  If $\vec{AC} = \frac{5}{4}\vec{AB}$, express $\vec{c}$ in terms of $\vec{a}$ and $\vec{b}$. **OR** (b) Check whether the lines given by equations $x = 2\lambda + 2$, $y = 7\lambda + 1$, $z = -3\lambda - 3$ and $x = -\mu - 2$, $y = 2\mu + 8$, $z = 4\mu + 5$ are perpendicular to each other or not.	
Ans	(a) According to question, $\vec{c} - \vec{a} = \frac{5}{4}(\vec{b} - \vec{a})$ $\therefore \vec{c} = \frac{5\vec{b}}{4} - \frac{\vec{a}}{4}$ OR (b) D.r.s. of lines are $< 2, 7, -3 >$ and $< -1, 2, 4 >$ Now $2.-1 + 7\cdot 2 + -3\cdot 4 = 0$ $\therefore$ given lines are perpendicular	$1\frac{1}{2}$ $\frac{1}{2}$ 1 1
24.	**24.** If $y = (x + \sqrt{x^2 - 1})^2$, then show that $(x^2 - 1)\left(\frac{dy}{dx}\right)^2 = 4y^2$.	
Ans	$\frac{dy}{dx} = 2\left(x + \sqrt{x^2 - 1}\right)\left(1 + \frac{x}{\sqrt{x^2 - 1}}\right) = \frac{2\left(x + \sqrt{x^2 - 1}\right)^2}{\sqrt{x^2 - 1}}$ $\sqrt{x^2 - 1}\,\frac{dy}{dx} = 2y$ $(x^2 - 1)\left(\frac{dy}{dx}\right)^2 = 4y^2$	1½ ½

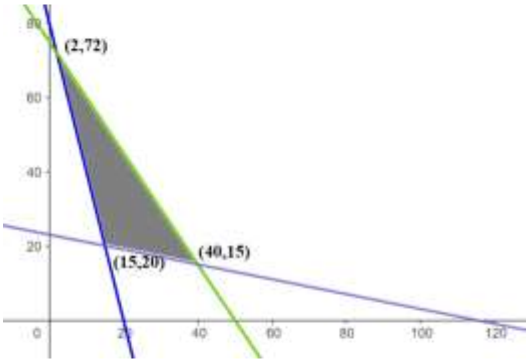
25.	**25.** Show that the function $f(x) = \frac{16 \sin x}{4 + \cos x} - x$, is strictly decreasing in $\left(\frac{\pi}{2}, \pi\right)$.	
Ans	$f'(x) = \frac{16[4 + \cos x] \cos x + 16 \sin^2 x}{(4 + \cos x)^2} - 1$	**1**
	$= \frac{\cos x\,(56 - \cos x)}{(4 + \cos x)^2}$	**½**
	in $(\frac{\pi}{2}, \pi)$, $\cos x < 0 \Rightarrow f'(x) < 0$	**½**
	$\therefore$ f(x) in strictly decreasing in $(\frac{\pi}{2}, \pi)$	

SECTION-C

(Question nos. 26 to 31 are short Answer type questions carrying 3 marks each)

26.	**26.** Evaluate : $$\int_0^{\frac{\pi}{2}} [\log (\sin x) - \log (2 \cos x)]\, dx.$$	
Ans	Let I = $\int_0^{\pi/2} [\log \sin x - \log (2\cos x)]dx = \int_0^{\pi/2} \log\left(\frac{\tan x}{2}\right)dx$	**½**
	Using property $\int_0^a f(x)\,dx = \int_0^a f(a-x)dx$	
	We get, I = $\int_0^{\pi/2} \log\left(\frac{\cot x}{2}\right)dx$	**1**
	$\therefore\ 2I = \int_0^{\pi/2} \log\left(\frac{\tan x}{2} \times \frac{\cot x}{2}\right)dx = \int_0^{\pi/2} \log\left(\frac{1}{4}\right)dx$	**½**
	$2I = \log\left(\frac{1}{4}\right) x \Big\vert_0^{\pi/2} = \frac{\pi}{2} \log \frac{1}{4}$	**½**
	$I = \frac{\pi}{4} \log \frac{1}{4}$ OR $-\frac{\pi}{2} \log 2$	**½**
27.	**27.** Find : $$\int \frac{1}{\sqrt{x}(\sqrt{x}+1)(\sqrt{x}+2)}dx$$	
Ans	Let I = $\int \frac{dx}{\sqrt{x}\,(\sqrt{x}+1)(\sqrt{x}+2)}$	

	Let $\sqrt{x} = t$, $\frac{1}{2\sqrt{x}} dx = dt$ $\therefore I = 2\int \frac{dt}{(t+1)(t+2)}$ $= 2\int\left(\frac{1}{t+1} - \frac{1}{t+2}\right)dt$ $= 2[\log\lvert t+1\rvert - \log\lvert t+2\rvert] + C$ $= 2[\log(\sqrt{x}+1) - \log(\sqrt{x}+2)] + C$ or $2\log\left(\frac{\sqrt{x}+1}{\sqrt{x}+2}\right) + C$	½ **1** **1** ½
28.	**28.** (a) Find the particular solution of the differential equation $\frac{dy}{dx} + \sec^2 x \cdot y = \tan x \cdot \sec^2 x$, given that $y(0) = 0$. **OR** (b) Solve the differential equation given by $x\,dy - y\,dx - \sqrt{x^2+y^2}\,dx = 0$.	
Ans	**Let** (a) Integrating factor = $e^{\int \sec^2 x\, dx} = e^{\tan x}$ Solution is $ye^{\tan x} = \int \tan x \sec^2 x\, e^{\tan x} dx + C$ Let $\tan x = t$ $\sec^2 x\, dx = dt$ $\therefore \int e^{\tan x} \tan x \sec^2 x\, dx = \int e^t\, t\, dt = e^t(t-1)$ $\therefore ye^{\tan x} = e^{\tan x}(\tan x - 1) + C$ $y(0) = 0$ gives $C = 1$ Particular solution is $ye^{\tan x} = e^{\tan x}(\tan x - 1) + 1$or $y = \tan x - 1 + e^{-\tan x}$ OR (b)Given differential equation can be written as $\frac{dy}{dx} = \frac{y}{x} + \sqrt{1+\left(\frac{y}{x}\right)^2}$ --------- (i) Let $y = vx \Rightarrow \frac{dv}{dx} = v + x\frac{dv}{dx}$ substituting in (i) We get $v + x\frac{dv}{dx} = v + \sqrt{1+v^2}$ $\Rightarrow \frac{dv}{\sqrt{1+v^2}} = \frac{dx}{x}$ Integrating both sides, we get $\log\lvert\sqrt{1+v^2} + v\rvert = \log\lvert x\rvert + \log C$ $y + \sqrt{x^2+y^2} = C x^2$	½ ½ ½ ½ ½ ½ ½ ½ ½ **1** ½

29.	**29.** Solve graphically the following linear programming problem : Maximise z = 6x + 3y, subject to the constraints $4x + y \geq 80$, $3x + 2y \leq 150$, $x + 5y \geq 115$, $x \geq 0, y \geq 0$.	
Ans	**Correct Graph**  Corner points — Value of Z (2, 72) — (12 + 216 = 228) (15, 20) — (90 + 60 = 150) (40, 15) — (240 + 45 = 285) Maximum	**2** **1**
30.	**30.** (a) The probability distribution of a random variable X is given below : X: 1, 2, 3 P(X): $\frac{k}{2}$, $\frac{k}{3}$, $\frac{k}{6}$ (i) Find the value of k. (ii) Find $P(1 \leq X < 3)$. (iii) Find E(X), the mean of X. **OR** (b) A and B are independent events such that $P(A \cap \overline{B}) = \frac{1}{4}$ and $P(\overline{A} \cap B) = \frac{1}{6}$. Find P(A) and P(B).	
Ans	(a) (i) $\frac{k}{2} + \frac{k}{3} + \frac{k}{6} = 1$ Gives k = 1 (ii) $P(1 \leq X < 3) = \frac{5k}{6} = \frac{5}{6}$ **(iii)**$E(X) = \sum p_i x_i = \frac{k}{2} + \frac{2k}{3} + \frac{k}{2} = \frac{5k}{3}$	**1** ½ ½ ½

	E(X) = $\frac{5}{3}$ OR (b)$P(A)\,P(\bar{B}) = \frac{1}{4}$ $P(\bar{A})\,P(B) = \frac{1}{6}$ Let P(A) = x P(B) = y $x(1-y) = \frac{1}{4},\ (1-x)y = \frac{1}{6} \Rightarrow x - y = \frac{1}{12}$ eliminating y, we get $12x^2 - 13x + 3 = 0$ gives $x = \frac{1}{3}, \frac{3}{4}$ $P(A) = \frac{1}{3} \Rightarrow P(B) = \frac{1}{4}$ $P(A) = \frac{3}{4} \Rightarrow P(B) = \frac{2}{3}$	½ ½ 1 1 ½
31.	**31.** (a) **Evaluate :** $\int_0^{\frac{\pi}{2}} e^x \sin x\, dx$ **OR** (b) **Find :** $\int \frac{1}{\cos(x-a)\ \cos(x-b)}\, dx$	
Ans	(a)Let $I = \int e^x \sin x\, dx$ $= e^x \sin x - \int \cos x\, e^x\, dx$ $= e^x \sin x - \cos x\, e^x - I$ $\therefore\ I = \frac{1}{2} e^x (\sin x - \cos x)$ $\therefore \int_0^{\pi/2} e^x \sin x\, dx = \frac{1}{2} e^{\pi/2} + \frac{1}{2}$ or $\frac{1}{2}(e^{\pi/2} + 1)$ OR (b)Let $I = \int \frac{1}{\cos(x-a)\cos(x-b)} dx$ $= \frac{1}{\sin(a-b)} \int \frac{\sin[(x-b)-(x-a)]}{\cos(x-a)\cos(x-b)} dx$ $= \frac{1}{\sin(a-b)} \left[\int \frac{\sin(x-b)\cos(x-a)}{\cos(x-a)\cos(x-b)} - \frac{\cos(x-b)\sin(x-a)}{\cos(x-a)\cos(x-b)}\right] dx$ $= \frac{1}{\sin(a-b)} \left[\int [\tan(x-b) - \tan(x-a)]\, dx\right]$	**1** ½ ½ **1** 1 ½ ½

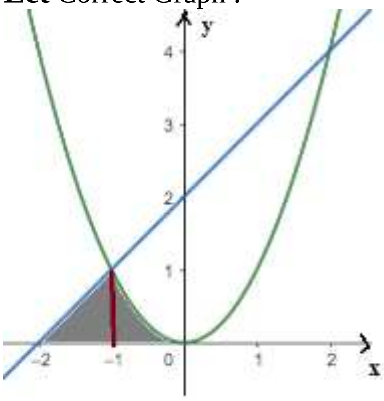
	$= \dfrac{1}{\sin(a-b)}[\log\lvert\sec(x-b)\rvert - \log\lvert\sec(x-a)\rvert] + C$	1

SECTION-D

(Question nos. 32 to 35 are Long Answer type questions carrying 5 marks each)

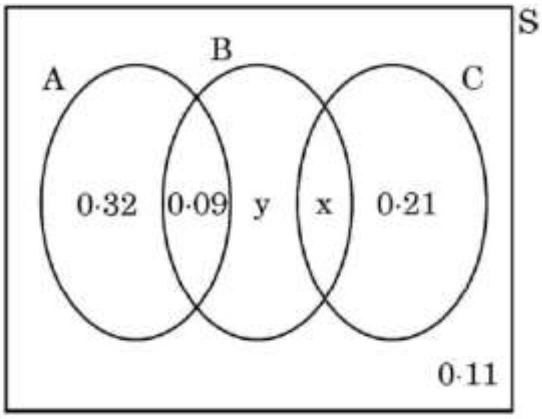
32.	**32.** A relation R is defined on a set of real numbers $\mathbb{R}$ as $R = \{(x, y) : x \cdot y \text{ is an irrational number}\}$. Check whether R is reflexive, symmetric and transitive or not.	
Ans	For reflexive $(1, 1) \notin R$ as 1^2 is rational (or any other counter example) R is not reflexive For symmetric Let $(x, y) \in R$ $\therefore$ x.y is an irrational number $\therefore$ (y.x) is an irrational number $\therefore (y, x) \in R$ $\therefore$ R is symmetric For Transitive $(1, \sqrt{2}) \in R, (\sqrt{2}, 2) \in R$ (or any other counter example) but $(1, 2) \notin R$ $\therefore$ R is not transitive	**1 ½** **1 ½** **2**
33.	**33.** (a) If $A = \begin{bmatrix} 1 & 2 & -2 \\ -1 & 3 & 0 \\ 0 & -2 & 1 \end{bmatrix}$ and $B^{-1} = \begin{bmatrix} 3 & -1 & 1 \\ -15 & 6 & -5 \\ 5 & -2 & 2 \end{bmatrix}$, find $(AB)^{-1}$. **OR** (b) Solve the following system of equations by matrix method : $x + 2y + 3z = 6$ $2x - y + z = 2$ $3x + 2y - 2z = 3$	
Ans	(a) $A = \begin{bmatrix} 1 & 2 & -2 \\ -1 & 3 & 0 \\ 0 & -2 & 1 \end{bmatrix}$, $B^{-1} = \begin{bmatrix} 3 & -1 & 1 \\ -15 & 6 & -5 \\ 5 & -2 & 2 \end{bmatrix}$ $(AB)^{-1} = B^{-1}A^{-1}$ $\lvert A\rvert = 1(3) - 2(-1) - 2(2) = 3 + 2 - 4 = 1 \neq 0$ **adj(A)** $= \begin{bmatrix} 3 & 2 & 6 \\ 1 & 1 & 2 \\ 2 & 2 & 5 \end{bmatrix}$ $\mathbf{A^{-1}} = \dfrac{1}{1}\begin{bmatrix} 3 & 2 & 6 \\ 1 & 1 & 2 \\ 2 & 2 & 5 \end{bmatrix}$ $\therefore B^{-1}A^{-1} = \begin{bmatrix} 3 & -1 & 1 \\ -15 & 6 & -5 \\ 5 & -2 & 2 \end{bmatrix}\begin{bmatrix} 3 & 2 & 6 \\ 1 & 1 & 2 \\ 2 & 2 & 5 \end{bmatrix}$	½ 1 2 ½

	$= \begin{bmatrix} 10 & 7 & 21 \\ -49 & -34 & -103 \\ 17 & 12 & 36 \end{bmatrix}$	1
	OR	
	(b)Given system is $\begin{bmatrix} 1 & 2 & 3 \\ 2 & -1 & 1 \\ 3 & 2 & -2 \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 6 \\ 2 \\ 3 \end{bmatrix}$ $A . X = B \Rightarrow X = A^{-1}B$ $\lvert A \rvert = 35 \neq 0$ $A_{11} = 0 \quad A_{12} = 7 \quad A_{13} = 7$ $A_{21} = 10 \quad A_{22} = -11 \quad A_{23} = 4$ $A_{31} = 5 \quad A_{32} = 5 \quad A_{33} = -5$ $\therefore A^{-1} = \frac{1}{35}\begin{bmatrix} 0 & 10 & 5 \\ 7 & -11 & 5 \\ 7 & 4 & -5 \end{bmatrix}$ $\Rightarrow X = \frac{1}{35}\begin{bmatrix} 0 & 10 & 5 \\ 7 & -11 & 5 \\ 7 & 4 & -5 \end{bmatrix}\begin{bmatrix} 6 \\ 2 \\ 3 \end{bmatrix} = \frac{1}{35}\begin{bmatrix} 35 \\ 35 \\ 35 \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$ $\therefore x = 1 \quad y = 1 \quad z = 1$	½ 1 1½ 1 1
34.	**34.** (a) Find the vector and the Cartesian equations of a line passing through the point (1, 2, – 4) and parallel to the line joining the points A(3, 3, – 5) and B(1, 0, – 11). Hence, find the distance between the two lines. **OR** (b) Find the equations of the line passing through the points A(1, 2, 3) and B(3, 5, 9). Hence, find the coordinates of the points on this line which are at a distance of 14 units from point B.	
Ans	(a) Vector equation of required line through (1, 2, – 4) is $\vec{r} = \hat{i} + 2\hat{j} - 4\hat{k} + \lambda(2\hat{i} + 3\hat{j} + 6\hat{k})$ and cartesian equation: $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z+4}{6}$ Equation of line through A(3, 3, – 5) and B(1, 0, – 11) is $\vec{r} = 3\hat{i} + 3\hat{j} - 5\hat{k} + \mu(2\hat{i} + 3\hat{j} + 6\hat{k})$ Distance between parallel lines is given by d = $\frac{\lvert(\vec{a_2} - \vec{a}_1)\times \vec{b}\rvert}{\lvert\vec{b}\rvert}$ Here $\vec{b} = 2\hat{i} + 3\hat{j} + 6\hat{k}$, $\vec{a}_1 = \hat{i} + 2\hat{j} - 4\hat{k}$, $\vec{a}_2 = 3\hat{i} + 3\hat{j} - 5\hat{k}$ $(\vec{a}_2 - \vec{a}_1) = 2\hat{i} + \hat{j} - \hat{k}$ $(\vec{a}_2 - \vec{a}_1) \times \vec{b} = 9\hat{i} - 14\hat{j} + 4\hat{k}$	**1** **1** ½ ½ **1**

	$\therefore\ d = \frac{\sqrt{293}}{7}$ **OR** (b)Equation of line AB is $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{6}$ Let coordinates of required point on AB be $(2\lambda + 1, 3\lambda + 2, 6\lambda + 3)$ for some λ According to Question $(2\lambda - 2)^2 + (3\lambda - 3)^2 + (6\lambda - 6)^2 = 14^2$ gives $\lambda^2 - 2\lambda - 3 = 0$ Solving we get $\lambda = 3$ and -1 $\therefore$ required points are (7, 11, 21) and (– 1, – 1, – 3)	**1** **1** **1** **1** **1** **1**
35.	**35.** Find the area of the region bounded by the curves $x^2 = y$, $y = x + 2$ and x-axis, using integration.	
Ans	**Let** Correct Graph :  x coordinates of point of intersection are – 1, 2 Required area = $\int_{-2}^{-1}(x+2)\,dx + \int_{-1}^{0}x^2\,dx$ $= \left.\frac{(x+2)^2}{2}\right\|_{-2}^{-1} + \left.\frac{x^3}{3}\right\|_{-1}^{0}$ $= \frac{1}{2} + \frac{1}{3} = \frac{5}{6}$	**1 ½** ½ **1½** **1** ½

SECTION-E

(Question nos. 36 to 38 are source based/case based/passage based/integrated units of assessment questions carrying 4 marks each)

36.	The Venn diagram below represents the probabilities of three different types of Yoga, A, B and C performed by the people of a society. Further, it is given that probability of a member performing type C Yoga is 0·44.  On the basis of the above information, answer the following questions : (i) Find the value of x. (ii) Find the value of y. (iii) (a) Find $P\left(\frac{C}{B}\right)$. **OR** (iii) (b) Find the probability that a randomly selected person of the society does Yoga of type A or B but not C.	
Ans	(i) $x + 0{\cdot}21 = 0{\cdot}44 \Rightarrow x = 0{\cdot}23$ (ii) $0{\cdot}41 + y + 0{\cdot}44 + 0.11 = 1 \Rightarrow y = 0{\cdot}04$ (iii) (a) $P\left(\frac{C}{B}\right) = \frac{P(C \cap B)}{P(B)}$ $P(B) = 0{\cdot}09 + 0{\cdot}04 + 0{\cdot}23 = 0{\cdot}36$ $P\left(\frac{C}{B}\right) = \frac{0{\cdot}23}{0{\cdot}36} = \frac{23}{36}$ **OR** (iii) (b) P(A or B but not C) $= 0{\cdot}32 + 0.09 + 0.04$ $= 0{\cdot}45$	1 1 1 1 1 ½ ½

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Case Study – 2

37. A tank, as shown in the figure below, formed using a combination of a cylinder and a cone, offers better drainage as compared to a flat bottomed tank.

A tap is connected to such a tank whose conical part is full of water. Water is dripping out from a tap at the bottom at the uniform rate of 2 cm^3/s. The semi-vertical angle of the conical tank is 45°.

On the basis of given information, answer the following questions :

(i) Find the volume of water in the tank in terms of its radius r.

(ii) Find rate of change of radius at an instant when $r = 2\sqrt{2}$ cm.

(iii) (a) Find the rate at which the wet surface of the conical tank is decreasing at an instant when radius $r = 2\sqrt{2}$ cm.

OR

(iii) (b) Find the rate of change of height 'h' at an instant when slant height is 4 cm.

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<tr><td>Ans</td><td>

(i) $v = \frac{1}{3}\pi r^2 h = \frac{1}{3}\pi r^3$ [as θ = 45° gives r = h]
(ii) $\frac{dv}{dt} = \pi r^2 \frac{dr}{dt}$
$\Rightarrow \left(\frac{dr}{dt}\right)_{r = 2\sqrt{2}} = -\frac{1}{4\pi}$ cm/sec
(iii)(a) $C = \pi r l = \pi r\sqrt{2}\, r = \sqrt{2}\,\pi r^2$
$\frac{dC}{dt} = \sqrt{2}\,\pi\, 2r \frac{dr}{dt}$
$\left(\frac{dC}{dt}\right)_{r = 2\sqrt{2}} = -2$ cm^2/sec
OR
(iii)(b) $l^2 = h^2 + r^2$
$l = 4 \Rightarrow r = h = 2\sqrt{2}$
$h = r \Rightarrow \frac{dh}{dt} = \frac{dr}{dt} = -\frac{1}{4\pi}$ cm/sec

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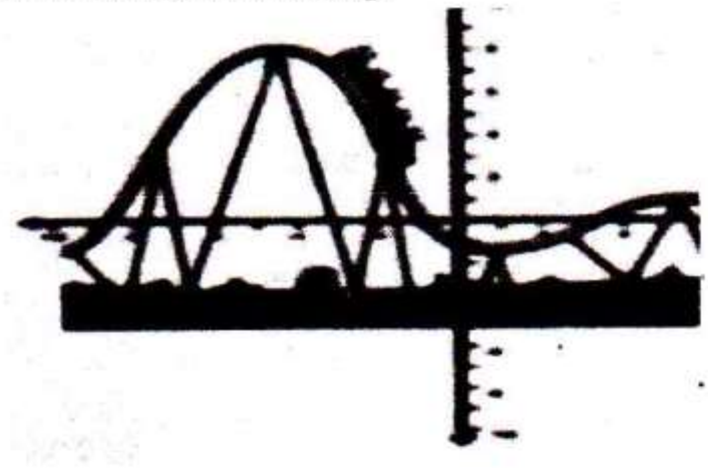
38.	**Case Study – 3** **38.** The equation of the path traced by a roller-coaster is given by the polynomial $f(x) = a(x + 9)(x + 1)(x - 3)$. If the roller-coaster crosses y-axis at a point (0, –1), answer the following :  (i) Find the value of 'a'. (ii) Find $f''(x)$ at $x = 1$.	
Ans	(i) $-1 = a(-27) \Rightarrow a = \frac{1}{27}$ (ii) $f(x) = \frac{1}{27}(x + 9)(x + 1)(x - 3)$ $= \frac{1}{27}(x^3 + 7x^2 - 21x - 27)$ $f'(x) = \frac{1}{27}(3x^2 + 14x - 21)$ $f''(x) = \frac{6x + 14}{27}$ $f''(1) = \frac{20}{27}$	**1 + 1** ½ ½ ½ ½