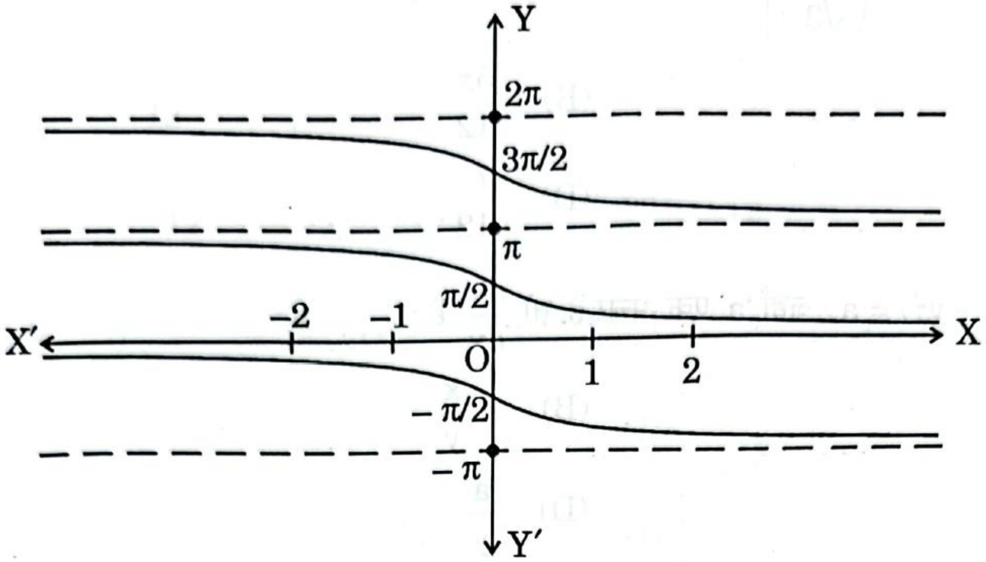
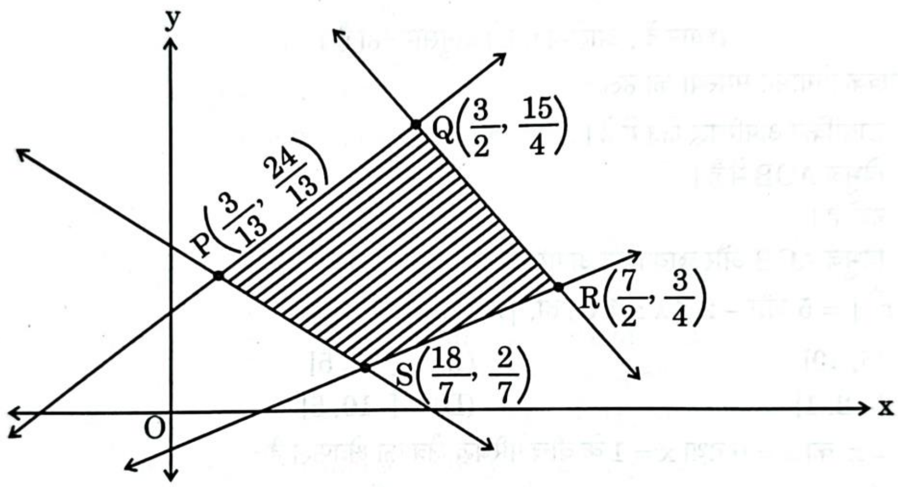
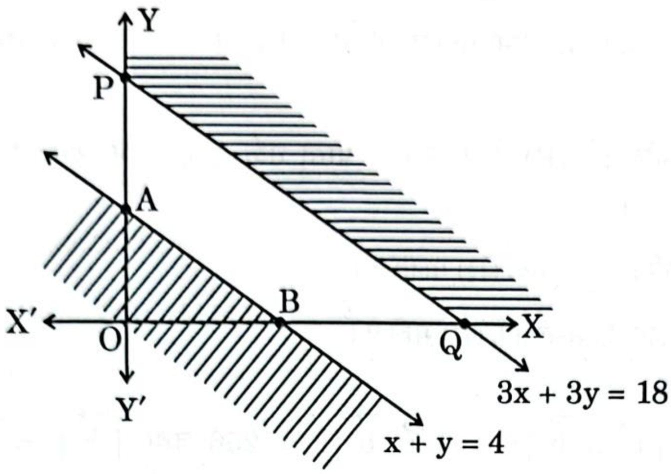
SOLUTIONS – 65/6/2

<table>
<tr><th>Q.No.</th><th>EXPECTED ANSWER / VALUE POINTS</th><th>Marks</th></tr>
<tr><td colspan="3">SECTION-A
This section comprises multiple choice questions (MCQs) of 1 mark each.</td></tr>
<tr><td>1.</td><td>Sum of two skew-symmetric matrices of same order is always a/an :
(A) skew-symmetric matrix
(B) symmetric matrix
(C) null matrix
(D) identity matrix</td><td></td></tr>
<tr><td>Ans</td><td>(A) skew-symmetric matrix</td><td>1</td></tr>
<tr><td>2.</td><td>If $A = \begin{bmatrix} 0 & -3 & 8 \\ 3 & 0 & 5 \\ -8 & -5 & 0 \end{bmatrix}$, then A is a :
(A) null matrix (B) symmetric matrix
(C) skew-symmetric matrix (D) diagonal matrix</td><td></td></tr>
<tr><td>Ans</td><td>(C) skew-symmetric matrix</td><td>1</td></tr>
<tr><td>3.</td><td>The graph shown below depicts :

(A) $y = \cot x$ (B) $y = \cot^{-1} x$
(C) $y = \tan x$ (D) $y = \tan^{-1} x$</td><td></td></tr>
<tr><td>Ans</td><td>(B) $y = \cot^{-1} x$</td><td>1</td></tr>
<tr><td>4.</td><td>Let both AB' and $B'A$ be defined for matrices A and B. If order of A is $n \times m$, then the order of B is :
(A) $n \times n$ (B) $n \times m$
(C) $m \times m$ (D) $m \times n$</td><td></td></tr>
<tr><td>Ans</td><td>(B) $n \times m$</td><td>1</td></tr>
</table>

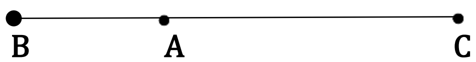
5.	If $f(x) = \begin{cases} \dfrac{\log(1+ax)+\log(1-bx)}{x}, & \text{for } x \neq 0 \\ k, & \text{for } x = 0 \end{cases}$ is continuous at x = 0, then the value of k is : (A) a (B) a + b (C) a – b (D) b	
Ans	**(C) a – b**	**1**
6.	If y = a cos (log x) + b sin (log x), then $x^2y_2 + xy_1$ is : (A) cot (log x) (B) y (C) – y (D) tan (log x)	
Ans	**(C) –y**	**1**
7.	$\left[\sec^{-1}(-\sqrt{2}) - \tan^{-1}\left(\frac{1}{\sqrt{3}}\right)\right]$ is equal to : (A) $\frac{11\pi}{12}$ (B) $\frac{5\pi}{12}$ (C) $-\frac{5\pi}{12}$ (D) $\frac{7\pi}{12}$	
Ans	**(D) $\frac{7\pi}{12}$**	**1**
8.	If $\tan^{-1}(x^2 - y^2) = a$, where 'a' is a constant, then $\frac{dy}{dx}$ is : (A) $\frac{x}{y}$ (B) $-\frac{x}{y}$ (C) $\frac{a}{x}$ (D) $\frac{a}{y}$	
Ans	**(A) $\frac{x}{y}$**	**1**
9.	Let $f(x) = x^2$, $x \in R$. Then, which of the following statements is ***incorrect*** ? (A) Minimum value of f does not exist. (B) There is no point of maximum value of f in R. (C) f is continuous at x = 0. (D) f is differentiable at x = 0.	
Ans	**(A) Minimum value of f does not exist**	**1**
10.	$\int \frac{x+5}{(x+6)^2} e^x \, dx$ is equal to : (A) log (x + 6) + C (B) $e^x + C$ (C) $\frac{e^x}{x+6} + C$ (D) $\frac{-1}{(x+6)^2} + C$	

Ans	**(C)** $\frac{e^x}{x+6} + C$	1
11.	Let $f'(x) = 3(x^2 + 2x) - \frac{4}{x^3} + 5$, $f(1) = 0$. Then, $f(x)$ is : (A) $x^3 + 3x^2 + \frac{2}{x^2} + 5x + 11$ (B) $x^3 + 3x^2 + \frac{2}{x^2} + 5x - 11$ (C) $x^3 + 3x^2 - \frac{2}{x^2} + 5x - 11$ (D) $x^3 - 3x^2 - \frac{2}{x^2} + 5x - 11$	
Ans	**(B)** $x^3 + 3x^2 + \frac{2}{x^2} + 5x - 11$	**1**
12.	The order and degree of the differential equation $\frac{d^2y}{dx^2} + 4\left(\frac{dy}{dx}\right) = x \log\left(\frac{d^2y}{dx^2}\right)$ are respectively : (A) 0, 3 (B) 2, 1 (C) 2, not defined (D) 1, not defined	
Ans	**(C) 2, not defined**	**1**
13.	For a Linear Programming Problem (LPP), the given objective function is $Z = x + 2y$. The feasible region PQRS determined by the set of constraints is shown as a shaded region in the graph.  (Note : The figure is not to scale) $P \equiv \left(\frac{3}{13}, \frac{24}{13}\right)$, $Q \equiv \left(\frac{3}{2}, \frac{15}{4}\right)$, $R \equiv \left(\frac{7}{2}, \frac{3}{4}\right)$, $S \equiv \left(\frac{18}{7}, \frac{2}{7}\right)$ Which of the following statements is correct ? (A) Z is minimum at $S\left(\frac{18}{7}, \frac{2}{7}\right)$ (B) Z is maximum at $R\left(\frac{7}{2}, \frac{3}{4}\right)$ (C) (Value of Z at P) > (Value of Z at Q) (D) (Value of Z at Q) < (Value of Z at R)	

<table>
<tr><td>Ans</td><td>(A) Z is minimum at S $(\frac{18}{7}, \frac{2}{7})$</td><td>1</td></tr>
<tr><td>14.</td><td>The area of the region bounded by the curve $y^2 = x$ between $x = 0$ and $x = 1$ is :
(A) $\frac{3}{2}$ sq units (B) $\frac{2}{3}$ sq units
(C) 3 sq units (D) $\frac{4}{3}$ sq units</td><td></td></tr>
<tr><td>Ans</td><td>(D) $\frac{4}{3}$ sq units</td><td>1</td></tr>
<tr><td>15.</td><td>Let $|\vec{a}| = 5$ and $-2 \le \lambda \le 1$. Then, the range of $|\lambda \vec{a}|$ is :
(A) [5, 10] (B) [– 2, 5]
(C) [– 2, 1] (D) [–10, 5]</td><td></td></tr>
<tr><td>Ans</td><td>1 mark for any attempt as correct answer is not given in any option</td><td>1</td></tr>
<tr><td>16.</td><td>The solution for the differential equation $\log\left(\frac{dy}{dx}\right) = 3x + 4y$ is :
(A) $3e^{4y} + 4e^{-3x} + C = 0$ (B) $e^{3x+4y} + C = 0$
(C) $3e^{-3y} + 4e^{4x} + 12C = 0$ (D) $3e^{-4y} + 4e^{3x} + 12C = 0$</td><td></td></tr>
<tr><td>Ans</td><td>(D) $3e^{-4y} + 4e^{3x} + 12C = 0$</td><td>1</td></tr>
<tr><td>17.</td><td>In a Linear Programming Problem (LPP), the objective function $Z = 2x + 5y$ is to be maximised under the following constraints :
$x + y \le 4,\ 3x + 3y \ge 18,\ x, y \ge 0$
Study the graph and select the correct option.


(Note : The figure is not to scale)
The solution of the given LPP :
(A) lies in the shaded unbounded region.
(B) lies in Δ AOB.
(C) does not exist.
(D) lies in the combined region of Δ AOB and unbounded shaded region.</td><td></td></tr>
<tr><td>Ans</td><td>(C)does not exist</td><td>1</td></tr>
</table>

18.	Chances that three persons A, B, and C go to the market are 30%, 60% and 50% respectively. The probability that at least one will go to the market is : (A) $\frac{14}{10}$ (B) $\frac{43}{50}$ (C) $\frac{9}{100}$ (D) $\frac{7}{50}$	
Ans	**(B)** $\frac{43}{50}$	**1**
	*Questions number **19** and **20** are Assertion and Reason based questions. Two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the codes (A), (B), (C) and (D) as given below.* (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). (B) Both Assertion (A) and Reason (R) are true, but Reason (R) is ***not*** the correct explanation of the Assertion (A). (C) Assertion (A) is true, but Reason (R) is false. (D) Assertion (A) is false, but Reason (R) is true.	
19.	*Assertion (A) :* If $\lvert \vec{a} \times \vec{b} \rvert^2 + \lvert \vec{a} . \vec{b} \rvert^2 = 256$ and $\lvert \vec{b} \rvert = 8$, then $\lvert \vec{a} \rvert = 2$. *Reason (R) :* $\sin^2 \theta + \cos^2 \theta = 1$ and $\lvert \vec{a} \times \vec{b} \rvert = \lvert \vec{a} \rvert \lvert \vec{b} \rvert \sin \theta$ and $\vec{a} . \vec{b} = \lvert \vec{a} \rvert \lvert \vec{b} \rvert \cos \theta$.	
Ans	**(A) Both Assertion (A) and Reason (R) are true, and Reason (R) is the correct explanation of the Assertion (A).**	**1**
20.	*Assertion (A) :* Let $f(x) = e^x$ and $g(x) = \log x$. Then $(f + g) x = e^x + \log x$ where domain of $(f + g)$ is R. *Reason (R) :* $\text{Dom}(f + g) = \text{Dom}(f) \cap \text{Dom}(g)$.	
Ans	**(D) Assertion (A) is false but, Reason (R) is true.**	**1**
SECTION-B **This section comprises 5 Very Short Answer (VSA) type questions of 2 marks each.**		

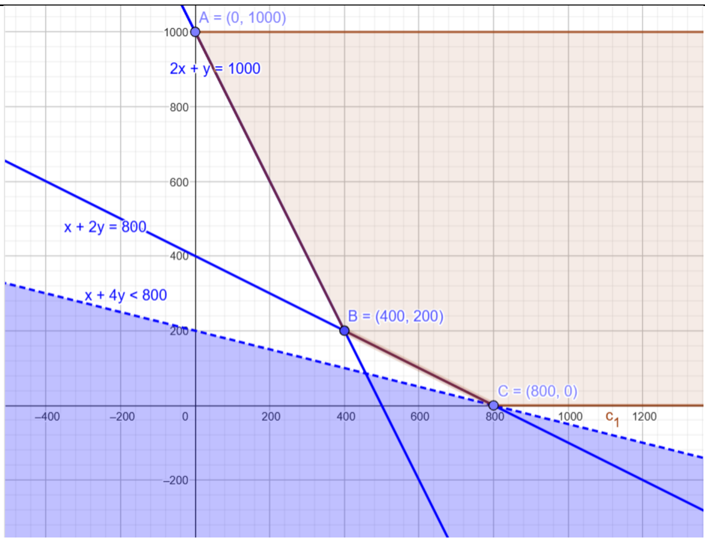
21.	(a) Differentiate $\sqrt{e^{\sqrt{2x}}}$ with respect to $e^{\sqrt{2x}}$ for $x > 0$. **OR** (b) If $(x)^y = (y)^x$, then find $\frac{dy}{dx}$.	
Ans	(a) $u = \sqrt{e^{\sqrt{2x}}}$ and $v = e^{\sqrt{2x}}$ Derivative of $\sqrt{v}$ wrt $v = \frac{1}{2\sqrt{v}}$. Required derivative $= \frac{1}{2\sqrt{e^{\sqrt{2x}}}}$. **OR** Taking log on both sides, we get $y \log x = x \log y$ Differentiating both sides w.r.t. x, we get $\frac{y}{x} + \log x \frac{dy}{dx} = \frac{x}{y}\frac{dy}{dx} + \log y$ $\Rightarrow \frac{dy}{dx} = \frac{y(x\log y - y)}{x(y\log x - x)}$	½ 1 ½ ½ 1 ½
22.	(a) If $\vec{a}$ and $\vec{b}$ are position vectors of point A and point B respectively, find the position vector of point C on BA produced such that BC = 3BA. **OR** (b) Vector $\vec{r}$ is inclined at equal angles to the three axes x, y and z. If magnitude of $\vec{r}$ is $5\sqrt{3}$ units, then find $\vec{r}$.	
Ans	(a) C divides BA in the ratio 3 :2 externally Required vector = $\vec{c} = \frac{3\vec{a}-2\vec{b}}{3-2} = 3\vec{a} - 2\vec{b}$  OR (b) Unit vector equally inclined to coordinate axis is $\frac{\hat{i}}{\sqrt{3}} + \frac{\hat{j}}{\sqrt{3}} + \frac{\hat{k}}{\sqrt{3}}$ $\vec{r} = 5\sqrt{3}\left(\frac{\hat{i}}{\sqrt{3}} + \frac{\hat{j}}{\sqrt{3}} + \frac{\hat{k}}{\sqrt{3}}\right) = 5\hat{i} + 5\hat{j} + 5\hat{k}$ or $-5\hat{i} - 5\hat{j} - 5\hat{k}$	1 1 1 1
23.	Determine those values of x for which $f(x) = \frac{2}{x} - 5,\ x \neq 0$ is increasing or decreasing.	
Ans	$f'(x) = \frac{-2}{x^2} < 0$ Hence f is decreasing in its domain.	$1\frac{1}{2}$ ½

24.	Find the domain of $f(x) = \sin^{-1}(-x^2)$.	
Ans	(a) $-1 \leq -x^2 \leq 1 \Rightarrow -1 \leq -x^2 \leq 0$ $\Rightarrow 0 \leq x^2 \leq 1 \Rightarrow -1 \leq x \leq 1$	1 1
25.	Find the value of λ if the following lines are perpendicular to each other : $l_1 : \frac{1-x}{-3} = \frac{3y-2}{2\lambda} = \frac{z-3}{3}$ $l_2 : \frac{x-1}{3\lambda} = \frac{1-y}{1} = \frac{2z-5}{3}$	
Ans	$l_1: \frac{x-1}{3} = \frac{y-\frac{2}{3}}{\frac{2}{3}\lambda} = \frac{z-3}{3}$ $l_2: \frac{x-1}{3\lambda} = \frac{y-1}{-1} = \frac{z-\frac{5}{2}}{\frac{3}{2}}$ lines are perpendicular $\Rightarrow 3(3\lambda) + \frac{2}{3}\lambda(-1) + 3.\frac{3}{2} = 0$ $\lambda = \frac{-27}{50}$	½ ½ ½ ½

SECTION-C

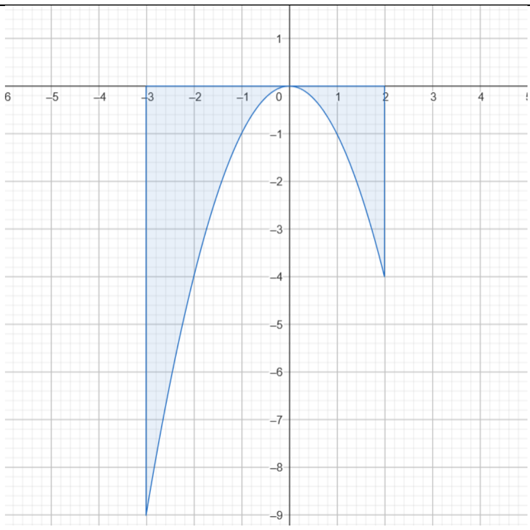
This section comprises 6 Short Answer (SA) type questions of 3 marks each.

26.	If $A = \begin{bmatrix} 1 & -1 & 0 \end{bmatrix}$, $B = \begin{bmatrix} 2 & 0 & 1 \\ -1 & 3 & 4 \\ 0 & 5 & 1 \end{bmatrix}$ and $C = \begin{bmatrix} 2 \\ 3 \\ 4 \end{bmatrix}$, are three matrices, then find ABC.	
Ans	Required product $= \begin{bmatrix} 2+1+0 & 0-3+0 & 1-4+0 \end{bmatrix} \begin{bmatrix} 2 \\ 3 \\ 4 \end{bmatrix}$ $= \begin{bmatrix} 3 & -3 & -3 \end{bmatrix} \begin{bmatrix} 2 \\ 3 \\ 4 \end{bmatrix}$ $= [-15]$	1 1 1
27.	**29.** Consider the Linear Programming Problem, where the objective function $Z = (x + 4y)$ needs to be minimized subject to constraints $2x + y \geq 1000$ $x + 2y \geq 800$ $x, y \geq 0.$ Draw a neat graph of the feasible region and find the minimum value of Z.	

Ans	 Correct Graph and shading: Corner points Value of Z (800, 0) 800 (400, 200) 1200 (0, 1000) 4000 **$x + 4y < 800$ has no region common with feasible region, hence 800 is minimum**	1 ½ 1 ½
28.	(a) Find the distance of the point P(2, 4, –1) from the line $\frac{x+5}{1} = \frac{y+3}{4} = \frac{z-6}{-9}$. **OR** (b) Let the position vectors of the points A, B and C be $3\hat{i} - \hat{j} - 2\hat{k}$, $\hat{i} + 2\hat{j} - \hat{k}$ and $\hat{i} + 5\hat{j} + 3\hat{k}$ respectively. Find the vector and cartesian equations of the line passing through A and parallel to line BC.	
Ans	(a) Let $\vec{a}_2 = 2\hat{i} + 4\hat{j} - \hat{k}$, $\vec{a}_1 = -5\hat{i} - 3\hat{j} + 6\hat{k}$ and $\vec{b} = \hat{i} + 4\hat{j} - 9\hat{k}$ Distance between point and line is given by $d = \frac{\lvert(\vec{a}_2 - \vec{a}_1)\times\vec{b}\rvert}{\lvert\vec{b}\rvert}$ Here $(\vec{a}_2 - \vec{a}_1) = 7\hat{i} + 7\hat{j} - 7\hat{k}$ $(\vec{a}_2 - \vec{a}_1)\times\vec{b} = -35\hat{i} + 56\hat{j} + 21\hat{k}$ $d = \frac{49\sqrt{2}}{7\sqrt{2}} = 7$ OR (b) Direction vector of line = $3\hat{j} + 4\hat{k}$ Vector equation is $\vec{r} = 3\hat{i} - \hat{j} - 2\hat{k} + \mu(3\hat{j} + 4\hat{k})$ Cartesian equation is $\frac{x-3}{0} = \frac{y+1}{3} = \frac{z+2}{4}$	 ½ 1 ½ 1 1 1 1

29.	**(a)** **Differentiate** $y = \sin^{-1}(3x - 4x^3)$ **w.r.t. x, if** $x \in \left[-\frac{1}{2}, \frac{1}{2}\right]$. **OR** **(b)** **Differentiate** $y = \cos^{-1}\left(\frac{1-x^2}{1+x^2}\right)$ **with respect to x, when** $x \in (0, 1)$.	
Ans	(a) $x = \sin t$ gives $y = \sin^{-1}(\sin 3t) = 3t = 3\sin^{-1}x$ $\frac{dy}{dx} = \frac{3}{\sqrt{1-x^2}}$ Aliter: $\frac{dy}{dx} = \frac{3-12x^2}{\sqrt{1-(3x-4x^3)^2}}$ OR (b) $x = \tan t$ gives $y = \cos^{-1}(\cos 2t) = 2t = 2\tan^{-1}x$ $\frac{dy}{dx} = \frac{2}{1+x^2}$ Aliter: $\frac{dy}{dx} = \frac{-1}{\sqrt{1-\left(\frac{1-x^2}{1+x^2}\right)^2}} \cdot \frac{-4x}{(1+x^2)^2}$.	$\frac{1}{2}+1+\frac{1}{2}$ 1 3 $\frac{1}{2}+1+\frac{1}{2}$ 1 3
30.	**(a)** A student wants to pair up natural numbers in such a way that they satisfy the equation $2x + y = 41$, $x, y \in N$. Find the domain and range of the relation. Check if the relation thus formed is reflexive, symmetric and transitive. Hence, state whether it is an equivalence relation or not. **OR** **(b)** Show that the function $f : N \to N$, where N is a set of natural numbers, given by $f(n) = \begin{cases} n-1, \text{ if n is even} \\ n+1, \text{ if n is odd} \end{cases}$ is a bijection.	
Ans	(a) R = {(1,39), (2, 37),_ _ _ ,(20, 1)} Domain = {1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20} Range = {1,3,5,7,9,11,13,15,17,19,21,23,25,27,29,31,33,35,37,39} (1, 1) does not belong to R hence not reflexive (1, 39) belongs to R but (39, 1) does not belong to R hence not symmetric (11, 19) and (19, 3) belong to R but (11, 3) does not belong to R hence not transitive Hence R is not an equivalence relation.	**½** **½** **½** **½** **1**

	OR **(b) Let f(x) = f(y)** **Let x and y are both odd or both even** **Then either x+1 = y + 1 or x-1 = y-1 gives** **x = y** **x odd and y even is rejected as** **x + 1 = y -1 gives x – y = -2 not possible as odd number and even number cannot differ by 2** **Hence f is one-one** **For onto: Let f(x) = y gives x = y + 1 or x = y - 1** **If y is odd, x is even and if y is even, x is odd** **Range = N = co-domain, hence onto** **As f is both one-one and onto hence bijective**	½ ½ ½ 1 ½
31.	A coin is biased so that the head is 3 times as likely to occur as tail. If the coin is tossed three times, find the probability distribution of number of tails. Hence, find the mean of the distribution.	
Ans	$P(H) = \frac{3}{4}, P(T) = \frac{1}{4}$ X 0 1 2 3 P(X) $\frac{27}{64}$ $\frac{27}{64}$ $\frac{9}{64}$ $\frac{1}{64}$ XP(X) 0 $\frac{27}{64}$ $\frac{18}{64}$ $\frac{3}{64}$ $\text{Mean} = \frac{3}{4}$	½ ½ 1 ½ ½
	SECTION-D **This section comprises 4 Long Answer (LA) type questions of 5 marks each.**	
32.	(a) Solve the differential equation : $x^2y\,dx - (x^3 + y^3)\,dy = 0$. **OR** (b) Solve the differential equation $(1 + x^2)\frac{dy}{dx} + 2xy - 4x^2 = 0$ subject to initial condition y(0) = 0.	
Ans	(a) Given differential equation can be written as $\frac{dy}{dx} = \frac{yx^2}{x^3+y^3}$--------- **(i)** Let $y = vx \Rightarrow \frac{dv}{dx} = v + x\frac{dv}{dx}$ substituting in (i)we get $v + x\frac{dv}{dx} = \frac{vx^3}{x^3+v^3x^3}\ \frac{v}{1+v^3}$ $x\frac{dv}{dx} = \frac{-v^4}{1+v^3}$	$\frac{1}{2}$ 1 1 1

	$\left(\frac{1}{v^4}+\frac{1}{v}\right)dv = \frac{-dx}{x}$ Integrating we get $\frac{-1}{3v^3} + \log\lvert v\rvert = -\log\lvert x\rvert + C$ $\frac{-x^3}{3y^3} + \log\lvert y\rvert = C$ OR **(b) Given D.E. is** $\frac{dy}{dx}+\frac{2x}{1+x^2}\,y = \frac{4x^2}{1+x^2}$ **Integrating factor is** $e^{\int\frac{2x}{1+x^2}dx} = e^{\log(1+x^2)} = (1+x^2)$ **Solution is** $y(1+x^2) = \int 4x^2dx + C$ $y(1+x^2) = \frac{4x^3}{3} + C$ y(0) = 0 gives C = 0, hence solution is $y(1+x^2) = \frac{4x^3}{3}$	1 $\frac{1}{2}$ 1 1 1 1 1
33.	Use integration to find the area of the region enclosed by curve $y = -x^2$ and the straight lines $x = -3$, $x = 2$ and $y = 0$. Sketch a rough figure to illustrate the bounded region.	
Ans	 Correct Graph: **Required area =** $\left\lvert\int_{-3}^{2} -x^2\,dx\right\rvert$ $= \left\lvert\left[-\frac{1}{3}x^3\right]_{-3}^{2}\right\rvert$ $= \left\lvert-\frac{1}{3}(8-(-27))\right\rvert$ $= \frac{35}{3}$	1 1 1 1 1

34.	(a) Find : $$\int \frac{x^2+1}{(x-1)^2(x+3)}\,dx$$ **OR** (b) Evaluate : $$\int_0^{\pi/2} \frac{x}{\sin x+\cos x}\,dx$$	
Ans	**(a)** $\frac{x^2+1}{(x-1)^2(x+3)} = \frac{A}{x-1} + \frac{B}{(x-1)^2} + \frac{C}{x+3} = \frac{3/8}{x-1} + \frac{1/2}{(x-1)^2} + \frac{5/8}{x+3}$ $I = \frac{3}{8}\log\|x-1\| - \frac{1}{2(x-1)} + \frac{5}{8}\log\|x+3\| + C$ **OR** **(b)** Let $I = \int_0^{\frac{\pi}{2}} \frac{x}{\sin x+\cos x}\,dx$ $I = \int_0^{\frac{\pi}{2}} \frac{\frac{\pi}{2}-x}{\sin x+\cos x}\,dx$ **using property** $2I = \int_0^{\frac{\pi}{2}} \frac{\frac{\pi}{2}}{\sin x+\cos x}\,dx$ $= \frac{\pi}{2}\frac{1}{\sqrt{2}}\int_0^{\frac{\pi}{2}} \frac{1}{\sin\left(\frac{\pi}{4}+x\right)}\,dx$ $= \frac{\pi}{2\sqrt{2}}\log\left\|\operatorname{cosec}\left(\frac{\pi}{4}+x\right) - \cot\left(\frac{\pi}{4}+x\right)\right\|_0^{\frac{\pi}{2}}$ $= \frac{\pi}{2\sqrt{2}}\log\frac{\sqrt{2}+1}{\sqrt{2}-1}$	**1 + 2** **2** **1** **1** **1** **1** **1**
35.	Find the foot of the perpendicular drawn from point (2, –1, 5) to the line $\frac{x-11}{10} = \frac{y+2}{-4} = \frac{z+8}{-11}$. Also, find the length of the perpendicular.	
Ans	Let *l*: $\frac{x-11}{10} = \frac{y+2}{-4} = \frac{z+8}{-11} = \lambda$ Coordinates of any point on *l* are $x = 10\lambda + 11, y = -4\lambda - 2, z = -11\lambda - 8$ Drs of perpendicular line are $(10\lambda + 9, -4\lambda - 1, -11\lambda - 13)$ Drs of given line are 10, – 4, – 11 As lines are perpendicular, so $(10\lambda + 9)10 + (-4\lambda - 1)(-4) + (-11\lambda - 13)\times(-11) = 0$ $\Rightarrow \lambda = -1$ Hence coordinates of point are (1, 2, 3) which is the foot of the ⊥ from P to *l*. length of $\perp = \sqrt{(1-2)^2 + (2+1)^2 + (3-5)^2} = \sqrt{1+9+4} = \sqrt{14}$	**1** **½** **½** **1** **1** **½** **½**
	SECTION-E **This section comprises 3 case study-based questions of 4 marks each**	

<table>
<tr><td>36.</td><td>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.

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</td><td></td></tr>
<tr><td>Ans</td><td>(i) P(Defective) $= 0.25\times 0.05 + 0.35\times 0.04 + 0.40\times 0.02$

$= 0.0345$

(ii) P(B/ 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 $\frac{28}{69}$</td><td>$1\frac{1}{2}$
$\frac{1}{2}$

$1\frac{1}{2}$

$\frac{1}{2}$</td></tr>
<tr><td>37.</td><td>Three students, Neha, Rani and Sam go to a market to purchase stationery items. Neha buys 4 pens, 3 notepads and 2 erasers and pays ₹ 60. Rani buys 2 pens, 4 notepads and 6 erasers for ₹ 90. Sam pays ₹ 70 for 6 pens, 2 notepads and 3 erasers.

Based upon the above information, answer the following questions :

(i) Form the equations required to solve the problem of finding the price of each item, and express it in the matrix form AX = B. 1

(ii) Find $|A|$ and confirm if it is possible to find A^{-1}. 1

(iii) (a) Find A^{-1}, if possible, and write the formula to find X. 2

OR

(iii) (b) Find $A^2 - 8I$, where I is an identity matrix. 2</td><td></td></tr>
<tr><td>Ans</td><td>(i)Let the price of each pen, notepad, eraser be ₹x, ₹y and ₹z respectively
Given system in the form AX = B is $\begin{pmatrix}4 & 3 & 2\\ 2 & 4 & 6\\ 6 & 2 & 3\end{pmatrix}\begin{pmatrix}x\\ y\\ z\end{pmatrix}=\begin{pmatrix}60\\ 90\\ 70\end{pmatrix}$

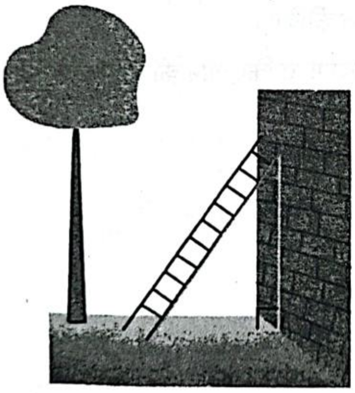
(ii)$|A| = 50 \neq 0$, hence A^{-1}exists

(iii) (a) $A^{-1} = \frac{\text{adj}A}{|A|} = \frac{1}{50}\begin{pmatrix}0 & -5 & 10\\ 30 & 0 & -20\\ -20 & 10 & 10\end{pmatrix}$

$X = A^{-1}B$
OR</td><td>1

1

1 ½
½</td></tr>
</table>

	(iii)(b) $A^2 = \begin{pmatrix} 4 & 3 & 2 \\ 2 & 4 & 6 \\ 6 & 2 & 3 \end{pmatrix}\begin{pmatrix} 4 & 3 & 2 \\ 2 & 4 & 6 \\ 6 & 2 & 3 \end{pmatrix} = \begin{pmatrix} 34 & 28 & 32 \\ 52 & 34 & 46 \\ 46 & 32 & 33 \end{pmatrix}$ $A^2 - 8I = \begin{pmatrix} 26 & 28 & 32 \\ 52 & 26 & 46 \\ 46 & 32 & 25 \end{pmatrix}$	1 ½ ½
38.	 **A ladder of fixed length 'h' is to be placed along the wall such that it is free to move along the height of the wall.** **Based upon the above information, answer the following questions :** **(i) Express the distance (y) between the wall and foot of the ladder in terms of 'h' and height (x) on the wall at a certain instant. Also, write an expression in terms of h and x for the area (A) of the right triangle, as seen from the side by an observer.** *1* **(ii) Find the derivative of the area (A) with respect to the height on the wall (x), and find its critical point.** *1* **(iii) (a) Show that the area (A) of the right triangle is maximum at the critical point.** *2* **OR** **(iii) (b) If the foot of the ladder whose length is 5 m, is being pulled towards the wall such that the rate of decrease of distance (y) is 2 m/s, then at what rate is the height on the wall (x) increasing, when the foot of the ladder is 3 m away from the wall ?** *2*	
Ans	(i) $y^2 = h^2 - x^2$ $A = \frac{1}{2}xy = \frac{1}{2}x\sqrt{h^2 - x^2}$ ii) $\frac{dA}{dx} = \frac{1}{2}\sqrt{h^2 - x^2} + \frac{1}{2}x\frac{-x}{\sqrt{h^2 - x^2}}$ $\frac{dA}{dx} = 0$ gives $x = \frac{h}{\sqrt{2}}$ (iii)(a) $A'' = \frac{1}{2}\frac{-4x.\sqrt{h^2 - x^2} - (h^2 - 2x^2)\frac{-x}{\sqrt{h^2 - x^2}}}{h^2 - x^2}$ is < 0 at $x = \frac{h}{\sqrt{2}}$	½ ½ ½ ½ $1\frac{1}{2}$

	Hence A is maximum at critical point	½
	OR	
	(iii)(b) $y^2 = 25 - x^2$ hence $y = 3$ gives $x = 4$	½
	$2y\frac{dy}{dt} = -2x\frac{dx}{dt}$	1
	$\frac{dx}{dt} = 1.5\text{m/s}$	½