केन्द्रीय विद्यालय संगठन, भोपाल संभाग
KENDRIYA VIDYALAYA SANGATHAN,BHOPAL REGION
कक्षा- XII /Class−XII
SESSION/सत्र -2024 -2025
SET-2/सेट-2
Marking Scheme
Mathematics (Code – 041)

Q. No.	Answer	Hints/solution
		Section: A (Multiple Choice Questions- 1 Mark each)
1.	(c)	bijective function
2.	(a)	$\sin\left[\frac{\pi}{3}+\sin^{-1}\left(\frac{1}{2}\right)\right]=\sin\left(\frac{\pi}{3}+\frac{\pi}{6}\right)=\sin\frac{\pi}{2}=1$
3.	(a)	P Order $p\times k$; Y Order $3\times k$; For PY to exist $k=3$, Order of $PY=p\times k$. W Order $n\times 3$; Y Order $3\times k$; Order of $WY=n\times k$. For $PY+WY$ to exist order(PY) = order(WY) $\therefore p=n$
4.	(b)	Number of Symmetric matrices of order 3 × 3 = 2^6 = 64
5.	(a)	4 = (3x – 2) – (x + 6) x = 6
6.	(d)	$\lvert 2A^T\rvert = 2^3\lvert A^T\rvert = 8\ \lvert A\rvert = 24$
7.	(d)	$\frac{dy}{dt}=3cos^2t.(-\sin t)$, $\frac{dx}{dt}=3sin^2 t.(\cos t)$ $\frac{dy}{dx}=\frac{-3cos^2t.\sin t}{3sin^2t.\cos t}=-\cot t$
8.	(d)	The graph of the function $f:R\to Z$ defined by $f(x)=[x]$; (where[.]denotes $G.I.F$) is a straight line $\forall x\in(2.5-h,2.5+h)$. '$h$' is an infinitesimally small positive quantity. Hence, the function is continuous and differentiable at $x=2.5$.

9.	(a)	We know, $\int_0^{2a} f(x)dx = 0$, if $f(2a-x) = -f(x)$ Let $f(x) = \operatorname{cosec}^7 x$. Now, $f(2\pi - x) = \operatorname{cosec}^7(2\pi - x) = -\operatorname{cosec}^7 x = -f(x)$ $\therefore \int_0^{2\pi} \operatorname{cosec}^7 x\, dx = 0$; Using the property $\int_0^{2a} f(x)dx = 0$, if $f(2a-x) = -f(x)$.
10.	(c)	$\frac{d}{dx}\left(\frac{dy}{dx}\right)^4 = 0 \Rightarrow \frac{d}{dx}(y')^4 = 0$ Solving the above, $4y'^3 \times y'' = 0$ Order, m=2 Degree, n=1 and m + n = 3
11.	(b)	A differential equation of the form $\frac{dy}{dx} = f(x,y)$ is said to be homogeneous, if $f(x,y)$ is a homogeneous function of degree 0. Now, $x^n \frac{dy}{dx} = y\left(\log_e \frac{y}{x} + \log_e e\right) \Rightarrow \frac{dy}{dx} = \frac{y}{x^n}\left(\log_e e.\left(\frac{y}{x}\right)\right) = f(x,y); (Let)$. $f(x,y)$ will be a homogeneous function of degree 0, if $n = 1$.
12.	(c)	$\lvert\vec{a}\rvert = 3, \lvert\vec{b}\rvert = 4, \lvert\vec{a}+\vec{b}\rvert = 5$ We have , $\lvert\vec{a}+\vec{b}\rvert^2 + \lvert\vec{a}-\vec{b}\rvert^2 = 2\left(\lvert\vec{a}\rvert^2 + \lvert\vec{b}\rvert^2\right) = 2(9+16) = 50 \Rightarrow \lvert\vec{a}-\vec{b}\rvert = 5$.
13.	(c)	Any vector in the direction of a vector $\vec{a}$ is given by $\frac{\vec{a}}{\lvert\vec{a}\rvert} = \frac{\hat{i}-2\hat{j}+2\hat{k}}{\sqrt{1^2+2^2+2^2}} = \frac{\hat{i}-2\hat{j}+2\hat{k}}{3}$ $\therefore$ Vector in the direction of $\vec{a}$ with magnitude 9 is $9\frac{\vec{a}}{\lvert\vec{a}\rvert} = 9.\frac{\hat{i}-2\hat{j}+2\hat{k}}{3} = 3(\hat{i}-2\hat{j}+2\hat{k})$
14.	(a)	We have, $\vec{a} = 2\hat{i} + 3\hat{j} + 2\hat{k}$ and $\vec{b} = \hat{i} + 2\hat{j} + \hat{k}$ $\therefore \quad \vec{a}\cdot\vec{b} = (2\hat{i} + 3\hat{j} + 2\hat{k})\cdot(\hat{i} + 2\hat{j} + \hat{k}) = 2 + 6 + 2 = 10$ and $\lvert\vec{b}\rvert = \sqrt{1^2 + 2^2 + 1^2} = \sqrt{6}$ Hence, projection of $\vec{a}$ on $\vec{b}$ is $\frac{\vec{a}\cdot\vec{b}}{\lvert\vec{b}\rvert} = \frac{10}{\sqrt{6}}$.

15.	(b)	We know that $cos^2\alpha + cos^2\beta + cos^2\gamma = 1$ so $sin^2\alpha + sin^2\beta + sin^2\gamma = 2$
16.	(c)	Equation of line $\frac{x-1/3}{1/6} = \frac{y+1/3}{1/3} = \frac{z-1}{1/2}$ so DR of line are 1, 2, 3
17.	(a)	Convex Polygon
18.	(a)	$P\left(\frac{A}{B}\right) = \frac{3}{8}$
19.	(c)	Option (c) is correct, because A is true and R is false
20.	(b)	Answer (b) is correct , because Corner points are (0, 0), (10, 0), (20/3, 20/3) and (0, 10) Z_{max} =x + 3y = 0 + 3x10 = 30 both A and R are true but R is not the correct explanation for A

SECTION: B
(VSA Questions of 2 marks each)

21.	sin $[cot^{-1}\{cos(tan^{-1}1)\}]$ = sin $[cot^{-1}\left\{cos\frac{\pi}{4}\right\}]$ = sin $[cot^{-1}\frac{1}{\sqrt{2}}]$ = sin $[sin^{-1}\frac{\sqrt{2}}{\sqrt{3}}]$ = $\frac{\sqrt{2}}{\sqrt{3}}$	½ ½ ½ ½
22.	RHL (at x = 3) = 3b + 3 LHL (at x = 3) = 3a + 1 f(3) = 3a + 1 f(x) is continuous at x = 3 so 3b + 3 = 3a + 1 Relation between a and b is 3a – 3b = 2	½ ½ ½ ½

23.(a)	$y = \tan^{-1} x$ and $z = \log_e x$ Then $\frac{dy}{dx} = \frac{1}{1+x^2}$ and $\frac{dz}{dx} = \frac{1}{x}$ So, $\frac{dy}{dz} = \frac{\frac{dy}{dx}}{\frac{dz}{dx}}$ $= \frac{\frac{1}{1+x^2}}{\frac{1}{x}} = \frac{x}{1+x^2}$.	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$
	OR	
23.(b)	Let $y = (\cos x)^x$. **logy = xlogcosx** On differentiating both sides with respect to x, we get $\Rightarrow \frac{dy}{dx} = (\cos x)^x \left\{\log_e \cos x \frac{d}{dx}(x) + x \frac{d}{dx}(\log_e \cos x)\right\}$ $\Rightarrow \frac{dy}{dx} = (\cos x)^x \left\{\log_e \cos x + x.\frac{1}{\cos x}(-\sin x)\right\} \Rightarrow \frac{dy}{dx} = (\cos x)^x(\log_e \cos x - x\tan x)$.	$\frac{1}{2}$ $\frac{1}{2}$ 1
24.(a)	We have $\vec{b} + \lambda\vec{c} = (-1+3\lambda)\hat{\imath} + (2+\lambda)\hat{\jmath} + \hat{k}$ $(\vec{b} + \lambda\vec{c}).\vec{a} = 0 \Rightarrow 2(-1+3\lambda) + 2(2+\lambda) + 3 = 0$ $\lambda = -\frac{5}{8}$	½ 1 ½
	OR	
24.(b)	$\overrightarrow{BA} = \overrightarrow{OA} - \overrightarrow{OB} = (4\hat{\imath} + 3\hat{k}) - \hat{k} = 4\hat{\imath} + 2\hat{k}$ Direction cosines are $\frac{2}{\sqrt{5}}, 0, \frac{1}{\sqrt{5}}$	$\frac{1}{2}$ 1.5
25.	**Writing the equation of line** **Putting value** **Proving perpendicular to z axis**	1/2 **1/2** **1**

	SECTION: C **(SA Questions of 3 marks each)**	
26.(a)	Let $I = \int_{-1}^{2} \lvert x^3 - x \rvert \, dx$ Again let $f(x) = x^3 - x = x(x^2 - 1) = x(x-1)(x+1)$ Now break the limit at x=0, 1(because on putting f(x)=0 we get x=0, 1, -1) It is clear that $x^3 - x \geq 0$ on [-1, 0] $x^3 - x \leq 0$ on [0,1] $x^3 - x \geq 0$ on [1,2] Hence, the interval of the integral can be subdivided as $\int_{-1}^{2} \lvert x^3 - x \rvert \, dx = \int_{-1}^{0} (x^3 - x) dx - \int_{0}^{1} (x^3 - x) dx + \int_{1}^{2} (x^3 - x) dx$ $= \frac{11}{4}$ OR	1 ½ ½ 1
26.(b)	**Ans:** Let $I = \int_0^{\pi} \frac{x \sin x}{1+\cos^2 x} dx$ ... (i) $= \int_0^{\pi} \frac{(\pi - x)\sin(\pi - x)}{1+[\cos(\pi - x)]^2} dx \quad \left[\because \int_0^a f(x)dx = \int_0^a f(a-x)dx \right] \Rightarrow I = \int_0^{\pi} \frac{(\pi - x)\sin x}{1+\cos^2 x} dx$ ...(ii) Adding (i) and (ii), we get $2I = \int_0^{\pi} \frac{\pi \sin x}{1+\cos^2 x} dx$ Put $\cos x = t \Rightarrow -\sin x \, dx = dt$ Also, $x = 0 \Rightarrow t = 1$ and $x = \pi \Rightarrow t = -1$ $\therefore \; 2I = \int_1^{-1} \frac{-\pi dt}{1+t^2} \Rightarrow I = \frac{\pi}{2} \int_{-1}^{1} \frac{dt}{1+t^2}$ $\therefore \; I = \frac{\pi}{2}[\tan^{-1} t]_{-1}^{1} = \frac{\pi}{2}[\tan^{-1}(1) - \tan^{-1}(-1)] = \frac{\pi}{2}\left[\frac{\pi}{4} - \left(-\frac{\pi}{4}\right)\right] = \frac{\pi^2}{4}$	**½** **½** **½** **½** **1**

27.	Putting $\frac{-x}{2} = t$, we get $x = -2t$ and $dx = -2dt$.	½
	$\therefore \quad I = \int \frac{\sqrt{1-\sin x}}{(1+\cos x)} e^{-x/2} dx$	½
	$= \int \frac{\sqrt{1-\sin(-2t)}}{\{1+\cos(-2t)\}} e^t (-2dt) = -2\int \frac{\sqrt{1+\sin 2t}}{(1+\cos 2t)} e^t dt$	½
	$= -2\int \frac{\sqrt{\cos^2 t + \sin^2 t + 2\sin t \cos t}}{2\cos^2 t} e^t dt$	½
	$= -2\int \frac{(\cos t + \sin t)}{2\cos^2 t} e^t dt = -\int (\sec t + \sec t \tan t) e^t dt$	
	$= -\int e^t \{f(t) + f'(t)\} dt$, where $f(t) = \sec t$	
	$= -e^t f(t) + C = -e^{-x/2} \sec\left(\frac{-x}{2}\right) + C = -e^{-x/2} \sec \frac{x}{2} + C.$	1
28.	Putting $\sin x = t$ and $\cos x \, dx = dt$, we get	½
	$I = \frac{\cos x}{(1-\sin x)(2-\sin x)} dx = \int \frac{dt}{(1-t)(2-t)}.$	
	Let $\frac{1}{(1-t)(2-t)} = \frac{A}{(1-t)} + \frac{B}{(2-t)}$	½
	$\Rightarrow \; 1 \equiv A(2-t) + B(1-t). \qquad \ldots \text{(i)}$	
	Putting $t = 1$ in (i), we get $A = 1$.	½
	Putting $t = 2$ in (i), we get $B = -1$.	
	$\therefore \quad \frac{1}{(1-t)(2-t)} = \frac{1}{(1-t)} - \frac{1}{(2-t)}$	
	$\Rightarrow \int \frac{\cos x}{(1-\sin x)(2-\sin x)} dx = \int \frac{dt}{(1-t)(2-t)}$	½
	$= \int \left\{\frac{1}{(1-t)} - \frac{1}{(2-t)}\right\} dt = \int \frac{dt}{(1-t)} - \int \frac{dt}{(2-t)}$	
	$= -\log\lvert 1-t\rvert + \log\lvert 2-t\rvert + C$	1
	$= \log\left\lvert\frac{2-t}{1-t}\right\rvert + C = \log\left\lvert\frac{2-\sin x}{1-\sin x}\right\rvert + C.$	
29.(a)	The given differential equation can be written as	
	$\frac{dy}{dx} = \frac{1+y^2}{(tan^{-1}y - x)}$ or $\frac{dx}{dy} = \frac{(tan^{-1}y - x)}{1+y^2}$	
	$\Longrightarrow \frac{dx}{dy} + \frac{x}{1+y^2} = \frac{(tan^{-1}y)}{1+y^2}$ linear in x where P = $\frac{1}{1+y^2}$, Q = $\frac{(tan^{-1}y)}{1+y^2}$	½+½
	$I.F. = \; e^{tan^{-1}y}$	½
	GS is x $e^{tan^{-1}y}$ = $(tan^{-1}y)\, e^{tan^{-1}y} - \; e^{tan^{-1}y}$+ C or x = $(tan^{-1}y) - 1$+ C $e^{-tan^{-1}y}$	1

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<td>29.(b)</td>
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When x = 0, y = 0 , C = 1
So PS is $x = (tan^{-1}y) + e^{-tan^{-1}y} - 1$
OR
The given differential equation can be written as

$$\frac{dy}{dx} = \frac{\left[xy\cos\left(\frac{y}{x}\right) + y^2\sin\left(\frac{y}{x}\right)\right]}{\left[xy\sin\left(\frac{y}{x}\right) - x^2\cos\left(\frac{y}{x}\right)\right]}$$

On showing this is homogenious equation
To solve it, we make the substitution

$$y = vx$$

or $$\frac{dy}{dx} = v + x\frac{dv}{dx}$$

or $$v + x\frac{dv}{dx} = \frac{v\cos v + v^2\sin v}{v\sin v - \cos v}$$

or $$x\frac{dv}{dx} = \frac{2v\cos v}{v\sin v - \cos v}$$

Solve by variable sepration

$$\log|\sec v| - \log|v| = 2\log|x| + \log|C_1|$$

$$\frac{\sec\left(\frac{y}{x}\right)}{\left(\frac{y}{x}\right)(x^2)} = C \text{ where, } C = \pm C_1$$

$$\sec\left(\frac{y}{x}\right) = C\,xy$$

which is the general solution of the given differential equation.
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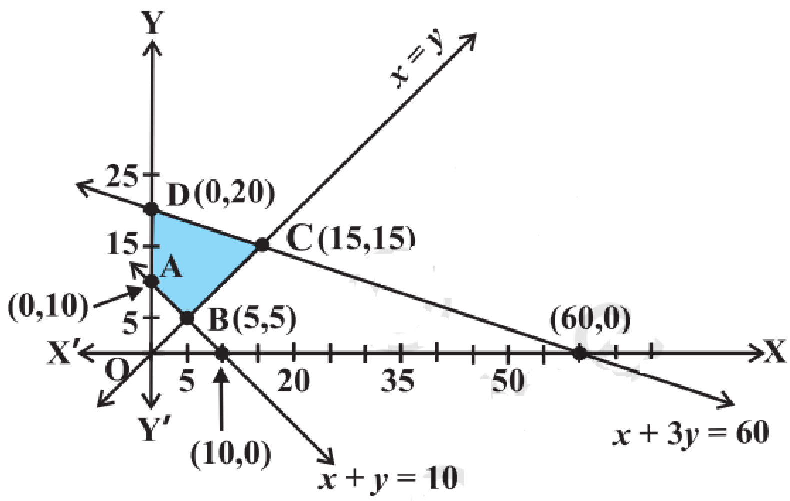
On correct graph of the system of linear inequalities
On correct corner points A, B, C and D are (0, 10), (5, 5), (15,15) and (0, 20)



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Corner Point	Corresponding value of Z = 3**x** + 9**y**	
A (0, 10)	90	
B (5, 5)	60 (Minimum)	
C (15, 15)	180 (Maximum)	**(Multiple optimal solutions)**
D (0, 20)	180 (Maximum)	

1

Minimum value of Z is 60 at the point B (5, 5) of the feasible region.
The maximum value of Z on the feasible region occurs at the two corner points C (15, 15) and D (0, 20) and it is 180 in each case.

31.(a)

Since the event of raining today and not raining today are complementary events so if the probability that it rains today is 0.4 then the probability that it does not rain today is **1- 0.4 = 0.6** $\Rightarrow \boldsymbol{P_1 = 0.6}$

If it rains today, the probability that it will rain tomorrow is 0.8 then the probability that it will not rain tomorrow is . **1- 0.8 = 0.2** $\Rightarrow \boldsymbol{P_2 = 0.2}$

If it does not rain today, the probability that it will rain tomorrow is 0.7 $\Rightarrow \boldsymbol{P_3 = 0.7}$ then the probability that it will not rain tomorrow is **1 - 0.7 = 0.3** $\Rightarrow \boldsymbol{P_4 = 0.3}$ 1

(i) $\boldsymbol{P_1 \times P_4 - P_2 \times P_3 = 0.6 \times 0.3 - 0.2 \times 0.7 = 0.04.}$ 1

(ii) Let $\boldsymbol{E_1}$ and $\boldsymbol{E_2}$ be the events that it will rain today and it will not rain today respectively.

$\boldsymbol{P(E_1) = 0.4}$ **&** $\boldsymbol{P(E_2) = 0.6}$

$\boldsymbol{A}$ be the event that it will rain tomorrow. $P\left(\frac{A}{E_1}\right) = 0.8$ & $P\left(\frac{A}{E_2}\right) = 0.7$

We have, $P(A) = P(E_1)P\left(\frac{A}{E_1}\right) + P(E_2)P\left(\frac{A}{E_2}\right) = 0.4 \times 0.8 + 0.6 \times 0.7 = 0.74.$ 1

The probability of rain tomorrow is **0.74**.

OR

31.(b) Let S denote the success (getting a '6') and F denote the failure (not getting a '6').

Thus, P(S) = $\frac{1}{6}$ and P(F) = $\frac{5}{6}$ ½

P(A wins in the first throw) = P(S) = $\frac{1}{6}$ ½

A gets the third throw, when the first throw by A and second throw by B result into failures.

Therefore, P(A wins in the 3rd throw) = P(FFS) = P(F)P(F)P(S) = $\frac{5}{6} \times \frac{5}{6} \times \frac{1}{6} = (\frac{5}{6})^2 \times \frac{1}{6}$ ½

P(A wins in the 5th throw) = P (FFFFS) = $(\frac{5}{6})^4 \times \frac{1}{6}$ and so on.

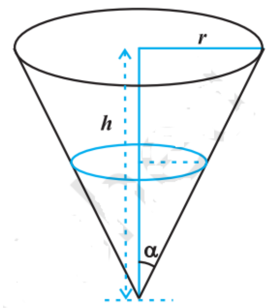
Hence, P(A wins) = $\frac{1}{6} + (\frac{5}{6})^2 \times \frac{1}{6} + (\frac{5}{6})^4 \times \frac{1}{6} + \ldots\ldots\ldots\ldots\ldots$ ½

$= \frac{\frac{1}{6}}{1 - \frac{25}{36}} = \frac{6}{11}$

P(B wins) = 1 – P (A wins) = $\frac{5}{11}$ 1

SECTION D

(Long answer type questions (LA) of 5 marks each)

32.	$A = \begin{bmatrix} -4 & 4 & 4 \\ -7 & 1 & 3 \\ 5 & -3 & -1 \end{bmatrix}$, B= $\begin{bmatrix} 1 & -1 & 1 \\ 1 & -2 & -2 \\ 2 & 1 & 3 \end{bmatrix}$ Then the product AB is $AB = 8\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} = 8I$ $\Longrightarrow B^{-1} = \frac{1}{8}A$ $\Longrightarrow B^{-1} = \frac{1}{8}\begin{bmatrix} -4 & 4 & 4 \\ -7 & 1 & 3 \\ 5 & -3 & -1 \end{bmatrix}$ Write equations in matrix form such a way that coff. Matrix = B and $C = \begin{bmatrix} 4 \\ 9 \\ 1 \end{bmatrix}$ Solving the equation $X = B^{-1}C$, we get $x = 3, y = -2, z = -1$	1 1/2 1/2 1 2
33.(a)	Let r, h and $\propto$ be as in Fig. Then $\tan\propto = \frac{r}{h}$  *Given* $\tan\propto = 0.5$ so $\frac{r}{h} = 0.5$ $\Longrightarrow r = \frac{h}{2}$ Let V be the volume of the cone. Then $V = \frac{1}{3}\pi r^2 h = \frac{\pi h^3}{12}$ Therefore $\frac{dV}{dt} = \frac{\pi h^2}{4}\frac{dh}{dt}$ $Given\ \frac{dV}{dt} = 5\ m^3/h\ \ and\ h = 4\ so\ \frac{dh}{dt} = \frac{5}{4\pi}\ or\ \frac{35}{88}\ m/h$ *OR*	1 1/2 1/2 1 2
33.(b)	$f(x) = \sin x + \cos x$, so $f'(x) = \cos x - \sin x$ Now $f'(x) = 0$ gives $\sin x = \cos x$ which gives that $x = \frac{\pi}{4}, \frac{5\pi}{4}$ $as\ 0 \le x \le 2\pi$ The points $x = \frac{\pi}{4}, \frac{5\pi}{4}$ divide the interval $[0, 2\pi]$ into three disjoint intervals namely $[0, \frac{\pi}{4})$, $(\frac{\pi}{4}, \frac{5\pi}{4})$, $(\frac{5\pi}{4}, 2\pi]$ $f'(x) > 0$ if $x \in [0, \frac{\pi}{4}) \cup (\frac{5\pi}{4}, 2\pi]$ so $f(x) = \sin x + \cos x$ is strictly increasing in $[0, \frac{\pi}{4}) \cup (\frac{5\pi}{4}, 2\pi]$ $f'(x) < 0$ if $x \in (\frac{\pi}{4}, \frac{5\pi}{4})$ so $f(x) = \sin x + \cos x$ is strictly decreasing in $(\frac{\pi}{4}, \frac{5\pi}{4})$	1/2 1 1 1+1/2 1

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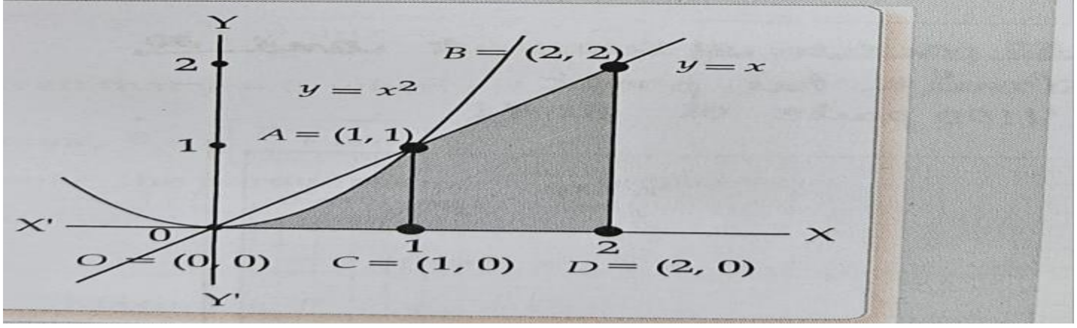
Parabola $y = x^2$ and line $y = x$ intersect at (0, 0) and (1, 1). 1

Correct Figure 1

Required Area $= \int_0^1 x^2 dx + \int_1^2 x\, dx$ 1

$= \left[\frac{x^3}{3}\right]_0^1 + \left[\frac{x^2}{2}\right]_1^2$ 1

$= \frac{1}{3} + \frac{3}{2} = \frac{11}{6}$ sq. units 1



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<td>35.(a)</td>
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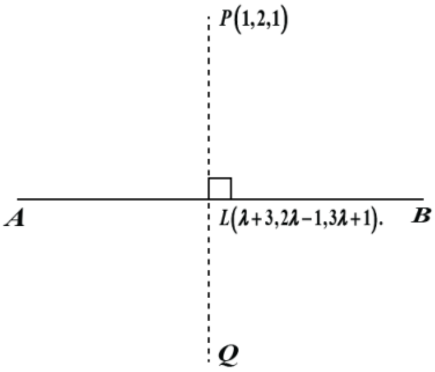

Let $\boldsymbol{P(1, 2, 1)}$ be the given point and $\boldsymbol{L}$ be the foot of the perpendicular from $\boldsymbol{P}$ to the given line $\boldsymbol{AB}$ $(as\ shown\ in\ the\ figure\ above)$.

Let's put $\frac{x-3}{1} = \frac{y+1}{2} = \frac{z-1}{3} = \lambda$. Then, $x = \lambda+3, y = 2\lambda-1, z = 3\lambda+1$

Let the coordinates of the point $\boldsymbol{L}$ be $\boldsymbol{(\lambda+3, 2\lambda-1, 3\lambda+1)}$.

So, direction ratios of $\boldsymbol{PL}$ are$(\lambda + 3 - 1, 2\lambda - 1 - 2, 3\lambda + 1 - 1) i.e., (\lambda + 2, 2\lambda - 3, 3\lambda)$

Direction ratios of the given line are **1, 2 and 3,** which is perpendicular to $\boldsymbol{PL}$. Therefore, we have,

$$(\lambda + 2).1 + (2\lambda - 3).2 + 3\lambda.3 = 0 \Rightarrow 14\lambda = 4 \Rightarrow \lambda = \frac{2}{7}$$

Then, $\lambda + 3 = \frac{2}{7} + 3 = \frac{23}{7};\ 2\lambda - 1 = 2\left(\frac{2}{7}\right) - 1 = -\frac{3}{7};\ \ 3\lambda + 1 = 3\left(\frac{2}{7}\right) + 1 = \frac{13}{7}$

Therefore, coordinates of the point $\boldsymbol{L}$ are $\left(\frac{23}{7}, -\frac{3}{7}, \frac{13}{7}\right)$.

Let $Q(x_1, y_1, z_1)$be the image of $\boldsymbol{P(1, 2, 1)}$ with respect to the given line. Then, $\boldsymbol{L}$ is the mid-point of $\boldsymbol{PQ}$.

Therefore, $\frac{1+x_1}{2} = \frac{23}{7}, \frac{2+y_1}{2} = -\frac{3}{7}, \frac{1+z_1}{2} = \frac{13}{7} \Rightarrow x_1 = \frac{39}{7}, y_1 = -\frac{20}{7}, z_1 = \frac{19}{7}$

Hence, the image of the point $\boldsymbol{P(1,2,1)}$ with respect to the given line $Q\left(\frac{39}{7}, -\frac{20}{7}, \frac{19}{7}\right)$.

The equation of the line joining $\boldsymbol{P(1,2,1)}$ and $Q\left(\frac{39}{7}, -\frac{20}{7}, \frac{19}{7}\right)$is

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1/2
½</td>
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	$\frac{x-1}{32/7} = \frac{y-2}{-34/7} = \frac{z-1}{12/7} \Rightarrow \frac{x-1}{16} = \frac{y-2}{-17} = \frac{z-1}{6}$. OR	1
35.(b)	The given equation of line can be written as $\vec{r} = \hat{\imath} + (-2)j + (3)\hat{k} + t(-\hat{\imath} + j + (-2)\hat{k})$ and $\vec{r} = \hat{\imath} + (-1)j - \hat{k}$ + s($\hat{\imath} + (2)j - (2)\hat{k}$) So $\overrightarrow{a_1} = \hat{\imath} + (-2)j + (3)\hat{k}$, $\overrightarrow{a_2} = \hat{\imath} + (-1)j - \hat{k}$ $\overrightarrow{b_1} = -\hat{\imath} + j + (-2)\hat{k}$, $\overrightarrow{b_2} = \hat{\imath} + (2)j - (2)\hat{k}$ $\overrightarrow{b_1} \times \overrightarrow{b_2} = 2\hat{\imath} - 4j - 3\hat{k}$ $\overrightarrow{a_2} - \overrightarrow{a_1} = j - 4\hat{k}$ SD = $\frac{8}{\sqrt{29}}$ So the given lines does not intersect to each other	1/2 1/2 1 1 1/2 1 1/2

SECTION E

(Case Studies/Passage based questions of 4 Marks each)

36.	**(i)** **Number of relations is equal to the number of subsets of the set** $B \times G = 2^{n(B\times G)}$ $= 2^{n(B)\times n(G)} = 2^{3\times 2} = 2^6$ ($\boldsymbol{Where n(A)\ denotes\ the\ number\ of\ the\ elements\ in\ the\ finite\ set\ A}$) **(ii)** **Smallest Equivalence relation on G is** $\{(g_1, g_1), (g_2, g_2)\}$ **(iii)** (a) (A) reflexive but not symmetric = $\{(b_1, b_2), (b_2, b_1), (b_1, b_1), (b_2, b_2), (b_3, b_3), (b_2, b_3)\}$. **So the minimum number of elements to be added are** $(b_1, b_1), (b_2, b_2), (b_3, b_3), (b_2, b_3)$ {Note : it can be any one of the pair from**,** (b_3, b_2), (b_1, b_3), (b_3, b_1) **in place of** (b_2, b_3) ***also***} (B) reflexive and symmetric but not transitive = $\{(b_1, b_2), (b_2, b_1), (b_1, b_1), (b_2, b_2), (b_3, b_3), (b_2, b_3), (b_3, b_2)\}$. **So the minimum number of elements to be added are** $(b_1, b_1), (b_2, b_2), (b_3, b_3), (b_2, b_3), (b_3, b_2)$ OR	1 1 1 1

	One-one and onto function $x^2 = 4y$. let $y = f(x) = \frac{x^2}{4}$ Let $x_1, x_2 \in [0, 20\sqrt{2}]$ such that $f(x_1) = f(x_2) \Rightarrow \frac{{x_1}^2}{4} = \frac{{x_1}^2}{4}$ $\Rightarrow {x_1}^2 = {x_2}^2 \Rightarrow (x_1 - x_2)(x_1 + x_2) = 0 \Rightarrow x_1 = x_2$ as $x_1, x_2 \in [0, 20\sqrt{2}]$ $\therefore$ f is one-one function Now, $0 \le y \le 200$ hence the value of y is non-negative and $f(2\sqrt{y}) = y$ $\therefore$ for any arbitrary $y \in [0, 200]$, the pre-image of y exists in $[0, 20\sqrt{2}]$ hence f is onto function.	½ ½ 1
37.	(i) Let E denote the event that the person selected is actually having HIV and A the event that the person's HIV test is diagnosed as +ive. We need to find P(A|E). P(A|E) = P(Person tested as HIV+ive given that he/she is actually having HIV) = 90% = 90 /100 = 0.9 (ii)(a) We need to find P(E|A). Also F denotes the event that the person selected is actually not having HIV Then P(E) = 0.001, P(F) = 1 – P(E) = 0.999, P(A|E) = P(Person tested as HIV+ive given that he/she is actually having HIV) = 90% = 90 /100 = 0.9 P(A|F) = P(Person tested as HIV +ive given that he/she is actually not having HIV) = 1% = 0.01 Now, by Bayes' theorem $P(E\|A) = \frac{P(E)P(A\|E)}{P(E)P(A\|E) + P(F)P(A\|F)}$ $= \frac{90}{1089}$ = 0.083 approx.	2 1 1

38.	(i) Let length of the side of square base be x cm and height of the box be y cm ∴ volume of box, $V = x^2 y = 1024$ (ii) Let C denotes the cost of the box $C = 2x^2 \times 5 + 4xy \times 2.5$ $\Rightarrow C(x) = 10x^2 + \frac{10240}{x}$ (iii)(a) On differentiating both sides w.r.t. x we get $C'(x) = 20x - \frac{10240}{x^2}$ $C''(x) = 20 + \frac{20480}{x^3}$ Now, $C'(x) = 0 \Rightarrow x = 8$ As, $C''(8) > 0$. So, at x= 8 the function has minimum value. For x=8 cost is minimum and the corresponding least cost of the box is: $C(8) = 10 \times 64 + \frac{10240}{8} = 1920$ ∴ least cost =Rs 1920 OR (iii)(b) Dimensions of required box are $8(2^{1/3})$cm, $8(2^{1/3})$cm and $8(2^{1/3})$cm.	1 1 1 1 2