CBSE Class 12 Maths Question Paper 2020 Set 2 Solution

CLASS XII

MATHS SET – II 65/3/1

S.NO	SOLUTION	MARK
1	**(D)** $f(x)=\|x\|+x=\begin{cases}2x & , x\geq 0\\ 0 & , x<0\end{cases}$ $g(x)=\|x\|-x=\begin{cases}0 & , x\geq 0\\ -2x & , x<0\end{cases}$ $f\left[g(x)\right]=\|x\|-x=\begin{cases}2:g(x) & , g(x)\geq 0\\ 0 & , g(x)<0\end{cases}$ $f\left[g(x)\right]=-4x \quad , \quad x<0$	1
2	**(A)** $\cot^{-1}\left(-\sqrt{3}\right)=\tan^{-1}\left(-\frac{1}{\sqrt{3}}\right)=-\frac{\pi}{6}$	1
3	**(A)** $A=\begin{bmatrix}-2 & 0 & 0\\ 0 & -2 & 0\\ 0 & 0 & -2\end{bmatrix}$ $\|A\|=-2(4-0)=-8$ $\|adj\ A\|=\|A\|^{3-1}=\|A\|^2=(-8)^2=64$	1
4	**(A)** $y=-x^3+3x^2+12x-5$ $\frac{dy}{dx}=-3x^2+6x+12$ $=-3\left(x^2-2x-4\right)$ $=-3\left((x-1)^2-5\right)$ $\frac{dy}{dx}=15-3(x-1)^2$ Maximum value $=15$	1
5	**(A)** $\int\frac{e^x(1+x)}{\cos^2\left(xe^x\right)dx}$ Let $xe^x=t \quad \Rightarrow \quad e^x(1+x).dx=dt$ $\int\frac{dt}{\cos^2 t}=\int\sec^2 t=\tan x+c=\tan\left(xe^x\right)+c$	1
6	**(A)**	1

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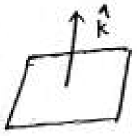
7	**(B)** $p\sqrt{3}=1 \quad \Rightarrow \quad p=\frac{1}{\sqrt{3}}$	1
8	**(A)** On XZ-plane y-coordinate is zero	1
9	**(A)** $\vec{r}.\hat{k}=0$ 	1
10	**(B)** $z=3x-4y$ at $(0,0) \Rightarrow z=0$ at $(0,8) \Rightarrow z=-32$ at $(5,0) \Rightarrow z=15$ at $(4,10) \Rightarrow z=-28$ Minimum $=-32$	1
11	$y=\tan^{-1}x+\cot^{-1}x$ $\frac{dy}{dx}=\frac{1}{1+x^2}-\frac{1}{1+x^2}=0$	1
	(OR) $y=\tan^{-1}x+\cot^{-1}x$ $y={\pi}/{2}$ $\frac{dy}{dx}=0$	1
	(OR) $\cos(xy)=k \quad \Rightarrow -\sin(xy).\left(x\frac{dy}{dx}+y\right)=0$ $\Rightarrow -\sin(x.y).x\frac{dy}{dx}=y.\sin(xy)$ $\Rightarrow \frac{dy}{dx}=\frac{-y\sin(xy)}{x\sin(xy)}=\frac{-y}{x}$	1
12	$\frac{-1}{\pi}$ $RHL=\cos\pi=-1$ $LHL=\lambda\pi$	1

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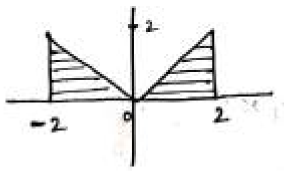
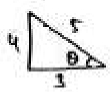
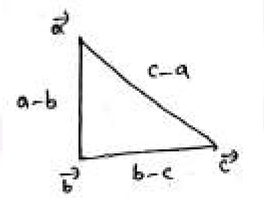
	$\Rightarrow \lambda\pi = -1 \quad \Rightarrow \lambda = -1/\pi$	
13	$y = \sec x$ $\frac{dy}{dx} = \sec x.\tan x$ at $(0,1) \quad \Rightarrow \frac{dy}{dx} = 0$ Equation of tangent $\rightarrow y - y_1 = m(x - x_1)$ $\rightarrow y - y = 0(x-0)$ $\rightarrow y = 1$	1
14	Area of parallelogram $= \frac{1}{2}\lvert d_1 \times d_2 \rvert = \frac{1}{2} \times 2 \times 3 = 3$	1
	(OR) $(2\hat{i} - \lambda\hat{j} + \hat{k}).(\hat{i} + 2\hat{j} - \hat{k}) = 0 \Rightarrow 2 - 2\lambda - 1 = 0 \Rightarrow \lambda = \frac{1}{2}$	1
15	$\frac{2}{7}$ $\frac{4c_1 \times 3c_1 \times 2c_1}{9c_3} = \frac{2}{7}$	1
16	$a_{ij} = \lvert (i)^2 - j \rvert$ $a_{11} = 1 - 1 = 0 \qquad a_{21} = 4 - 1 = 3$ $a_{12} = \lvert 1-2 \rvert = 1 \qquad a_{22} = 4 - 2 = 2$ $\therefore \quad A = \begin{bmatrix} 0 & 1 \\ 3 & 2 \end{bmatrix}$	1
17	$y = \sin^2 \sqrt{x}$ $\frac{dy}{dx} = 2\sin^2 \sqrt{x}.\cos\sqrt{x}.\frac{1}{2\sqrt{x}}$ $\frac{dy}{dx} = \frac{\sin\sqrt{x}.\cos\sqrt{x}}{\sqrt{x}}$	1
18	$f(x) = 7 - 4x - x^2$ $f'(x) = -4 - 2x$ $f'(x) > 0$	½

	$-4-2x>0 \quad \Rightarrow -4>2x \quad \Rightarrow x<-2$	½
19	$\int_{-2}^{2} \lvert x \rvert \, dx$ Area $=\left(\frac{1}{2}\times 2\times 2\right)+\left(\frac{1}{2}\times 2\times 2\right)$ $=4$ sq. units 	½ ½
	(OR) $\int \frac{dx}{9+4x^2}=\frac{1}{4}\int \frac{dx}{9/4+x^2}=\frac{1}{4}.\frac{2}{3}\tan^{-1}\left(\frac{2x}{3}\right)$ $\int \frac{dx}{x^2+a^2}=\frac{1}{a}\tan^{-1}\left(x/a\right)+c=\frac{1}{6}\tan^{-1}\left(\frac{2x}{3}\right)$	½ ½
20	Sample space $=\{HH, HT, TH, TT\}$ Probability of getting at least one head $=\frac{3}{4}$	1
21	$\sin^{-1}4x+\sin^{-1}(3x)=\frac{-\pi}{2}$ $\sin^{-1}4x+\frac{\pi}{2}-\cos^{-1}(3x)=\frac{-\pi}{2}$ $\sin^{-1}4x+\frac{-\pi}{2}-\frac{\pi}{2}+\cos^{-1}(3x)$ $\sin^{-1}(4x)+-\pi+\cos^{-1}(3x)$ $\sin^{-1}(4x)+-\left[\pi-\cos^{-1}3x\right]$ $\sin^{-1}(4x)+-\cos^{-1}(-3x)$ $\sin^{-1}(-4x)+\cos^{-1}(-3x)$  Let $\sin^{-1}(-4x)=\theta \qquad \cos^{-1}(-3x)=\theta$ $-4x=\sin\theta \qquad -3x=\cos\theta$	½ ½ ½

	$\frac{\sin\theta}{\cos\theta}=\frac{4}{3} \quad \Rightarrow \tan\theta = 4/3$ $-4x = 4/5$ $x=\frac{-1}{5}$	½
	(OR) $\tan^{-1}\left(\frac{\cos x}{1-\sin x}\right)$ $=\tan^{-1}\left(\frac{\cos^2 x/2-\sin^2 x/2}{1-2\sin x/2 . \cos x/2}\right)$ $=\tan^{-1}\left(\frac{\left(\cos x/2+\sin x/2\right)\left(\cos x/2-\sin x/2\right)}{\left(\cos x/2-\sin x/2\right)^2}\right)$ $=\tan^{-1}\left(\frac{\cos x/2+\sin x/2}{\cos x/2-\sin x/2}\right)$ $=\tan^{-1}\left(\frac{1+\tan x/2}{1-\tan x/2}\right)$ $=\tan^{-1}\left[\tan\left(\pi/4+x/2\right)\right]$ $=\frac{\pi}{4}+\frac{x}{2}$	½ ½ ½ ½
22	$A=\begin{bmatrix}4 & -3\\ 2 & -1\end{bmatrix}$ $A^T=\begin{bmatrix}4 & 2\\ -3 & -1\end{bmatrix}$ $\frac{1}{2}\left(A+A^T\right)=\frac{1}{2}\begin{bmatrix}8 & -1\\ -1 & -2\end{bmatrix}=\begin{bmatrix}4 & -1/2\\ -1/2 & -1\end{bmatrix}$ $\frac{1}{2}\left(A-A^T\right)=\frac{1}{2}\begin{bmatrix}0 & -5\\ 5 & 0\end{bmatrix}=\begin{bmatrix}0 & -5/2\\ 5/2 & 0\end{bmatrix}$	½ ½

	Let $P=\frac{1}{2}\left(A+A^{T}\right)=\begin{bmatrix}4 & -1/2\\ -1/2 & -1\end{bmatrix}$ $P^{T}=\begin{bmatrix}4 & -1/2\\ -1/2 & -1\end{bmatrix}=P$ Since $P^{T}=P$ P is symmetric matrix Let $Q=\frac{1}{2}\left(A-A^{T}\right)=\begin{bmatrix}0 & -5/2\\ 5/2 & 0\end{bmatrix}$ $Q^{T}=\begin{bmatrix}0 & -5/2\\ 5/2 & 0\end{bmatrix}=-Q$ Since $Q^{T}=-Q$ Q is skew symmetric matrix Now $P+Q=\frac{1}{2}\left(A+A^{T}\right)+\frac{1}{2}\left(A-A^{T}\right)$ $=A$ $\therefore$ A is a sum of symmetric and skew symmetric matrix.	½ ½
23	$y^{2}.\cos\left(\frac{1}{x}\right)=a^{2}$ $y^{2}.-\sin\left(\frac{1}{x}\right).\left(\frac{-1}{x^{2}}\right)+\cos\left(\frac{1}{x}\right).2y.\frac{dy}{dx}=0$ $\frac{y^{2}}{x^{2}}.\sin\left(\frac{1}{x}\right)=-2y\cos\left(1/x\right).\frac{dy}{dx}$ $\frac{dy}{dx}=-\frac{y^{2}}{x^{2}}.\frac{\sin\left(1/x\right)}{\cos\left(1/x\right)}.\frac{1}{2y}$ $\frac{dy}{dx}=-\frac{y^{2}}{2x^{2}}.\tan\left(1/x\right)$	1 1
24	$\|a+b\|=\|a-b\|$	

	$a^2+b^2+2(ab)=a^2+b^2-2(ab)$ $ab=0$ $\therefore$ a and b are perpendicular	1 1
	(OR) $a-b=-\hat{i}-8\hat{j}$ $\lvert a-b\rvert \sqrt{1+64}=\sqrt{65}$ $b-c=-2\hat{i}+\hat{j}-\hat{k}$ $\lvert b-c\rvert=\sqrt{4+1+4}=\sqrt{6}$ $c-a=3\hat{i}+7\hat{j}+\hat{k}$ $\lvert c-a\rvert=\sqrt{9+49+1}=\sqrt{59}$ $\lvert a-b\rvert^2=\lvert b-a^1+\lvert c-a\rvert^2$ $\therefore$ $\vec{a},\vec{b},\vec{c}$ are sides of Right angled $\Delta le.$ 	½ ½ ½ ½
25	On ZX plane y = 0 Dr's of the line → 6, -3, 18 Eqn of the line → $\frac{x+1}{6}=\frac{y-1}{-3}=\frac{z+8}{18}=\lambda$ $x=6\lambda-1, y=-3\lambda+1, z=18\lambda-8$ $y=0 \quad \Rightarrow -3\lambda+1=0 \Rightarrow \lambda=\frac{1}{3}$ $\therefore$ The point $=(1,0,-2)$	½ ½ ½ ½
26	$P(A)=0.4$ $P(B)=0.3$ $P(A\cup B)=0.6$ $P(B'\cap A)=0.3$	1

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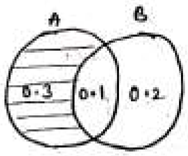
	 	1
27	$f(x)=\dfrac{x}{1+\lvert x\rvert}$ $\lvert x\rvert=\begin{cases} x & , \quad x\ge 0 \\ -x & , \quad x<0 \end{cases}$ $f(x)=\begin{cases} \dfrac{x}{1+x} & , \quad x\ge 0 \\ \underline{x} & , \quad x<0 \end{cases}$ **<u>one-one:</u>** For $x\ge 0$ $f(x_1)=f(x_2)$ $\dfrac{x_1}{1+x_1}=\dfrac{x_2}{1+x_2}$ $x_1+x_1x_2=x_2+x_1x_2$ $x_1=x_2$ For $x<0$ $f(x_1)=f(x_2)$ $\dfrac{x_1}{1-x_1}=\dfrac{x_2}{1-x_2}$ $x_1-x_1x_2=x_2-x_1x_2$ $x_1=x_2$ Hence $f(x_1)=f(x_2)\Rightarrow x_1x_2$ $\therefore$ f is one-one **<u>onto:</u>**	 1 1

	For $x \geq 0$ Let $f(x) = y$ $y = \frac{x}{1+x}$ $y + xy = x$ $y = x(1-y)$ $x = \frac{y}{1-y}$ For $x < 0$ Let $f(x) = y$ $y = \frac{x}{1-x}$ $y - xy = x$ $y = x(1+y)$ $x = \frac{y}{1+y}$ $\therefore$ f is onto. Hence f is both one-one and onto.	1 1
	(OR)	
28	$y = x^3(\cos x)^x + \sin^{-1}\sqrt{x}$ Let $u = (\cos x)^x \quad \Rightarrow \log u = x.\log(\cos x)$ $\Rightarrow \frac{1}{4}.\frac{du}{dx} = x\frac{1}{\cos x}(-\sin x) + \log(\cos x)$ $\Rightarrow \frac{du}{dx} = (\cos x)^x[\log(\cos x) - x\tan x]$ Now, $y = x^3(\cos x)^x + \sin^{-1}\sqrt{x}$ $\frac{dy}{dx} = x^3(\cos x)^x[\log(\cos x) - \tan x] + 3x^2(\cos x)^x + \frac{1}{\sqrt{1-x}}.\frac{1}{2\sqrt{x}}$	1 1 2
29	$\int_{-1}^{5}(\lvert x\rvert + \lvert x+1\rvert + \lvert x-5\rvert)\,dx$ $I_1 = \int_{-1}^{5}\lvert x\rvert = \int_{-1}^{0}-x + \int_{-1}^{5}x = -\left[\frac{x^2}{2}\right]_{-1}^{0} + \left[\frac{x^2}{2}\right]_{0}^{5}$ $I_2 = \int_{-1}^{5}(x+1)\,dx\left[\frac{x^2}{2} + x\right]_{-1}^{5} = \left(\frac{25}{2} + 5\right) - \left(\frac{1}{2} - 1\right)$ $= \frac{35}{2} + \frac{1}{2} = 18$	1 1

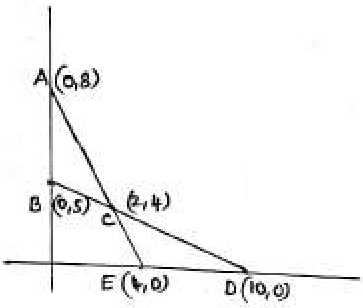
	$I_3=\int_{-1}^{5}(5-x)\,dx\left[5x-\frac{x^2}{2}\right]_{-1}^{5}=\left(25-\frac{25}{2}\right)-\left(-5-\frac{1}{2}\right)$	1
	$=\frac{25}{2}+\frac{11}{2}=18$	
	$I=I_1+I_2+I_3=13+18+18=49$	1
30	$x^2y\ dx-\left(x^3+y^3\right)dy=0$	
	$\frac{dy}{dx}=\frac{x^2y}{x^3+y^3}$	1
	Which is a homogeneous differential equation.	
	Let $y=vx \Rightarrow \frac{dy}{dx}=v+x\frac{dv}{dx}$	
	$v+x.\frac{dv}{dx}=\frac{x^2(vx)}{x^3+v^3x^3}$	1
	$x.\frac{dv}{dx}=\frac{v}{1+v^3}-v$	
	$x.\frac{dv}{dx}=\frac{v-v-v^4}{1+v^3}$	
	$\int\frac{1+v^3}{v^4}dv=-\int\frac{dx}{x}$	
	$\int v^{-4}.dv+\int\frac{1}{v}dv=-\log\lvert x\rvert+c$	1
	$\frac{v^{-3}}{-3}+\log v+\log\lvert x\rvert=c$	
	$\frac{-1}{3}\frac{x^3}{y^3}+\log\frac{y}{x}.x=c$	
	$\frac{-x^3}{3y^3}+\log\lvert y\rvert=c.$	1
31	$2x+y=8\rightarrow(0,8),(4,0)$	
	$2x+y>8\rightarrow$ away from origin	1
	$x+2y=10\rightarrow(0,5),(10,0)$	
	$x+2y>10\rightarrow$ away from origin	
	$z=5x+7y$	1

at $(0,8)\rightarrow z=56$

at $(2,4)\rightarrow z=38$ 1

at $(10,0)\rightarrow z=50$

Minimum value = 38 at $c(2,4)$



1

32

	Head	Tail
Biased	0.6	0.4
Unbiased	0.5	0.5

2

(OR) $P\left(\frac{U}{T}\right)=\frac{\frac{1}{2}\times0.5}{\frac{1}{2}\times0.4+\frac{1}{2}\times0.5}=\frac{1/4}{\frac{1}{5}+\frac{1}{4}}=\frac{1/4}{\frac{9}{20}}=\frac{1}{4}\times\frac{20}{9}=\frac{5}{9}$ 2

33

$x-y+2z=7$

$2x-y+3z=12$

$3x+2y-z=5$

$$\begin{bmatrix}1&-1&2\\2&-1&3\\3&2&-1\end{bmatrix}\begin{bmatrix}x\\y\\z\end{bmatrix}=\begin{bmatrix}7\\12\\5\end{bmatrix}$$ 1

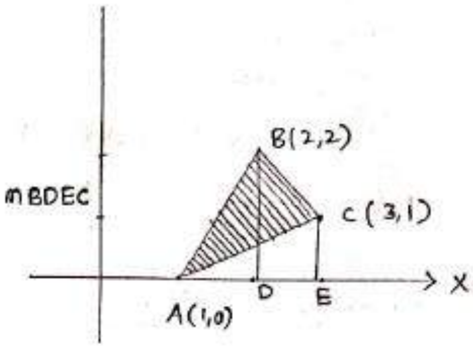
$|A|=1(1-6)+1(-2-9)+2(4+3)$

$=-5-11+14=-2$

$$adj\ A=\begin{bmatrix}-5&11&7\\3&-7&-5\\-1&1&1\end{bmatrix}^{-1}=\begin{bmatrix}-5&3&-1\\11&-7&1\\7&-5&1\end{bmatrix}$$ 1

$$A^{-1}=\frac{adj\ A}{|A|}=\frac{-1}{2}\begin{bmatrix}-5&3&-1\\11&-7&1\\7&-5&1\end{bmatrix}$$ 1

	$x = A^{-1}.B = \frac{-1}{2}\begin{bmatrix}-5 & 3 & -1\\ 11 & -7 & 1\\ 7 & -5 & 1\end{bmatrix}\begin{bmatrix}7\\12\\5\end{bmatrix}$ $= \frac{-1}{2}\begin{bmatrix}-35+36-5\\ 77-84+5\\ 49-60+5\end{bmatrix} = \begin{bmatrix}2\\1\\3\end{bmatrix}$ $\therefore\quad x = 2, y = 1, 2 = 3.$	1 1 1
	(OR)	
34	$9y^2 = x^3 \quad \rightarrow (i)$ $18y.\frac{dy}{dx} = 3x^2$ Given $m = \pm 1$ $\frac{-6y}{x^2} = \pm 1$ $\frac{-6y}{x^2} = 1$ or $\frac{-6y}{x^2} = -1$ $x^2 = -6y$ or $x^2 = 6y$ Substitute the above in (i) $9\left(\frac{x^4}{36}\right) = x^3 \Rightarrow x = 0$ or 4 If $x = 4 \Rightarrow y = \pm\frac{8}{3}$ Equation of normal $\Rightarrow y - y_1 = \frac{-dx}{dy}(x - x_1)$ $\Rightarrow y - 8/3 = \frac{-6\left(\frac{8}{3}\right)}{16}(x-4)$ $\Rightarrow \frac{3y-8}{3} = -x+4$ $\Rightarrow 3y - 8 = -3x + 12$ $\Rightarrow 3x + 3y = 20$	1 1 1 1 2
35	Let $A(1,0), B(2,2), C(3,1)$ be the vertices of triangle ABC	

	Area of $\Delta ABC =$ Area of $\Delta ABD +$ Area of Trapezium $BDEC -$ Area of ΔAEC Equation of side $AB \to y = 2(x-1)$ Equation of side $BC \to y = 4 - x$ Equation of side $CA \to y = \frac{1}{2}(x-1)$ Area of $\Delta ABC = \int_1^2 2(x-1)\,dx + \int_2^3 (4-x)\,dx - \int_1^3 \frac{x-1}{2}.dx$ $= 2\left[\frac{x^2}{2} - x\right]_1^2 + \left[4x - \frac{x^2}{2}\right]_2^3 - \frac{1}{2}\left[\frac{x^2}{2} - x\right]_1^2$ $= \frac{3}{2}.$  	1 1 1 2 1
	(OR)	
36	$\frac{x-2}{1} = \frac{y-2}{3} = \frac{2-3}{1} = \lambda$ and $\frac{x-2}{1} = \frac{y-3}{4} = \frac{z-4}{2} = \mu$ $x = \lambda + 2 \qquad x = \mu + 2$ $y = 3\lambda + 2 \qquad y = 4\mu + 3$ $z = \lambda + 3 \qquad z = 2\mu + 4$ $\lambda + 2 = \mu + 2 \Rightarrow \lambda = \mu$ $3\lambda + 2 = 4\mu + 3 \Rightarrow \lambda = \mu = -1$ $\lambda + 3 = 2\mu + 4 \Rightarrow 2 = 2$ $\therefore$ The lines are intersect at $(1,-1,2)$ Equation of plane is	1 1 1

	$\begin{vmatrix} x-x_1 & y-y_1 & z-z_1 \\ x_1 & m_1 & n_1 \\ x_2 & m_2 & n_2 \end{vmatrix} = 0 \Rightarrow \begin{vmatrix} x-2 & y-2 & z-3 \\ 1 & 3 & 1 \\ 1 & 4 & 2 \end{vmatrix} = 0$	2
	$\Rightarrow 2x - y + z = 5$	1