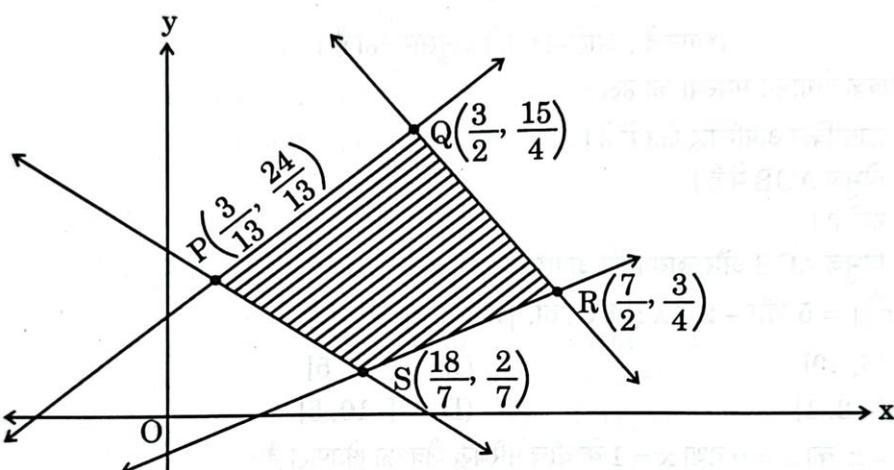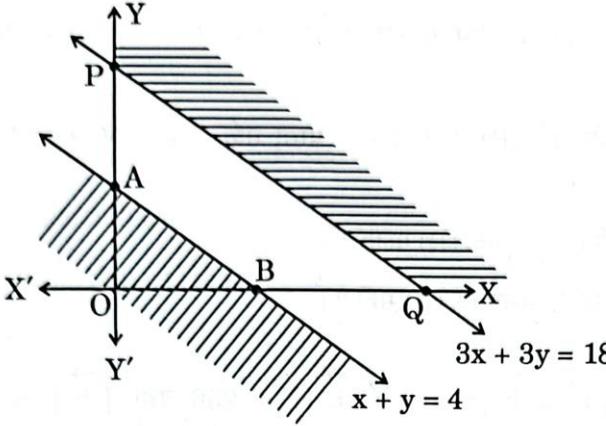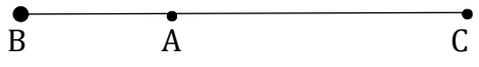| Q.No.	EXPECTED ANSWER / VALUE POINTS	Marks
	SECTION-A This section comprises multiple choice questions (MCQs) of 1 mark each.	
1.	If $\tan^{-1}(x^2 - y^2) = a$, where 'a' is a constant, then $\dfrac{dy}{dx}$ is : (A) $\dfrac{x}{y}$ (B) $-\dfrac{x}{y}$ (C) $\dfrac{a}{x}$ (D) $\dfrac{a}{y}$	
Ans	(A) $\dfrac{x}{y}$	1
2.	If $A = \begin{bmatrix} 0 & 0 & -5 \\ 0 & 3 & 0 \\ 4{\cdot}3 & 0 & 0 \end{bmatrix}$, then A is a : (A) skew-symmetric matrix (B) scalar matrix (C) diagonal matrix (D) square matrix	
Ans	(D) square matrix	1
3.	 (A) $y = \sec^{-1} x$ (B) $y = \sec x$ (C) $y = \csc^{-1} x$ (D) $y = \csc x$	
Ans	(A) $y = \sec^{-1} x$	1

4.	$\left[\sec^{-1}(-\sqrt{2}) - \tan^{-1}\left(\dfrac{1}{\sqrt{3}}\right)\right]$ is equal to : (A) $\dfrac{11\pi}{12}$ (B) $\dfrac{5\pi}{12}$ (C) $-\dfrac{5\pi}{12}$ (D) $\dfrac{7\pi}{12}$	
Ans	(D) $\dfrac{7\pi}{12}$	1
5.	Let both AB′ and B′A be defined for matrices A and B. If order of A is n × m, then the order of B is : (A) n × n (B) n × m (C) m × m (D) m × n	
Ans	(B) n × m	1
6.	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	
Ans	(A) skew-symmetric matrix	1
7.	If $y = a \cos(\log x) + b \sin(\log x)$, then $x^2 y_2 + x y_1$ is : (A) $\cot(\log x)$ (B) y (C) $-y$ (D) $\tan(\log x)$	
Ans	(C) –y	1
8.	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
9.	$f(x) = x^x$ has a critical point at : (A) $x = e$ (B) $x = e^{-1}$ (C) $x = 0$ (D) $x = 1$	
Ans	(B) $x = e^{-1}$	1
10.	The solution for the differential equation $\log\left(\dfrac{dy}{dx}\right) = 3x + 4y$ is : (A) $3e^{4y} + 4e^{-3x} + C = 0$ (B) $e^{3x+4y} + C = 0$ (C) $3e^{-3y} + 4e^{4x} + 12C = 0$ (D) $3e^{-4y} + 4e^{3x} + 12C = 0$	
Ans	(D) $3e^{-4y} + 4e^{3x} + 12C = 0$	1

11.	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)	
Ans	(A) Z is minimum at S $\left(\frac{18}{7}, \frac{2}{7}\right)$	1
12.	The order and degree of the differential equation $\left[\dfrac{d^2y}{dx^2} - 1\right]^2 = \dfrac{dy}{dx}$ are, respectively : (A) 2, 2 (B) 2, not defined (C) 1, 2 (D) 1, not defined	
Ans	(A) 2, 2	1
13.	Let $f'(x) = 3(x^2 + 2x) - \dfrac{4}{x^3} + 5$, $f(1) = 0$. Then, $f(x)$ is : (A) $x^3 + 3x^2 + \dfrac{2}{x^2} + 5x + 11$ (B) $x^3 + 3x^2 + \dfrac{2}{x^2} + 5x - 11$ (C) $x^3 + 3x^2 - \dfrac{2}{x^2} + 5x - 11$ (D) $x^3 - 3x^2 - \dfrac{2}{x^2} + 5x - 11$	
Ans	(B) $x^3 + 3x^2 + \dfrac{2}{x^2} + 5x - 11$	1

14.	In a Linear Programming Problem (LPP), the objective function $Z = 2x + 5y$ is to be maximised under the following constraints : $\quad$ $x + y \le 4$, $\quad 3x + 3y \ge 18$, $\quad x, y \ge 0$ Study the graph and select the correct option. (Note : The figure is not to scale) The solution of the given LPP : (A)$\quad$ lies in the shaded unbounded region. (B)$\quad$ lies in $\triangle$ AOB. (C)$\quad$ does not exist. (D)$\quad$ lies in the combined region of $\triangle$ AOB and unbounded shaded region.	
Ans	(C) does not exist	1
15.	The area of the region bounded by the curve $y^2 = x$ between $x = 0$ and $x = 1$ is : (A)$\quad \dfrac{3}{2}$ sq units $\qquad\qquad$ (B)$\quad \dfrac{2}{3}$ sq units (C)$\quad 3$ sq units $\qquad\qquad$ (D)$\quad \dfrac{4}{3}$ sq units	
Ans	(D) $\dfrac{4}{3}$ sq units	1
16.	$\displaystyle\int \dfrac{x+5}{(x+6)^2} e^x \, dx$ $\quad$ is equal to : (A)$\quad \log(x+6) + C \qquad\qquad$ (B)$\quad e^x + C$ (C)$\quad \dfrac{e^x}{x+6} + C \qquad\qquad$ (D)$\quad \dfrac{-1}{(x+6)^2} + C$	
Ans	(C) $\dfrac{e^x}{x+6} + C$	1
17.	Let $|\vec{a}| = 5$ and $-2 \le \lambda \le 1$. Then, the range of $|\lambda \vec{a}|$ is : (A)$\quad [5, 10] \qquad\qquad$ (B)$\quad [-2, 5]$ (C)$\quad [-2, 1] \qquad\qquad$ (D)$\quad [-10, 5]$	
Ans	1 mark for any attempt as correct answer is not given in any option	1

18.	A meeting will be held only if all three members A, B and C are present. The probability that member A does not turn up is 0·10, member B does not turn up is 0·20 and member C does not turn up is 0·05. The probability of the meeting being cancelled is : (A) 0·35 (B) 0·316 (C) 0·001 (D) 0·65	
Ans	(B) 0.316	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.	**19.** *Assertion (A)* : If $\|\vec{a} \times \vec{b}\|^2 + \|\vec{a}.\vec{b}\|^2 = 256$ and $\|\vec{b}\| = 8$, then $\|\vec{a}\| = 2$. *Reason (R)* : $\sin^2\theta + \cos^2\theta = 1$ and $\|\vec{a} \times \vec{b}\| = \|\vec{a}\|\|\vec{b}\|\sin\theta$ and $\vec{a}.\vec{b} = \|\vec{a}\|\|\vec{b}\|\cos\theta$.	
Ans	(A) Both Assertion (A) and Reason (R) are true, and Reason (R) is the correct explanation of the Assertion (A).	1
20.	**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) 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 B———A————————C 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 axes is $\frac{\hat{i}}{\sqrt{3}} + \frac{\hat{j}}{\sqrt{3}} + \frac{\hat{k}}{\sqrt{3}}$ $\vec{r} = 5\sqrt{3}(\frac{\hat{i}}{\sqrt{3}} + \frac{\hat{j}}{\sqrt{3}} + \frac{\hat{k}}{\sqrt{3}}) = 5\hat{i} + 5\hat{j} + 5\hat{k}$ (or $-5\hat{i} - 5\hat{j} - 5\hat{k}$)	1 1 1 1
22.	Find the domain of $f(x) = \sin^{-1}(-x^2)$.	
Ans	(a) $-1 \le -x^2 \le 1 \implies -1 \le -x^2 \le 0$ $\implies 0 \le x^2 \le 1 \implies -1 \le x \le 1$	1 1
23.	Find the interval in which $f(x) = x + \frac{1}{x}$ is always increasing, $x \ne 0$.	
Ans	$f'(x) = 1 - \frac{1}{x^2} = \frac{x^2-1}{x^2}$ $f'(x) = 0$ gives $x = 1, -1$ f is decreasing in $(-1, 0) \cup (0, 1)$ as $f'(x) < 0$ f is increasing in $R - (-1, 1)$ as $f'(x) > 0$	1 1 1
24.	(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
		½
		1
		
		½

	Taking log on both sides, we get y logx = x logy	½
	Differentiating both sides w.r.t. x, we get $$\frac{y}{x.} + logx\frac{dy}{dx} = \frac{x}{y.}\frac{dy}{dx} + logy$$	1
	$$\Rightarrow \frac{dy}{dx} = \frac{y(xlogy-y)}{x(ylogx-x)}$$	½
25.	Find the angle at which the given lines are inclined to each other : $$l_1 : \frac{x-5}{2} = \frac{y+3}{1} = \frac{z-1}{-3}$$ $$l_2 : \frac{x}{3} = \frac{y-1}{2} = \frac{z+5}{-1}$$	
Ans	Let θ be the angle between given lines $$\therefore \cos\theta = \frac{(2\times 3) + (1\times 2) + (-3\times -1)}{\sqrt{14}\sqrt{14}}$$ $$\Rightarrow \cos\theta = \frac{11}{14}$$ $$\Rightarrow \theta = \cos^{-1}\left(\frac{11}{14}\right)$$	1 ½ ½

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

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26.	Find the value of x, if $[1 \quad x \quad 1]\begin{bmatrix} 1 & 3 & 2 \\ 2 & 5 & 1 \\ 15 & 3 & 2 \end{bmatrix}\begin{bmatrix} 1 \\ 2 \\ x \end{bmatrix} = O.$	
Ans	$$[1 \quad x \quad 1]\begin{bmatrix} 1 & 3 & 2 \\ 2 & 5 & 1 \\ 15 & 3 & 2 \end{bmatrix}\begin{bmatrix} 1 \\ 2 \\ x \end{bmatrix} = 0$$ $$[1 \quad x \quad 1]\begin{bmatrix} 7+2x \\ 12+x \\ 21+2x \end{bmatrix} = 0$$	1
	$$x^2 + 16x + 28 = 0$$	1
	$$\Rightarrow (x+14)(x+2) = 0$$	
	$$\Rightarrow x = -14, x = -2$$	1

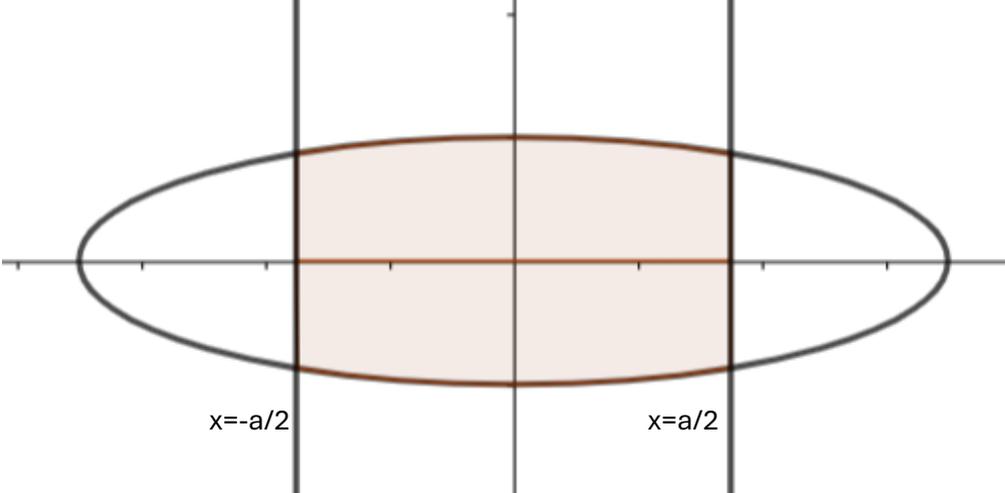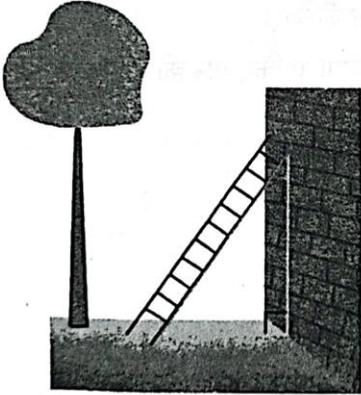|		
27.	**(a)** Find the distance of the point P(2, 4, −1) from the line $\frac{x+5}{1} = \frac{y+3}{4} = \frac{z-6}{-9}$.	
	OR	
	(b) Let the position vectors of the points A, B and C be $3\hat{i} - \hat{j} - 2\hat{k}$, $\hat{i} + 2\hat{j} - \hat{k}$ and $\hat{i} + 5\hat{j} + 3\hat{k}$ respectively. 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 $d = \frac{|(\vec{a_2} - \vec{a_1}) \times \vec{b}|}{|\vec{b}|}$	
	Here $(\vec{a_2} - \vec{a_1}) = 7\hat{i} + 7\hat{j} - 7\hat{k}$	½
	$(\vec{a_2} - \vec{a_1}) \times \vec{b} = -35\hat{i} + 56\hat{j} + 21\hat{k}$	1½
	$d = \frac{49\sqrt{2}}{7\sqrt{2}} = 7$	1
	OR	
	(b) Direction vector of line $= 3\hat{j} + 4\hat{k}$	1
	Vector equation is $\vec{r} = 3\hat{i} - \hat{j} - 2\hat{k} + \mu(3\hat{j} + 4\hat{k})$	1
	Cartesian equation is $\frac{x-3}{0} = \frac{y+1}{3} = \frac{z+2}{4}$	1
28.	Consider the Linear Programming Problem, where the objective function $Z = (x + 4y)$ needs to be minimized subject to constraints $\qquad 2x + y \geq 1000$ $\qquad x + 2y \geq 800$ $\qquad x, y \geq 0$. 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 minimum
	   (400, 200) 1200
	   (0, 1000) 4000
	$x + 4y < 800$ has no region common with feasible region, hence 800 is minimum
		1½
		
		1
		
		½

29.	(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 $f(n) = \begin{cases} n-1, & \text{if } n \text{ is even} \\ n+1, & \text{if } n \text{ is odd} \end{cases}$ 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.
	                               OR
	   (a) 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
		
		½
		
		1
		
		½
		
		½
		½
		
		1
		
		½

30.	(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
31.	Bag I contains 4 white and 5 black balls. Bag II contains 6 white and 7 black balls. A ball drawn randomly by from bag I is transferred to bag II and then a ball is drawn randomly from bag II. Find the probability that the ball drawn is white.	
Ans	P(white ball transferred) $= \frac{4}{9}$, Probability(black ball transferred) $= \frac{5}{9}$ P(white ball drawn from bag II) $= \frac{4}{9} \cdot \frac{7}{14} + \frac{5}{9} \cdot \frac{6}{14}$ $= \frac{29}{63}$	1 $1\frac{1}{2}$ 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	½ 1

$$v + x\frac{dv}{dx} = \frac{vx^3}{x^3 + v^3 x^3} = \frac{v}{1 + v^3}$$

$$x\frac{dv}{dx} = \frac{-v^4}{1 + v^3}$$

1

$$\left(\frac{1}{v^4} + \frac{1}{v}\right) dv = \frac{-dx}{x}$$

Integrating we get

1

$$\frac{-1}{3v^3} + \log|v| = -\log|x| + C$$

1

$$\frac{-x^3}{3y^3} + \log|y| = C$$

½

OR

(b) Given D.E. is $\frac{dy}{dx} + \frac{2x}{1+x^2} y = \frac{4x^2}{1+x^2}$

1

Integrating factor is $e^{\int \frac{2x}{1+x^2}dx} = e^{\log(1+x^2)} = (1 + x^2)$

1

Solution is $y(1 + x^2) = \int 4x^2 dx + C$

1

$$y(1 + x^2) = \frac{4x^3}{3} + C$$

1

$y(0) = 0$ gives $C = 0$, hence solution is $y(1 + x^2) = \frac{4x^3}{3}$

1

33.

Using integration, find the area of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ bounded

between the lines $x = -\frac{a}{2}$ to $x = \frac{a}{2}$.

Ans

x=-a/2   x=a/2

Correct Graph:

1

$$\text{Required area} = \frac{4b}{a} \int_0^{\frac{a}{2}} \sqrt{a^2 - x^2}\, dx$$

2

	$$= \frac{4b}{a}\left[\frac{x}{2}\sqrt{a^2-x^2}+\frac{a^2}{2}\sin^{-1}\frac{x}{a}\right]_0^{\frac{a}{2}}$$ $$= \frac{4b}{a}\left[\frac{a}{4}\cdot\frac{\sqrt{3}a}{2}+\frac{a^2}{2}\cdot\frac{\pi}{6}\right]$$ $$= ab\left[\frac{\sqrt{3}}{2}+\frac{\pi}{3}\right]$$	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) $\dfrac{x^2+1}{(x-1)^2(x+3)} = \dfrac{A}{x-1}+\dfrac{B}{(x-1)^2}+\dfrac{C}{x+3} = \dfrac{3/8}{x-1}+\dfrac{1/2}{(x-1)^2}+\dfrac{5/8}{x+3}$ $I = \dfrac{3}{8}\log|x-1| - \dfrac{1}{2(x-1)} + \dfrac{5}{8}\log|x+3| + C$ OR (b) Let $I = \displaystyle\int_0^{\frac{\pi}{2}} \dfrac{x}{\sin x+\cos x}\,dx$ $I = \displaystyle\int_0^{\frac{\pi}{2}} \dfrac{\frac{\pi}{2}-x}{\sin x+\cos x}\,dx$ $2I = \displaystyle\int_0^{\frac{\pi}{2}} \dfrac{\frac{\pi}{2}}{\sin x+\cos x}\,dx$ $= \dfrac{\pi}{2}\dfrac{1}{\sqrt{2}}\displaystyle\int_0^{\frac{\pi}{2}} \dfrac{1}{\sin\left(\frac{\pi}{4}+x\right)}\,dx$ $2I = \dfrac{\pi}{2\sqrt{2}}\log\left|\operatorname{cosec}\left(\frac{\pi}{4}+x\right)-\cot\left(\frac{\pi}{4}+x\right)\right|_0^{\frac{\pi}{2}}$ $I = \dfrac{\pi}{4\sqrt{2}}\log\dfrac{\sqrt{2}+1}{\sqrt{2}-1}$	1 + 2 2 1 1 1 1 1
35.	Show that the line passing through the points A (0, –1, –1) and B (4, 5, 1) intersects the line joining points C (3, 9, 4) and D (– 4, 4, 4).	
Ans	Drs of line passing through points A and B are < 4,6,2>	1

	Drs of line passing through C and D are <-7, -5, 0>	1
	Consider $\begin{vmatrix} x_2 - x_1 & y_2 - y_1 & z_2 - z_1 \\ a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \end{vmatrix} = \begin{vmatrix} 3 - 0 & 9 - (-1) & 4 - (-1) \\ 4 & 6 & 2 \\ -7 & -5 & 0 \end{vmatrix}$	2
	$= 3(+10) - 10(+14) + 5(22)$ $= 0$	1
	Hence lines intersect each other	

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SECTION-E

This section comprises 3 case study-based questions of 4 marks each

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36.	**Case Study – 2** 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) $y^2 = h^2 - x^2$	½

	$A = \frac{1}{2}xy = \frac{1}{2}x\sqrt{h^2 - x^2}$	½
	ii) $\frac{dA}{dx} = \frac{1}{2}\sqrt{h^2 - x^2} + \frac{1}{2}x\frac{-x}{\sqrt{h^2 - x^2}}$	½
	$\frac{dA}{dx} = 0$ gives $x = \frac{h}{\sqrt{2}}$	½
	(iii)(a) $A'' = \frac{1}{2}\dfrac{-4x.\sqrt{h^2 - x^2}-(h^2 - 2x^2)\frac{-x}{\sqrt{h^2 - x^2}}}{h^2 - x^2}$ is < 0 at $x = \frac{h}{\sqrt{2}}$	$1\frac{1}{2}$
	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
37.	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**	
Ans	(i) P(Defective) $= 0.25 \times 0.05 + 0.35 \times 0.04 + 0.40 \times 0.02$	$1\frac{1}{2}$
	$= 0.0345$	½
	(ii) P(B/ Defective) $= \dfrac{0.35 \times 0.04}{0.25 \times 0.05 + 0.35 \times 0.04 + 0.40 \times 0.02}$	$1\frac{1}{2}$
	$= \dfrac{140}{345}$ or $\dfrac{28}{69}$	½

38.	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	
Ans	(i) Let the price of each pen, notepad, eraser be ₹x, ₹y and ₹z respectively Given system in the form AX = B is $\begin{pmatrix} 4 & 3 & 2 \\ 2 & 4 & 6 \\ 6 & 2 & 3 \end{pmatrix}\begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 60 \\ 90 \\ 70 \end{pmatrix}$	1	
	(ii) $|A| = 50 \neq 0$, hence A^{-1} exists	1	
	(iii) (a) $A^{-1} = \dfrac{adjA}{|A|} = \dfrac{1}{50}\begin{pmatrix} 0 & -5 & 10 \\ 30 & 0 & -20 \\ -20 & 10 & 10 \end{pmatrix}$	1 ½	
	$X = A^{-1}B$	½	
	OR		
	(iii)(b) $A^2 = \begin{pmatrix} 4 & 3 & 2 \\ 2 & 4 & 6 \\ 6 & 2 & 3 \end{pmatrix}\begin{pmatrix} 4 & 3 & 2 \\ 2 & 4 & 6 \\ 6 & 2 & 3 \end{pmatrix} = \begin{pmatrix} 34 & 28 & 32 \\ 52 & 34 & 46 \\ 46 & 32 & 33 \end{pmatrix}$	1 ½	
	$A^2 - 8I = \begin{pmatrix} 26 & 28 & 32 \\ 52 & 26 & 46 \\ 46 & 32 & 25 \end{pmatrix}$	½	