CBSE Class 12 Maths Question Paper Solution 2017

QUESTION PAPER CODE 65/1/1

EXPECTED ANSWER/VALUE POINTS

SECTION A

1. $|A^{-1}| = \dfrac{1}{|A|} \Rightarrow k = -1$ 1

2. $\lim\limits_{x \to 0_-} f(x) = \lim\limits_{x \to 0_-} \dfrac{kx}{|x|} = -k$ $\frac{1}{2}$

$k = -3$ $\frac{1}{2}$

3. $\int_2^3 3^x dx = \left[\dfrac{3^x}{\log 3}\right]_2^3 = \dfrac{18}{\log 3}$ $\frac{1}{2}+\frac{1}{2}$

4. $\cos^2 90° + \cos^2 60° + \cos^2 \gamma = 1$ $\frac{1}{2}$

$\cos\gamma = \pm\dfrac{\sqrt{3}}{2}, \gamma = \dfrac{\pi}{6}$ or $\dfrac{5\pi}{6}$ $\frac{1}{2}$

SECTION B

5. Let $A = [a_{ij}]_{n \times n}$ be skew symmetric matrix

A is skew symmetric

$\therefore \quad A = -A'$ 1

$\Rightarrow \quad a_{ij} = -a_{ji} \ \forall\, i, j$

For diagonal elements i = j,

$\Rightarrow \quad 2a_{ii} = 0$

$\Rightarrow \quad a_{ii} = 0 \Rightarrow$ diagonal elements are zero. 1

6. From the given equation

$$2\sin y \cos y \cdot \frac{dy}{dx} - \sin xy \cdot \left[x \cdot \frac{dy}{dx} + y \cdot 1\right] = 0$$ 1

$$\Rightarrow \quad \frac{dy}{dx} = \frac{y\sin xy}{\sin 2y - x\sin(xy)}$$

$$\therefore \quad \left.\frac{dy}{dx}\right|_{x=1,\, y=\frac{\pi}{4}} = \frac{\pi}{4(\sqrt{2}-1)}$$ 1

7. $V = \frac{4}{3}\pi r^3$

$$\Rightarrow \quad \frac{dv}{dt} = 4\pi r^2 \frac{dr}{dt} \Rightarrow \frac{dr}{dt} = \frac{3}{4\pi r^2}$$ 1

$S = 4\pi r^2$

$$\Rightarrow \quad \frac{dS}{dt} = 8\pi r \cdot \frac{dr}{dt}$$ $\frac{1}{2}$

$$\Rightarrow \quad \left.\frac{dS}{dt}\right|_{r=2} = 3cm^2/s$$ $\frac{1}{2}$

8. $f(x) = 4x^3 - 18x^2 + 27x - 7$

$f'(x) = 12x^2 - 36x + 27$ $\frac{1}{2}$

$= 3(2x-3)^2 \geq 0 \;\; \forall\, x \in R$ 1

$\Rightarrow$ f(x) is increasing on R $\frac{1}{2}$

9. Equation of given line is $\frac{x-5}{1/5} = \frac{y-2}{-1/7} = \frac{z}{1/35}$ $\frac{1}{2}$

Its DR's $\left\langle \frac{1}{5}, -\frac{1}{7}, \frac{1}{35} \right\rangle$ or $\langle 7, -5, 1\rangle$ $\frac{1}{2}$

Equation of required line is

$\vec{r} = (\hat{i} + 2\hat{j} - \hat{k}) + \lambda(7\hat{i} - 5\hat{j} + \hat{k})$ 1

10. $P(E \cap F') = P(E) - P(E \cap F)$ 1

$= P(E) - P(E) \cdot P(F)$ $\frac{1}{2}$

$= P(E)[1 - P(F)]$

$= P(E)P(F')$ $\frac{1}{2}$

$\Rightarrow$ E and F' are independent events.

11. Let x necklaces and y bracelets are manufactured

$\therefore$ L.P.P. is

Maximize profit, $P = 100x + 300y$ $\frac{1}{2}$

subject to constraints

$x + y \le 24$

$\frac{1}{2}x + y \le 16$ or $x + 2y \le 32$ $\frac{1}{2} \times 3 = 1\frac{1}{2}$

$x, y, \ge 1$

12. $\int \frac{dx}{x^2 + 4x + 8} = \int \frac{dx}{(x+2)^2 + (2)^2}$ 1

$= \frac{1}{2} \tan^{-1} \frac{x+2}{2} + C$ 1

SECTION C

13. Let $\frac{1}{2} \cos^{-1} \frac{a}{b} = x$ $\frac{1}{2}$

LHS $= \tan\left(\frac{\pi}{4} + x\right) + \tan\left(\frac{\pi}{4} - x\right) = \frac{1 + \tan x}{1 - \tan x} + \frac{1 - \tan x}{1 + \tan x}$ $1\frac{1}{2}$

$= \frac{2(1 + \tan^2 x)}{1 - \tan^2 x} = \frac{2}{\cos 2x}$ 1

$= \frac{2b}{a} = \text{RHS}$ 1

14. $$\begin{vmatrix} x & x+y & x+2y \\ x+2y & x & x+y \\ x+y & x+2y & x \end{vmatrix}$$

$C_1 \rightarrow C_1 + C_2 + C_3$

$$= 3(x+y)\begin{vmatrix} 1 & x+y & x+2y \\ 1 & x & x+y \\ 1 & x+2y & x \end{vmatrix}$$ 1

$R_1 \rightarrow R_1 - R_2,\ R_3 \rightarrow R_3 - R_2$

$$= 3(x+y)\begin{vmatrix} 0 & y & y \\ 1 & x & x+y \\ 0 & 2y & -y \end{vmatrix}$$ 1+1

$= -3(x + y)(-y^2 - 2y^2) = 9y^2(x + y)$ 1

OR

Let $D = \begin{bmatrix} x & y \\ z & w \end{bmatrix}$ $\frac{1}{2}$

$CD = AB \Rightarrow \begin{bmatrix} 2x+5z & 2y+5w \\ 3x+8z & 3y+8w \end{bmatrix} = \begin{bmatrix} 3 & 0 \\ 43 & 22 \end{bmatrix}$ 1+1

$2x + 5z = 3,\ 3x + 8z = 43;\ 2y + 5w = 0,\ 3y + 8w = 22.$

Solving, we get $x = -191,\ y = -110,\ z = 77,\ w = 44$ 1

$\therefore\ D = \begin{bmatrix} -191 & -110 \\ 77 & 44 \end{bmatrix}$ $\frac{1}{2}$

15. $y = (\sin x)^x + \sin^{-1}\sqrt{x}$

$y = u + v \Rightarrow \frac{dy}{dx} = \frac{du}{dx} + \frac{dv}{dx}$ 1

$u = (\sin x)^x$

$\Rightarrow \quad \log u = x \log \sin x$ $\frac{1}{2}$

$\Rightarrow \quad \frac{du}{dx} = (\sin x)^x [x \cot x + \log \sin x]$ 1

$$v = \sin^{-1}\sqrt{x}$$

$$\Rightarrow \quad \frac{dv}{dx} = \frac{1}{2\sqrt{x - x^2}} \qquad 1$$

$$\therefore \quad \frac{dy}{dx} = (\sin x)^x[x \cot x + \log \sin x] + \frac{1}{2\sqrt{x - x^2}} \qquad \frac{1}{2}$$

OR

$$x^m \cdot y^n = (x + y)^{m+n}$$

$$\Rightarrow \quad m \log x + n \log y = (m + n) \log (x + y) \qquad 1$$

$$\Rightarrow \quad \frac{m}{x} + \frac{n}{y} \cdot \frac{dy}{dx} = \frac{m+n}{x+y}\left(1 + \frac{dy}{dx}\right) \qquad 1$$

$$\Rightarrow \quad \frac{dy}{dx} = \frac{y}{x} \qquad \text{...(i)} \qquad 1$$

$$\frac{d^2y}{dx^2} = \frac{x\frac{dy}{dx} - y}{x^2} = 0 \qquad \text{...(ii) (using (i))} \qquad 1$$

16. $\displaystyle\int \frac{2x}{(x^2+1)(x^2+2)^2} = \int \frac{dy}{(y+1)(y+2)^2}$ [by substituting $x^2 = y$] 1

$$= \int \frac{dy}{y+1} - \int \frac{dy}{y+2} - \int \frac{dy}{(y+2)^2} \qquad \text{(using partial fraction)} \qquad 1\frac{1}{2}$$

$$= \log(y+1) - \log(y+2) + \frac{1}{y+2} + C \qquad 1$$

$$= \log(x^2+1) - \log(x^2+2) + \frac{1}{x^2+2} + C \qquad \frac{1}{2}$$

17. $\displaystyle I = \int_0^{\pi} \frac{x \sin x}{1 + \cos^2 x} dx$

$$= \int_0^{\pi} \frac{(\pi - x)\sin x}{1 + \cos^2 x} dx \qquad 1$$

$$\Rightarrow 2I = \pi\int_0^{\pi} \frac{\sin x\, dx}{1+\cos^2 x}$$

Put $\cos x = t$ and $-\sin x\, dx = dt$ 1

$$= -\pi\int_1^{-1} \frac{dt}{1+t^2}$$

$$= \pi[\tan^{-1} t]_{-1}^{1} = \frac{\pi^2}{2}$$ $1\frac{1}{2}$

$$\Rightarrow \quad I = \frac{\pi^2}{4}$$ $\frac{1}{2}$

OR

$$I = \int_0^{3/2} |x \sin \pi x|\, dx$$

$$= \int_0^1 x \sin \pi x \cdot dx - \int_1^{3/2} x \sin \pi x\, dx$$ $1\frac{1}{2}$

$$= \left[-x\frac{\cos \pi x}{\pi} + \frac{\sin \pi x}{\pi^2}\right]_0^1 - \left[-\frac{x\cos \pi x}{\pi} + \frac{\sin \pi x}{\pi^2}\right]_1^{3/2}$$ $1\frac{1}{2}$

$$= \frac{2}{\pi} + \frac{1}{\pi^2}$$ 1

18. $x^2 - y^2 = C(x^2 + y^2)^2 \Rightarrow 2x - 2yy' = 2C(x^2 + y^2)(2x + 2yy')$ 1

$$\Rightarrow \quad (x - yy') = \frac{x^2 - y^2}{y^2 + x^2}(2x + 2yy') \Rightarrow (y^2 + x^2)(x - yy') = (x^2 - y^2)(2x + 2yy')$$ 1

$$\Rightarrow \quad [-2y(x^2 - y^2) - y(y^2 + x^2)]\frac{dy}{dx} = 2x(x^2 - y^2) - x(y^2 + x^2)$$ 1

$$\Rightarrow \quad (y^3 - 3x^2y)\frac{dy}{dx} = (x^3 - 3xy^2)$$

$$\Rightarrow \quad (y^3 - 3x^2y)dy = (x^3 - 3xy^2)dx$$ 1

Hence $x^2 - y^2 = C(x^2 + y^2)^2$ is the solution of given differential equation.

19. $[\vec{a}\ \vec{b}\ \vec{c}] = \begin{vmatrix} 1 & 1 & 1 \\ 1 & 0 & 0 \\ c_1 & c_2 & c_3 \end{vmatrix} = c_2 - c_3$ 1

(a) $c_1 = 1,\ c_2 = 2$

$[\vec{a}\ \vec{b}\ \vec{c}] = 2 - c_3$ 1

$\because\ \vec{a}, \vec{b}, \vec{c}$ are coplanar $[\vec{a}\ \vec{b}\ \vec{c}] = 0 \Rightarrow c_3 = 2$ 1

(b) $c_2 = -1,\ c_3 = 1$

$[\vec{a}\ \vec{b}\ \vec{c}] = c_2 - c_3 = -2 \neq 0$

$\Rightarrow$ No value of c_1 can make $\vec{a}, \vec{b}, \vec{c}$ coplanar 1

20. $|\vec{a}| = |\vec{b}| = |\vec{c}|$ and $\vec{a}\cdot\vec{b} = 0 = \vec{b}\cdot\vec{c} = \vec{c}\cdot\vec{a}$ ...(i) 1

Let α, β and γ be the angles made by $(\vec{a}+\vec{b}+\vec{c})$ with $\vec{a}$, $\vec{b}$ and $\vec{c}$ respectively

$(\vec{a}+\vec{b}+\vec{c})\cdot\vec{a} = |\vec{a}+\vec{b}+\vec{c}|\,|\vec{a}|\cos\alpha$

$\Rightarrow \alpha = \cos^{-1}\left(\dfrac{|\vec{a}|}{|\vec{a}+\vec{b}+\vec{c}|}\right)$

Similarly, $\beta = \cos^{-1}\left(\dfrac{|\vec{b}|}{|\vec{a}+\vec{b}+\vec{c}|}\right)$ and $\gamma = \cos^{-1}\left(\dfrac{|\vec{c}|}{|\vec{a}+\vec{b}+\vec{c}|}\right)$ 1

using (i), we get $\alpha = \beta = \gamma$ $\frac{1}{2}$

Now $|\vec{a}+\vec{b}+\vec{c}|^2 = |\vec{a}|^2 + |\vec{b}|^2 + |\vec{c}|^2 + 2(\vec{a}\cdot\vec{b} + \vec{b}\cdot\vec{c} + \vec{c}\cdot\vec{a})$ 1

$\Rightarrow |\vec{a}+\vec{b}+\vec{c}|^2 = 3|\vec{a}|^2$ (using (i))

$\Rightarrow |\vec{a}+\vec{b}+\vec{c}| = \sqrt{3}\,|\vec{a}|$

$\therefore\ \alpha = \cos^{-1}\left(\dfrac{1}{\sqrt{3}}\right) = \beta = \gamma$ $\frac{1}{2}$

21.

x	P(x)
0	p
1	p
2	k
3	k

$\Sigma p(x) = 1 \Rightarrow 2p + 2k = 1 \Rightarrow k = \frac{1}{2} - p$ 1

x_i	p_i	$p_i x_i$	$p_i x_i^2$
0	p	0	0
1	p	p	p
2	$\frac{1}{2} - p$	$1 - 2p$	$2 - 4p$
3	$\frac{1}{2} - p$	$\frac{3}{2} - 3p$	$\frac{9}{2} - 9p$
		$\frac{5}{2} - 4p$	$\frac{13}{2} - 12p$

2

As per problem, $\Sigma\, p_i x_i^2 = 2\Sigma\, p_i x_i$

$\Rightarrow \quad p = \frac{3}{8}$ 1

22. Let H_1 be the event that 6 appears on throwing a die

H_2 be the event that 6 does not appear on throwing a die

E be the event that he reports it is six 1

$P(H_1) = \frac{1}{6}, P(H_2) = 1 - \frac{1}{6} = \frac{5}{6}$

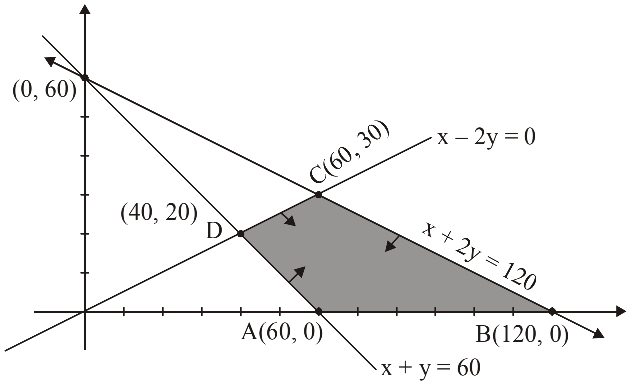
$P(E/H_1) = \frac{4}{5}, P(E/H_2) = \frac{1}{5}$ 1

$P(H_1/E) = \frac{P(H_1) \cdot P(E/H_1)}{P(H_1) \cdot P(E/H_1) + P(H_2) P(E/H_2)}$ $\frac{1}{2}$

$= \frac{4}{9}$ $\frac{1}{2}$

Relevant value: Yes, Truthness leads to more respect in society. 1

23.



Correct graph of 3 lines $1\frac{1}{2}$

Correct shade of 3 lines $1\frac{1}{2}$

$Z = 5x + 10y$

$Z|_{A(60,\ 0)} = 300$

$Z|_{B(120,\ 0)} = 600$

$Z|_{C(60,\ 30)} = 600$

$Z|_{D(40,\ 20)} = 400$

Minimum value of Z = 300 at x = 60, y = 0 1

SECTION D

24. $A = \begin{bmatrix} 1 & -1 & 2 \\ 0 & 2 & -3 \\ 3 & -2 & 4 \end{bmatrix} \cdot \begin{bmatrix} -2 & 0 & 1 \\ 9 & 2 & -3 \\ 6 & 1 & -2 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ 1

$AB = I \Rightarrow A^{-1} = B = \begin{bmatrix} -2 & 0 & 1 \\ 9 & 2 & -3 \\ 6 & 1 & -2 \end{bmatrix}$ 1

Given equations in matrix form are:

$$\begin{bmatrix} 1 & 0 & 3 \\ -1 & 2 & -2 \\ 2 & -3 & 4 \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 9 \\ 4 \\ -3 \end{bmatrix}$$ 1

$A'X = C$ $\frac{1}{2}$

$\Rightarrow \quad X = (A')^{-1}\ C = (A^{-1})'C$ 1

$$\Rightarrow \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} -2 & 9 & 6 \\ 0 & 2 & 1 \\ 1 & -3 & -2 \end{bmatrix}\begin{bmatrix} 9 \\ 4 \\ -3 \end{bmatrix} = \begin{bmatrix} 0 \\ 5 \\ 3 \end{bmatrix}$$ 1

$\Rightarrow \quad x = 0,\ y = 5,\ z = 3$ $\frac{1}{2}$

25. Clearly $f^{-1}(y) = g(y): [-5, \infty) \to R_+$ and,

$$\text{fog}(y) = f\left(\frac{\sqrt{y+6}-1}{3}\right) = 9\left(\frac{\sqrt{y+6}-1}{3}\right)^2 + 6\left(\frac{\sqrt{y+6}-1}{3}\right) - 5 = y$$ 2

and $(\text{gof})(x) = g(9x^2 + 6x - 5) = \dfrac{\sqrt{9x^2+6x+1}-1}{3} = x$ 2

$\therefore\ g = f^{-1}$ 1

(i) $f^{-1}(10) = \dfrac{\sqrt{16}-1}{3} = 1$ $\frac{1}{2}$

(ii) $f^{-1}(y) = \dfrac{4}{3} \Rightarrow y = 19$ $\frac{1}{2}$

OR

Note: Some short comings have been observed in this question which makes the question unsolvable.

So, 6 marks may be given for a genuine attempt.

$a * b = a - b + ab \ \forall a, b \in A = Q - [1]$

$b * a = b - a + ba$

$(a * b) \neq b * a \Rightarrow *$ is not commutative. $1\frac{1}{2}$

$(a * b) * c = (a - b + ab) * c$

$\qquad = a - b - c + ab + ac - bc + abc$

$a * (b * c) = a * (b - c + bc)$

$\qquad = a - b + c + ab - ac - bc + abc$

$(a * b) * c \neq a * (b * c)$ $1\frac{1}{2}$

$\Rightarrow *$ is not associative.

Existence of identity

$a * e = a - e + ae = a$ $\qquad$ $e * a = e - a + ea = a$

$\Rightarrow e\,(a - 1) = 0$ $\qquad$ $\Rightarrow e(1 + a) = 2a$

$\Rightarrow e = 0$ $\qquad$ $\Rightarrow e = \dfrac{2a}{1+a}$ $\qquad 1\frac{1}{2}$

$\because$ e is not unique

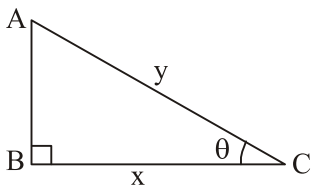
$\therefore$ No idendity element exists.

$a * b = e = b * a$

$\therefore$ No identity element exists. $\qquad 1\frac{1}{2}$

$\Rightarrow$ Inverse element does not exist.

26.



Given $x + y = k$ $\qquad 1$

$$\text{Area of } \Delta = \frac{1}{2} x \sqrt{y^2 - x^2}$$

$$\text{Let } Z = \frac{1}{4}x^2(y^2 - x^2)$$

$$= \frac{1}{4}x^2[(k - x)^2 - x^2]$$

$$= \frac{1}{4}[k^2x^2 - 2kx^3] \qquad 1$$

$$\frac{dz}{dx} = \frac{1}{4}[2k^2x - 6kx^2] = 0 \Rightarrow k - 3x = 0 \Rightarrow x = \frac{k}{3} \qquad 1\frac{1}{2}$$

$\Rightarrow x + y - 3x = 0$ or $y = 2x$

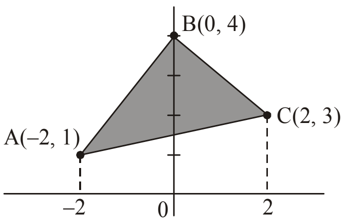
$$\frac{d^2z}{dx^2} = \frac{1}{4}[2k^2 - 12kx] \qquad 1$$

$$\left.\frac{d^2z}{dx^2}\right|_{x=\frac{k}{3}} = \frac{1}{4}[2k^2 - 4k^2] = -\frac{k^2}{2} < 0$$

$\therefore$ Area will be maximum for $2x = y$ $\qquad 1$

$$\text{but } \frac{x}{y} = \cos\theta \Rightarrow \cos\theta = \frac{x}{2x} = \frac{1}{2} \Rightarrow \theta = \frac{\pi}{3} \qquad \frac{1}{2}$$

27.



Equation of AB: $y = \frac{3}{2}x + 4$ — Correct Figure: 1

Equation of BC; $y = 4 - \frac{x}{2}$

Equation of AC; $y = \frac{1}{2}x + 2$ — $1\frac{1}{2}$

Required area $= \int_{-2}^{0}\left(\frac{3}{2}x + 4\right)dx + \int_{0}^{2}\left(4 - \frac{x}{2}\right)dx - \int_{-2}^{2}\left(\frac{1}{2}x + 2\right)dx$ — 1

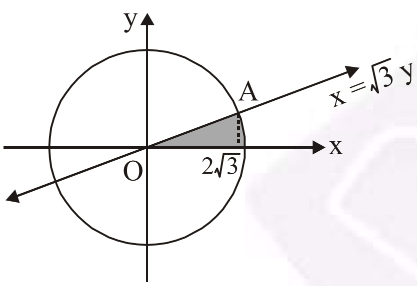
$$= \left[\frac{3x^2}{4} + 4x\right]_{-2}^{0} + \left[4x - \frac{x^2}{4}\right]_{0}^{2} - \left[\frac{x^2}{4} + 2x\right]_{-2}^{2}$$ $1\frac{1}{2}$

$= 5 + 7 - 8$ — 1

$= 4$ sq.units

OR

Note: In this problem, two regions are possible instead of a unique one, so full 6 marks may be given for finding the area of either region correctly.



Correct Figure — 1

x-coordinate of points of intersection is $x = \pm 2\sqrt{3}$ — 1

Required area

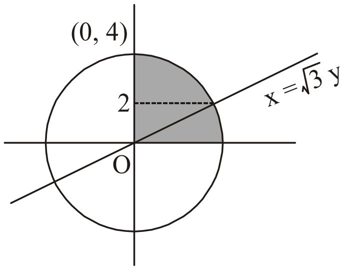
$$= \int_{0}^{2\sqrt{3}} \frac{x}{\sqrt{3}} \cdot dx + \int_{2\sqrt{3}}^{4} \sqrt{4^2 - x^2}\, dx$$ $1\frac{1}{2}$

$$= \left[\frac{x^2}{2\sqrt{3}}\right]_{0}^{2\sqrt{3}} + \left[\frac{x\sqrt{16 - x^2}}{2} + 8\sin^{-1}\frac{x}{4}\right]_{2\sqrt{3}}^{4}$$ $1\frac{1}{2}$

$$= 2\sqrt{3} + 8\left(\frac{\pi}{2} - \frac{\pi}{3}\right) - 2\sqrt{3}$$

$$= \frac{4\pi}{3} \text{ sq.units}$$ 1

Alternate Solution



Correct figure 1

y-co-ordinate of point of intersection is y = 2 1

Required Area

$$= \sqrt{3}\int_0^2 y\,dx + \int_2^4 \sqrt{(4)^2 - y^2}\,dy \qquad 1\frac{1}{2}$$

$$= \sqrt{3}\left[\frac{y^2}{2}\right]_0^2 + \left[\frac{y\sqrt{16-y^2}}{2} + 8\sin^{-1}\frac{y}{4}\right]_2^4 \qquad 1\frac{1}{2}$$

$$= 2\sqrt{3} + 4\pi - 2\sqrt{3} - \frac{4\pi}{3}$$

$$= \frac{8\pi}{3}\text{ sq.units} \qquad 1$$

28. The given equation can be written as

$$\frac{dy}{dx} + \frac{y}{x} = \cos x + \frac{\sin x}{x} \qquad 1$$

$$\text{I.F.} = e^{\int \frac{1}{x}dx} = e^{\log x} = x \qquad 1$$

$\therefore$ Solution is

$$y \cdot x = \int (x\cos x + \sin x)dx + c \qquad 1$$

$$\Rightarrow y \cdot x = x \sin x + c \qquad 1$$

$$\text{or } y = \sin x + \frac{c}{x}$$

when $x = \frac{\pi}{2}, y = 1$, we get $c = 0$ 1

Required solution is $y = \sin x$ 1

29. Equation of family of planes

$$\vec{r}\cdot[(2\hat{i} - 3\hat{j} + 4\hat{k}) + \lambda(\hat{i} - \hat{j})] = 1 - 4\lambda \qquad 1$$

$\Rightarrow \vec{r}\cdot[(2+\lambda)\hat{i}+(-3-\lambda)\hat{j}+4\hat{k}] = 1 - 4\lambda$ ...(i) 1

plane (i) is perpendicular to

$\vec{r}\cdot(2\hat{i}-\hat{j}+\hat{k})+8 = 0$

$2(2+\lambda) - 1(-3-\lambda) + 1(4) = 0 \Rightarrow \lambda = -\frac{11}{3}$ 1+1

Substituting $\lambda = -\frac{11}{3}$ in equation (i), we get

$\vec{r}\cdot\left(-\frac{5}{3}\hat{i}+\frac{2}{3}\hat{j}+4\hat{k}\right) = \frac{47}{3}$

$\left.\begin{aligned}&\Rightarrow \boxed{\vec{r}\cdot(-5\hat{i}+2\hat{j}+12\hat{k}) = 47} \text{ (vector equation)}\\ &\text{or } \boxed{-5x+2y+12z-47 = 0} \text{ (cartesian equation)}\end{aligned}\right\}$ (ii) 1

Line $\frac{x-1}{1} = \frac{y-2}{1/2} = \frac{z-4}{1/3}$ lies on the plane

$\because$ (i) Point P(1, 2, 4) satisfies equation (ii) $\frac{1}{2}$

and $a_1a_2 + b_1b_2 + c_1c_2 = -5 + 1 + 4 = 0$ $\frac{1}{2}$

$\Rightarrow$ Line is perpendicular to the normal of plane $\therefore$ Plane contains the given line

OR

Equation of line L_1 passing through (1, 2, –4) is

$\frac{x-1}{a} = \frac{y-2}{b} = \frac{z+4}{c}$ 1

L_2: $\frac{x-8}{3} = \frac{y+19}{-16} = \frac{z-10}{7}$

L_3: $\frac{x-15}{3} = \frac{y-29}{8} = \frac{z-5}{-5}$

$\because L_1 \perp L_2 \Rightarrow 3a - 16b + 7c = 0$ 1

$L_1 \perp L_3 \Rightarrow 3a + 8b - 5c = 0$ 1

Solving, we get

$$\frac{a}{24} = \frac{b}{36} = \frac{c}{72} \Rightarrow \frac{a}{2} = \frac{b}{3} = \frac{c}{6}$$ 1

$\therefore$ Required cartesian equation of line

$$\frac{x-1}{2} = \frac{y-2}{3} = \frac{z+4}{6}$$ 1

Vector equation

$$\vec{r} = (\hat{i} + 2\hat{j} - 4\hat{k}) + \lambda(2\hat{i} + 3\hat{j} + 6\hat{k})$$ 1