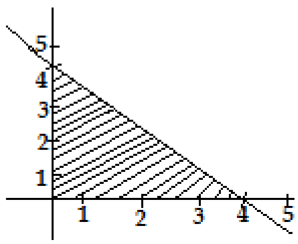
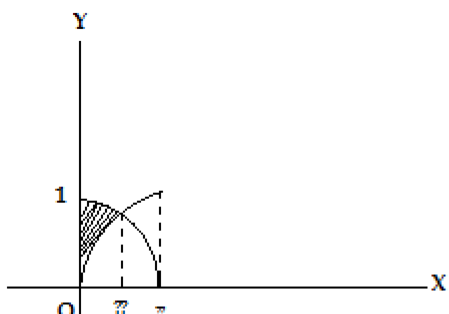
SAMPLE QUESTION PAPER
CLASS-XII (2016-17)
MATHEMATICS (041)
Marking Scheme

1.	$\tan^{-1}\left(\tan\frac{2\pi}{3}\right) = \tan^{-1}\left(-\tan\frac{\pi}{3}\right) = -\frac{\pi}{3}$	1
2.	$\lvert 3AB \rvert = 3^3 \lvert A \rvert \lvert B \rvert = 27 \times 2 \times 3 = 162$	1
3.	Distance of the point (p, q, r) from the x-axis = Distance of the point (p, q, r) from the point (p,0,0) $= \sqrt{q^2 + r^2}$	1
4.	$gof(x) = g\{f(x)\} = g(3x^2 - 5) = \frac{3x^2-5}{(3x^2-5)^2+1} = \frac{3x^2-5}{9x^4 - 30x^2 + 26}$	1
5.	Equivalence relations could be the following: { (1,1), (2,2), (3,3), (1,2), (2,1)} and (1) { (1,1), (2,2), (3,3), (1,2), (1,3), (2,1), (2,3), (3,1), (3,2)} (1) So, only two equivalence relations.(Ans.)	2
6.	$AA' = \begin{bmatrix} l_1 & m_1 & n_1 \\ l_2 & m_2 & n_2 \\ l_3 & m_3 & n_3 \end{bmatrix} \begin{bmatrix} l_1 & l_2 & l_3 \\ m_1 & m_2 & m_3 \\ n_1 & n_2 & n_3 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} = I_3$ ⟶ (1) because $l_i^2 + m_i^2 + n_i^2 = 1$, for each i = 1, 2, 3 ⟶ $^1/_2$ $l_i l_j + m_i m_j + n_i n_j = 0$ (i ≠j) for each i, j = 1, 2, 3 ⟶ $^1/_2$	2
7.	On differentiating $e^y(x + 1) = 1$ w.r.t. x, we get $e^y + (x + 1)e^y\frac{dy}{dx} = 0$ ⟶ (1) $\Rightarrow e^y + \frac{dy}{dx} = 0$ $\Rightarrow \frac{dy}{dx} = -e^y$ ⟶ (1)	2
8.	Here, $\left\{\frac{d^2y}{dx^2} + (1 + x)\right\}^3 = -\frac{dy}{dx}$ ⟶ (1) Thus, order is 2 and degree is 3. So, the sum is 5 ⟶ (1)	2
9.	Here, $\frac{x+3}{3} = \frac{y-4}{5} = \frac{8-z}{-6}$ is same as $\frac{x+3}{3} = \frac{y-4}{5} = \frac{z-8}{6}$ Cartesian equation of the line is $\frac{x+2}{3} = \frac{y-4}{5} = \frac{z+5}{6}$ ⟶ (1) Vector equation of the line is $\vec{r} = (-2\hat{\imath} + 4\hat{\jmath} - 5\hat{k}) + \lambda(3\hat{\imath} + 5\hat{\jmath} + 6\hat{k})$ ⟶ (1)	2

10.	The feasible region is a triangle with vertices O(0,0), A(4,0) and B(0,4) $Z_o = 3\times0 + 4\times0 = 0$ $Z_A = 3\times4 + 4\times0 = 12$ $Z_B = 3\times0 + 4\times4 = 16$ ⟶ (1) Thus, maximum of Z is at B(0,4) and the maximum value is 16 ⟶ $^1/_2$  ⟶ $^1/_2$	2
11.	Sample space = { B_1B_2, B_1G_2, G_1B_2, G_1G_2} , B_1 and G_1 are the older boy and girl respectively. Let E_1 = both the children are boys; E_2 = one of the children is a boy ; E_3 = the older child is a boy Then, (i) $P(E_1/E_2) = P\left(\frac{E_1 \cap E_2}{E_2}\right) = \frac{1/4}{3/4} = \frac{1}{3}$ ⟶ (1) (ii) $P(E_1/E_3) = P\left(\frac{E_1 \cap E_3}{E_3}\right) = \frac{1/4}{2/4} = \frac{1}{2}$ ⟶ (1)	2
12.	Here, Area(A) = $\frac{\sqrt{3}}{4}x^2$, where 'x' is the side of the equilateral triangle ⟶ $^1/_2$ So. $\frac{dA}{dt} = \frac{\sqrt{3}}{2} \times \frac{dx}{dt}$ ⟶ (1) $= \frac{\sqrt{3}}{2}(10)(2) = 10\sqrt{3}\ cm^2/sec$ ⟶ $^1/_2$	2
13.	As A + B + C = π, $\begin{vmatrix} \sin(A+B+C) & \sin B & \cos C \\ -\sin B & 0 & \tan A \\ \cos(A+B) & -\tan A & 0 \end{vmatrix} = \begin{vmatrix} 0 & \sin B & \cos C \\ -\sin B & 0 & \tan A \\ -\cos C & -\tan A & 0 \end{vmatrix}$ ⟶ (2) $= 0 \times \begin{vmatrix} 0 & \tan A \\ -\tan A & 0 \end{vmatrix} - \sin B \times \begin{vmatrix} -\sin B & \tan A \\ -\cos C & 0 \end{vmatrix} + \cos C \times \begin{vmatrix} -\sin B & 0 \\ -\cos C & -\tan A \end{vmatrix}$ = 0 – sin B tan A cos C + cos C sin B tan A = 0 (Ans.) ⟶ (2) **OR**	4

	Let $\Delta = \begin{vmatrix} b+c & a-b & a \\ c+a & b-c & b \\ a+b & c-a & c \end{vmatrix}$ Applying $C_1 \rightarrow C_1 + C_3$, we get $\Delta = (a+b+c)\begin{vmatrix} 1 & a-b & a \\ 1 & b-c & b \\ 1 & c-a & c \end{vmatrix}$ ⟶ **(1)** Applying $R_2 \rightarrow R_2 - R_1$, and $R_3 \rightarrow R_3 - R_1$, we get $\Delta = (a+b+c)\begin{vmatrix} 1 & a-b & a \\ 0 & 2b-a-c & b-a \\ 0 & 2a+b+c & c-a \end{vmatrix}$ ⟶ **(1)** Expanding Δ along first column, we have the result ⟶ (2)	4
14.	Since Rolle's theorem holds true, f(1) = f(3) i.e., $(1)^3 - 6(1)^2 + a(1) + b = (3)^3 - 6(3)^2 + a(3) + b$ i.e., a + b + 22 = 3a + b $\Longrightarrow$ a = 11 ⟶ (2) Also, $f'(x) = 3x^2 - 12x + a$ or $3x^2 - 12x + 11$ As $f'(c) = 0$, we have $3\left(2 + \frac{1}{\sqrt{3}}\right)^2 - 12\left(2 + \frac{1}{\sqrt{3}}\right) + 11 = 0$ As it is independent of b, b is arbitrary. ⟶ (2)	4
15.	Here, $f'(x) = 3x^2 - 3x^{-4} = \frac{3(x^6 - 1)}{x^4}$ ⟶ (1) $= \frac{3(x^4 + x^2 + 1)}{x^4}(x+1)(x-1)$ Critical points are – 1 and 1 ⟶ (1) $\Longrightarrow$ $f'(x) > 0$ if $x > 1$ or $x < -1$; and $f'(x) < 0$ if $-1 < x < 1$ $\{\because \frac{3(x^4 + x^2 + 1)}{x^4}$ always + ive$\}$ Hence, f(x) is strictly increasing for x > 1 ⟶ (1) or x < – 1; and strictly decreasing for (-1,0)u(0,1) [1] ⟶ (1) **OR** Here, $\frac{dy}{dx} = 3x^2 - 11$ ⟶ $^1/_2$ So, slope of the tangent is $3x^2 - 11$	4 4

	Slope of the given tangent line is 1. Thus, $3x^2 - 11 = 1$ ⟶ (1) that gives x = ± 2 When x = 2, y = 2 − 11 = -9 When x = − 2, y = $-2 - 11 = -13$ Out of the two points (2, − 9) and (–2, –13) ⟶ (2) only the point (2, − 9) lies on the curve Thus, the required point is (2, –9) ⟶ $^1/_2$	
16.	Here, f(x) = $x^2 + 3$, a = 0 , b = 2 and nh = b − a = 2 ⟶ (1) $\int_0^2 (x^2 + 1)$ dx = $\lim_{h \to 0} h[\, f(a) + f(a+h) + f(a+2h) + \ldots.. + f(a + \overline{n-1}\, h)]$ ⟶ (1) $= \lim_{h \to 0} h[\, 3 + 1^2h^2 + 3 + 2^2h^2 + 3 + \cdots \ldots + (n-1)^2h^2 + 3]$ $= \lim_{h \to 0} h[\, 3n + h^2 \{1^2 + 2^2 + 3^2 + \cdots \ldots (n-1)^2\}]$ $= \lim_{h \to 0}[\, 3nh + h^3 \{\frac{(n-1)n\,(2n-1)}{6}\}]$ $= \lim_{h \to 0}[\, 3nh + \{\frac{(nh-h)nh\,(2nh-h)}{6}\}]$ ⟶ (1) $= \lim_{h \to 0}[\, 3 \times 2 + \{\frac{(2-h)2\,(4-h)}{6}\}]$ $= 6 + \frac{16}{6}$,i.e., $\frac{26}{3}$ ⟶ **(1)**	4
17.	The rough sketch of the bounded region is shown on the right. ⟶ (1) Required area = $\int_0^{\pi/4} \cos x \, dx - \int_0^{\pi/4} \sin x \, dx$ ⟶ (1) $= (\sin x + \cos x)\Big]_0^{\pi/4}$ ⟶ (1) $= \sin\frac{\pi}{4} + \cos\frac{\pi}{4} - \sin 0 - \cos 0$ $= \frac{2}{\sqrt{2}} - 1$, i.e, $(\sqrt{2} - 1)$ sq units ⟶ (1)  Fig	4
18.	y = ax + $\frac{b}{a}$ .... (**1**) gives $\frac{dy}{dx}$ = a ⟶ $\left(1\frac{1}{2}\right)$ Substituting this value of 'a' in (1), we get	4

	$y = x\frac{dy}{dx} + \frac{b}{\frac{dy}{dx}}$ $\longrightarrow$ $\left(1\frac{1}{2}\right)$ **Thus, $y = ax + \frac{b}{a}$ is a solution of the following differential equation $y = x\frac{dy}{dx} + \frac{b}{\frac{dy}{dx}}$.** $\longrightarrow$ **1** **OR** Given differential equation can be written as $\frac{dy}{dx} = \frac{1+xy+\cos\left(\frac{y}{x}\right)}{x^2} = \frac{y}{x} + [\frac{1+\cos\left(\frac{y}{x}\right)}{x^2}]$ ......(1) Let F(x,y) = $\frac{y}{x} + [\frac{1+\cos\left(\frac{y}{x}\right)}{x^2}]$. Then F(λx, λy) = $\frac{\lambda y}{\lambda x} + [\frac{1+\cos\left(\frac{\lambda y}{\lambda x}\right)}{(\lambda x)^2}]$ $= \frac{y}{x} + [\frac{1+\cos\left(\frac{y}{x}\right)}{\lambda^2 x^2}] \neq F(x,y)$ Hence, the given D.E. is not a homogeneous equation. $\longrightarrow$ (1) Putting y = vx and $\frac{dy}{dx} = v + x\frac{dv}{dx}$ in (1), we get $v + x\frac{dv}{dx} = v + \frac{1+\cos v}{x^2}$ $\Rightarrow \frac{dv}{1+\cos v} = \frac{1}{x^3}dx$ $\Rightarrow \boldsymbol{sec^2}\left(\frac{v}{2}\right)dv = \frac{2}{x^3}dx$ $\longrightarrow$ (1) Integrating both sides, we get $2\tan\frac{v}{2} = -\frac{1}{x^2} + C$ $\longrightarrow$ $1\frac{1}{2}$ or $2\tan\frac{y}{2x} = -\frac{1}{x^2} + C$ $\longrightarrow$ $\frac{1}{2}$	4
19.	Since the vector $\vec{p}$, $\vec{q}$ and $\vec{r}$ are coplanar $\therefore [\vec{p}, \vec{q}, \vec{r}] = 0$ $[\vec{p} \quad \vec{q} \quad \vec{r}] = 0$ $\longrightarrow$ (1) i.e., $\begin{vmatrix} a & 1 & 1 \\ 1 & b & 1 \\ 1 & 1 & c \end{vmatrix} = 0$ $R_2 \rightarrow R_2 - R_1$ $R_3 \rightarrow R_3 - R_1$ $\longrightarrow$ (1) or $\begin{vmatrix} a & 1 & 1 \\ 1-a & b-1 & 0 \\ 1-a & 0 & c-1 \end{vmatrix} = 0$	4

	$\Rightarrow$ a(b -1)(c-1) -1 (1-a)(c -1) - 1(1-a)(b – 1) = 0 i.e., a(1 - b)(1- c) + (1-a)(1 - c) + (1- a)(1 – b) = 0 $\longrightarrow$ (1) Dividing both the sides by (1-a)(1 - b)(1- c), we get $\frac{a}{1-a} + \frac{1}{1-b} + \frac{1}{1-c} = 0$ i.e., $-\left(1 - \frac{1}{1-a}\right) + \frac{1}{1-b} + \frac{1}{1-c} = 0$ i.e., $\frac{1}{1-a} + \frac{1}{1-b} + \frac{1}{1-c} = 1$ $\longrightarrow$ (1)	
20.	We know that the equation of the plane having intercepts a, b and c on the three coordinate axes is $\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1$ $\longrightarrow$ (1) Here, the coordinates of A, B and C are (a,0,0), (0,b,0) and (0,0,c) respectively. The centroid of Δ ABC is ($\frac{a}{3}, \frac{b}{3}, \frac{c}{3}$). $\longrightarrow$ (1) Equating ($\frac{a}{3}, \frac{b}{3}, \frac{c}{3}$) to (α, β,γ), we get a = 3α, b = 3β and c = 3γ $\longrightarrow$ (1) Thus, the equation of the plane is $\frac{x}{3\alpha} + \frac{y}{3\beta} + \frac{z}{3\gamma} = 1$ or $\frac{x}{\alpha} + \frac{y}{\beta} + \frac{z}{\gamma} = 3$ $\longrightarrow$ **(1)**	4
21.	Let the distance covered with speed of 25 km/h = x km and the distance covered with speed of 40 km/h = y km (½) Total distance covered = z km The L.P.P. of the above problem, therefore, is $\longrightarrow$ (1) Maximize z = x + y subject to constraints 4x + 5y ≤ 200 $\longrightarrow$ (1) $\frac{x}{25} + \frac{y}{40} \leq 1$ $x \geq 0, y \geq 0$ **(1)** Any one value $\longrightarrow$ (½)	4
22.	Here, X 0 1 2 P(X) k 2k 3k (i) Since P(0) + P(1) + P(2)= 1, we have	4

	$k + 2k + 3k = 1$ i.e., $6k = 1$, or $k = \frac{1}{6}$ ⟶ (1) (ii) $P(X<2) = P(0) + P(1) = k + 2k = 3k = \frac{1}{2}$; ⟶ (1) (iii) $P(X \leq 2) = P(0) + P(1) + P(2) = k + 2k + 3k = 6k = 1$ ⟶ (1) (iv) $P(X \geq 2) = P(2) = 3k = \frac{1}{2}$ ⟶ (1)	
23.	Let the events be described as follows: E_1 : a coin having head on both sides is selected. E_2 : a fair coin is selected. A : head comes up in tossing a selected coin $P(E_1) = \frac{n}{2n+1}$; $P(E_2) = \frac{n+1}{2n+1}$; $P(A/E_1) = 1$; $P(A/E_2) = \frac{1}{2}$ ⟶ (2) It is given that $P(A) = \frac{31}{42}$. So, $P(E_1)P(A/E_1) + P(E_2)P(A/E_2) = \frac{31}{42}$ $\Rightarrow \frac{n}{2n+1} \times 1 + \frac{n+1}{2n+1} \times \frac{1}{2} = \frac{31}{42}$ ⟶ (1) $\Rightarrow \frac{1}{2n+1}[n + \frac{n+1}{2}] = \frac{31}{42}$ $\Rightarrow 42(3n+1) = 62(2n+1)$ $\Rightarrow 2n = 20,\ or\ n = 10$ ⟶ (1)	4
24.	$I = \int_0^{\pi} \frac{x}{1+\sin x} dx = \int_0^{\pi} \frac{\pi - x}{1+\sin(\pi - x)} dx$ (1) $= \pi \int_0^{\pi} \frac{1}{1+\sin x} dx - \int_0^{\pi} \frac{x}{1+\sin x} dx$ $\Rightarrow 2I = \pi \int_0^{\pi} \frac{1}{1+\sin x} dx$ (1) $\Rightarrow \frac{\pi}{2} \int_0^{\pi} \frac{1}{1+\cos(\frac{\pi}{2} - x)} dx$ $\Rightarrow \frac{\pi}{2} \int_0^{\pi} \frac{1}{2\cos^2(\frac{\pi}{4} - \frac{x}{2})} dx$ $\Rightarrow \frac{\pi}{4} \int_0^{\pi} sec^2(\frac{\pi}{4} - \frac{x}{2}) dx$ (1) $\Rightarrow I = \frac{\pi}{4} [-2\tan[(\frac{\pi}{4} - \frac{x}{2})]_0^{\pi}$ (2) $\Rightarrow I = \frac{\pi}{4}[2 - (-2)] = \pi$ (1) **OR**	6

	Let I = $\int \frac{\sin x}{\sin^3 x+\cos^3 x}\,dx = \int \frac{\tan x \sec^2 x}{\tan^3 x+1}\,dx$ (½) On substituting tan x = t and $\sec^2 x\,dx = dt$, we get (1) **I =** $\int \frac{t}{t^3+1}\,dt = \int \frac{t}{(t+1)(t^2-t+1)}\,dt$ (½) $= -\frac{1}{3}\int \frac{1}{t+1}\,dt + \frac{1}{3}\int \frac{t+1}{t^2-t+1}\,dt$ $= -\frac{1}{3}\log\lvert t+1\rvert + \frac{1}{6}\int \frac{(2t-1)+3}{t^2-t+1}\,dt$ (1) $= -\frac{1}{3}\log\lvert t+1\rvert + \frac{1}{6}\int \frac{2t-1}{t^2-t+1}\,dt + \frac{1}{2}\int \frac{1}{t^2-t+1}\,dt$ $= -\frac{1}{3}\log\lvert t+1\rvert + \frac{1}{6}\log\lvert t^2-t+1\rvert + \frac{1}{2}\int \frac{1}{\left(t-\frac{1}{2}\right)^2+\left(\frac{\sqrt{3}}{2}\right)^2}\,dt$ $= -\frac{1}{3}\log\lvert t+1\rvert + \frac{1}{6}\log\lvert t^2-t+1\rvert + \frac{1}{\sqrt{3}}\tan^{-1}\left(\frac{2t-1}{\sqrt{3}}\right)$ (2) $= -\frac{1}{3}\log\lvert \tan x+1\rvert + \frac{1}{6}\log\lvert \tan^2 x-\tan x+1\rvert + \frac{1}{\sqrt{3}}\tan^{-1}\left(\frac{2\tan x-1}{\sqrt{3}}\right) + c$ (1)	6
25.	$\tan^{-1}\left(\frac{x+1}{x-1}\right) + \tan^{-1}\left(\frac{x-1}{x}\right) = -\tan^{-1} 7$ $\Rightarrow \tan^{-1}\left[\frac{\left(\frac{x+1}{x-1}\right)+\left(\frac{x-1}{x}\right)}{1-\left(\frac{x+1}{x-1}\right)\left(\frac{x-1}{x}\right)}\right] = -\tan^{-1} 7$, if $\left(\frac{x+1}{x-1}\right)\left(\frac{x-1}{x}\right) < 1$ .....(*) (2) $\Rightarrow \tan^{-1}\left[\frac{x(x+1)+(x-1)^2}{(x-1)x-(x+1)(x-1)}\right] = -\tan^{-1} 7$ $\Rightarrow \frac{(x^2+x)+(x^2+1-2x)}{(x^2-x)-(x^2-1)} = \tan\left[-\tan^{-1} 7\right]$ $\Rightarrow \frac{2x^2-x+1}{-x+1} = -7$ (1) $\Rightarrow 2x^2-8x+8 = 0$ $\Rightarrow (x-2)^2 = 0$ $\Rightarrow x = 2$ (1) Let us now verify whether x = 2 satisfies the condition (*) For x = 2, $\left(\frac{x+1}{x-1}\right)\left(\frac{x-1}{x}\right) = 3 \times \frac{1}{2} = \frac{3}{2}$ which is not less than 1 Hence, this value does not satisfy the condition (*) (1) i.e., there is no solution to the given trigonometric equation. (1) **OR** Given $*$ on $\mathbb{Q}$, defined by a$*$b = ab+1 Let, a$\in\mathbb{Q}$, b$\in\mathbb{Q}$ then ab$\in\mathbb{Q}$	6

	and (ab+1)∈Q ⇒ a∗b=ab+1 is defined on Q ∴ ∗ is a binary operation on Q (1) **Commutative**: a∗b = ab+1 b∗a = ba+1 =ab+1 (∵ ba = ab in Q) ⇒ a∗b =b∗a So ∗ is commutative on Q (1) **Associative**: (a∗b)∗c= (ab+1)∗c =(ab+1)c+1 = abc+c+1 a∗(b∗c)=a∗(bc+1) = a(bc+1)+1 = abc+a+1 ∴ (a∗b)∗c ≠ a∗(b∗c) So ∗ is not associative on ℚ (1) **Identity Element :** Let e ϵℚ be the identity element, then for every a ϵℚ a∗e=a and e∗a=a ae+1=a and ea+1=a ⇒ e= $\frac{a-1}{a}$ and e= $\frac{a-1}{a}$ (1) e is not unique as it depend on \`a' ,hence identity element does not exist for ∗ (1) **Inverse**: since there is no identity element hence, there is no inverse. (1)	6
26.	The relation A' = A^{-1} gives A'A = $A^{-1}A$ = I (1) Thus, $\begin{bmatrix}0 & x & x\\2y & y & -y\\z & -z & z\end{bmatrix}\begin{bmatrix}0 & 2y & z\\x & y & -z\\x & -y & z\end{bmatrix}=\begin{bmatrix}1 & 0 & 0\\0 & 1 & 0\\0 & 0 & 1\end{bmatrix}$ $\left(1\frac{1}{2}\right)$ $\Rightarrow \begin{bmatrix}0+x^2+x^2 & 0+xy-xy & 0-xz+xz\\0+xy-xy & 4y^2+y^2+y^2 & 2yz-yz-yz\\0-zx+zx & 2yz-yz-yz & z^2+z^2+z^2\end{bmatrix}=\begin{bmatrix}1 & 0 & 0\\0 & 1 & 0\\0 & 0 & 1\end{bmatrix}$ $\Rightarrow \begin{bmatrix}2x^2 & 0 & 0\\0 & 6y^2 & 0\\0 & 0 & 3z^2\end{bmatrix}=\begin{bmatrix}1 & 0 & 0\\0 & 1 & 0\\0 & 0 & 1\end{bmatrix}$ (2) $\Rightarrow\ 2x^2 = 1;\ 6y^2 = 1\ \text{ and }\ 3z^2 = 1$ $\Rightarrow\ x = \pm\frac{1}{\sqrt{2}};\quad y = \pm\frac{1}{\sqrt{6}};\quad z = \pm\frac{1}{\sqrt{3}}$ $\left(1\frac{1}{2}\right)$ **OR**	6

	Here, $\|A\| = \begin{vmatrix} 1 & -1 & 2 \\ 3 & 0 & -2 \\ 1 & 0 & 3 \end{vmatrix}$ = 1(0+0) +1(9+2) +2(0– 0) =11 (1) $\Rightarrow$ $\|A\|I = \begin{bmatrix} 11 & 0 & 0 \\ 0 & 11 & 0 \\ 0 & 0 & 11 \end{bmatrix}$ ....(1) (½) adj A = $\begin{bmatrix} 0 & 3 & 2 \\ -11 & 1 & 8 \\ 0 & -1 & 3 \end{bmatrix}$ (2) Now, A(adj A) = $\begin{bmatrix} 1 & -1 & 2 \\ 3 & 0 & -2 \\ 1 & 0 & 3 \end{bmatrix}\begin{bmatrix} 0 & 3 & 2 \\ -11 & 1 & 8 \\ 0 & -1 & 3 \end{bmatrix} = \begin{bmatrix} 11 & 0 & 0 \\ 0 & 11 & 0 \\ 0 & 0 & 11 \end{bmatrix}$ (1) and (adj A)A = $\begin{bmatrix} 0 & 3 & 2 \\ -11 & 1 & 8 \\ 0 & -1 & 3 \end{bmatrix}\begin{bmatrix} 1 & -1 & 2 \\ 3 & 0 & -2 \\ 1 & 0 & 3 \end{bmatrix} = \begin{bmatrix} 11 & 0 & 0 \\ 0 & 11 & 0 \\ 0 & 0 & 11 \end{bmatrix}$ (1) Thus, it is verified that A(adj A) = (adj A)A = $\|A\|I$ (½)		6
27.	Putting x = cos 2θ in $\left\{2\tan^{-1}\sqrt{\frac{1-x}{1+x}}\right\}$, we get (1) $2\tan^{-1}\sqrt{\frac{1-\cos 2\theta}{1+\cos 2\theta}}$ i.e., $2\tan^{-1}\sqrt{\frac{2\sin^2\theta}{2\cos^2\theta}} = 2\tan^{-1}(\tan\theta) = 2\theta = \cos^{-1}x$ (2) Hence, $y = e^{\sin^2 x}\cos^{-1}x$ $\Rightarrow \log y = \sin^2 x + \log(\cos^{-1}x)$ $\Rightarrow \frac{1}{y}\times\frac{dy}{dx} = 2\sin x\cos x + \frac{1}{\cos^{-1}x}\times\frac{-1}{\sqrt{1-x^2}} = \sin 2x - \frac{1}{\cos^{-1}x\sqrt{1-x^2}}$ (2) $\Rightarrow \frac{dy}{dx} = e^{\sin^2 x}\cos^{-1}x\left[\sin 2x - \frac{1}{\cos^{-1}x\sqrt{1-x^2}}\right]$ (1)		6
28.	Let (t^2, t) be any point on the curve $y^2 = x$. Its distance (S) from the line x – y + 1 = 0 is given by $1/2$ $S = \left\|\frac{t-t^2-1}{\sqrt{1+1}}\right\|$ $1/2$ $= \frac{t^2-t+1}{\sqrt{2}}$ $\{\because t^2 - t + 1 = \left(t-\frac{1}{2}\right)^2 + \frac{3}{4} > 0\}$ (1) $\Rightarrow \frac{dS}{dt} = \frac{1}{\sqrt{2}}(2t-1)$ (1) and $\frac{d^2S}{dt^2} = \sqrt{2} > 0$ (1) Now, $\frac{dS}{dt} = 0 \Rightarrow \frac{1}{\sqrt{2}}(2t-1) = 0$,i.e., $t = \frac{1}{2}$ (1) Thus, S is minimum at $t = \frac{1}{2}$		6

So, the required shortest distance is $\frac{(\frac{1}{2})^2-(\frac{1}{2})+1}{\sqrt{2}} = \frac{3}{4\sqrt{2}}$, or $\frac{3\sqrt{2}}{8}$ (1)

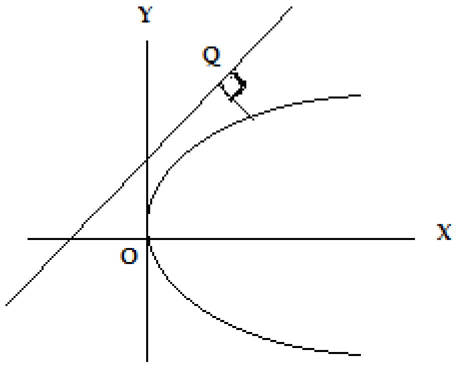


Fig. 1

29. 1) the line which are neither intersecting nor parallel. (1)

2) The given equations are

$\vec{r} = 8\hat{\imath} - 9\hat{\jmath} + 10\hat{k} + \mu(3\hat{\imath} - 16\hat{\jmath} + 7\hat{k})$ ....(1) (½)

$\vec{r} = 15\hat{\imath} + 29\hat{\jmath} + 5\hat{k} + \mu(3\hat{\imath} + 8\hat{\jmath} - 5\hat{k})$ ....(2)

Here, $\overrightarrow{a_1} = 8\hat{\imath} - 9\hat{\jmath} + 10\hat{k}$; $\overrightarrow{a_2} = 15\hat{\imath} + 29\hat{\jmath} + 5\hat{k}$

$\overrightarrow{b_1} = 3\hat{\imath} - 16\hat{\jmath} + 7\hat{k}$; $\overrightarrow{b_2} = 3\hat{\imath} + 8\hat{\jmath} - 5\hat{k}$

Now, $\overrightarrow{a_2} - \overrightarrow{a_1} = (15-8)\hat{\imath} + (29+9)\hat{\jmath} + (5-10)\hat{k} = 7\hat{\imath} + 38\hat{\jmath} - 5\hat{k}$ (½)

and

$$\overrightarrow{b_1} \times \overrightarrow{b_2} = \begin{vmatrix} \hat{\imath} & \hat{\jmath} & \hat{k} \\ 3 & -16 & 7 \\ 3 & 8 & -5 \end{vmatrix} = 24\hat{\imath} + 36\hat{\jmath} + 72\hat{k}$$ (1)

$\Rightarrow (\overrightarrow{b_1} \times \overrightarrow{b_2}).(\overrightarrow{a_2} - \overrightarrow{a_1}) = (24\hat{\imath} + 36\hat{\jmath} + 72\hat{k}).(7\hat{\imath} + 38\hat{\jmath} - 5\hat{k}) = 1176$ (1)

Shortest distance = $\left|\frac{(\overrightarrow{b_1} \times \overrightarrow{b_2}).(\overrightarrow{a_2} - \overrightarrow{a_1})}{|\overrightarrow{b_1} \times \overrightarrow{b_2}|}\right|$ (1)

$= \left|\frac{1176}{\sqrt{24^2+36^2+72^2}}\right| = \frac{1176}{\sqrt{7056}} = \frac{1176}{84} = \frac{98}{7}$ (1)

--0-0-0--