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COMMON PUBLIC EXAMINATION –MARCH –2023

XII - MATHEMATICS **TENTATIVE ANSWER KEY**

PART – I

Q.No	CODE – A	CODE – B	MARKS
1.	(b) ρ(A) = n	(a) $\frac{1}{e^2}$	1
2.	(d) 1	(b) $x\epsilon\left[\frac{1}{2},1\right]$	1
3.	(b) $x\epsilon\left[\frac{1}{2},1\right]$	(a) 3	1
4.	(a) y=kx	(a) $\frac{8}{3}$	1
5.	(a) 3	(b) z	1
6.	(c) 0	(b) log 2	1
7.	(b) 2	(d) 2	1
8.	(d) 2	(d) 1	1
9.	(a) $\frac{1}{e^2}$	(a) $\frac{-\pi}{6}$	1
10.	(d) z	(d) - 4	1
11.	(a) $\frac{8}{3}$	(d) n	1
12.	(a) $\frac{\pi}{2}$	(c) 5	1
13.	(c) 5	(c) 2	1
14.	(c) 2	(a) y=kx	1
15.	(b) z	(b) 2ab	1
16.	(d) - 4	(a) $\frac{\pi}{2}$	1
17.	(b) log 2	(b) ρ(A) = n	1
18.	(d) n	(b) 2	1
19.	(a) $\frac{-\pi}{6}$	(d) z	1
20.	(b) 2ab	(c) 0	1

PART – II

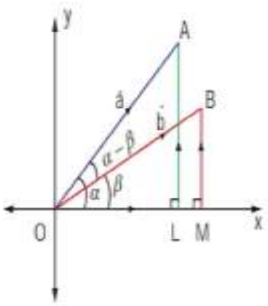
21.	Let $\lvert z_1\rvert=\lvert z\rvert = 2$ and $\lvert z_2\rvert=\lvert 3+4i\rvert = 5$ We know that $\lvert\lvert z_1\rvert - \lvert z_2\rvert\rvert \le \lvert z_1+z_2\rvert \le \lvert z_1\rvert+\lvert z_2\rvert$ $\lvert 2-5\rvert \le \lvert z+3+4i\rvert \le 2+5$ $3 \le \lvert z+3+4i\rvert \le 7$	2

22.	$lx^2+nx+n = 0 \Rightarrow$ $p+q = \frac{-n}{l}$ and $pq = \frac{n}{l}$ $\sqrt{\frac{p}{q}}+\sqrt{\frac{q}{p}}+\sqrt{\frac{n}{l}} = \frac{-\frac{n}{l}\sqrt{\frac{n}{l}}}{\sqrt{-\frac{n}{l}}}+\frac{\sqrt{n}}{\sqrt{l}} = 0$	1 1
23.	Condition for line tangent to the circle is $c^2 = a^2\,(1+m^2)$ $c^2 = 9\,(17)$ $c = \pm 3\sqrt{17}$	2
24.	Given: r =10cm and dr =9.9-10=-0.1 volume of a sphere $V= \frac{4}{3}\pi r^3$ $dV= \frac{4}{3}\pi 3r^2 dr$ $= -40\pi cm^3$	1 1
25.	$\int_b^{\infty} \frac{1}{a^2+x^2}\,dx = \left[\frac{1}{a}\tan^{-1}\left(\frac{x}{a}\right)\right]_b^{\infty}$ $=\frac{1}{a}\left[\tan^{-1}(\infty) - \tan^{-1}\left(\frac{a}{b}\right)\right]$ $=\frac{1}{a}\left[\frac{\pi}{2} - \tan^{-1}\left(\frac{b}{a}\right)\right]$	1 1
26.	Given p =7 and $\vec{d} = 3\hat{\imath} - 4\hat{\jmath} + 5\hat{k}$ $\hat{d} = \frac{\vec{d}}{\lvert\vec{d}\rvert} = \frac{1}{5\sqrt{2}}(3\hat{\imath} - 4\hat{\jmath} + 5\hat{k})$ The vector equation of the plane is $\hat{r}.\hat{d} = p$ $\hat{r}.\frac{1}{5\sqrt{2}}(3\hat{\imath} - 4\hat{\jmath} + 5\hat{k})= 7$	2
27.	$A \vee B=\begin{bmatrix}1 & 1\\1 & 1\end{bmatrix}$ and $A \wedge B = \begin{bmatrix}0 & 1\\0 & 1\end{bmatrix}$	1 1
28.	Let $A = \begin{bmatrix}\cos\theta & -\sin\theta\\ \sin\theta & \cos\theta\end{bmatrix}$; $A^T=\begin{bmatrix}\cos\theta & \sin\theta\\ -\sin\theta & \cos\theta\end{bmatrix}$ $AA^T=\begin{bmatrix}\cos\theta & -\sin\theta\\ \sin\theta & \cos\theta\end{bmatrix}\begin{bmatrix}\cos\theta & \sin\theta\\ -\sin\theta & \cos\theta\end{bmatrix}=\begin{bmatrix}1 & 0\\0 & 1\end{bmatrix}=I_2$ *similarly* $A^TA=I_2$ $\therefore AA^T=A^TA=I_2$ $\therefore$ A is orthogonal	1 1
29.	$y = x^2 +3x -2$ $\frac{dy}{dx}=2x +3$ at (1,2) $\Rightarrow$ m = 5 Equation of the tangent: $5x-y-3=0$	1 1
30.	$e^{\cos\theta+i\sin\theta} = e^{\cos\theta}e^{i\sin\theta}$ $= e^{\cos\theta}[\cos(\sin\theta) + i\sin(\sin\theta)]$ (or) $= e^{\cos\theta}\cos(\sin\theta) + i\,e^{\cos\theta}\sin(\sin\theta)$	2

PART – III

31.	The equation of parabola is $(x+1)^2 = 4a\,(y + 2)$ It passes (3,6) $\Rightarrow$ $a = \frac{1}{2}$ $(x+1)^2 = 2\,(y+2)$ (or) $x^2 + 2x - 2y - 3 = 0$	1 1 1
32.	The maximum distance = $a+ae=152 \times 10^6$-------(1) The minimum distance = $a-ae= 94.5 \times 10^6$-------(2) (1)- (2) $2ae = (152- 94.5) \times 10^6$ $= 57.5 \times 10^6$ $= 575 \times 10^5$ The distance from the Sun to the other focus = 575×10^5	1 2
33.	The Domain is $-1<3x-1<0$ $0<3x<1$ $0< x<\frac{1}{3}$ (or) $x \in (0, \frac{1}{3})$	1 2
34.	$\hat{b}= 2\hat{\imath}+2\hat{\jmath} -\hat{k}$ and $\lvert\hat{b}\rvert=\sqrt{4+4+1} =\sqrt{9} =3$ The direction cosines of the straight line are $\frac{2}{3}, \frac{2}{3}, \frac{-1}{3}$ $\cos\alpha = \frac{2}{3}$, $\cos\beta = \frac{2}{3}$ and $\cos\gamma=\frac{-1}{3}$ $\alpha =\cos^{-1}\left(\frac{2}{3}\right)$, $\beta= \cos^{-1}\left(\frac{2}{3}\right)$ and , $\gamma = \cos^{-1}\left(\frac{-1}{3}\right)$	1 2
35.	Let $f(x) =(x)^{\frac{2}{3}}$, $x_0=125$ and $\Delta x = -2$ $f'(x) = \frac{2}{3}x^{\frac{-1}{3}} \Rightarrow f'(x) = \frac{2}{3x^{\frac{-1}{3}}}$ $L(x) = f(x_0)+ f'(x_0)(x - x_0)$ $L(x) =(125)^{\frac{2}{3}}+\frac{2}{3(125)^{\frac{1}{3}}}(x - 125)$ $(123)^{\frac{2}{3}} \approx 24.73$	1 1 1
36.	$\cos y\, dy = \frac{e^x(x\log x+1)}{x}dx$ $= e^x\left(\log x + \frac{1}{x}\right)dx$ Integrating weget, $\sin y = e^x \log x+c$	1 2
37.	$\lvert F(\alpha)\rvert = 1$ $\text{adj}[F(\alpha)] = \begin{bmatrix} \cos\alpha & 0 & -\sin\alpha \\ 0 & 1 & 0 \\ \sin\alpha & 0 & \cos\alpha \end{bmatrix}$ $[F(\alpha)]^{-1} = \begin{bmatrix} \cos\alpha & 0 & -\sin\alpha \\ 0 & 1 & 0 \\ \sin\alpha & 0 & \cos\alpha \end{bmatrix} = [F(-\alpha)]$	1 2

<table>
<tr><td>38.</td><td><table><tr><td>p</td><td>q</td><td>$p \to q$</td><td>$q \to p$</td></tr><tr><td>T</td><td>T</td><td>T</td><td>T</td></tr><tr><td>T</td><td>F</td><td>F</td><td>T</td></tr><tr><td>F</td><td>T</td><td>T</td><td>F</td></tr><tr><td>F</td><td>F</td><td>T</td><td>T</td></tr></table>Last two columns are not equal
$p \to q \neq q \to p$</td><td>2
1</td></tr>
<tr><td>39.</td><td>Z = (2+3i)(1-i) =5+i
$z^{-1} = \frac{1}{z} = \frac{1}{5+i} = \frac{10-24i}{52}$
$z^{-1} = \frac{5}{26} - \frac{1}{26}i$</td><td>2
1</td></tr>
<tr><td>40.</td><td>a+b+c=0 and b+c=-a,c+a=-b,a+b=-c
$(b+c-a)x^2+(c+a-b)x+(a+b-c)=0$
$(-2a)x^2+(-2bx)x+(-2c)=0$
$ax^2+bx+c=0$
$\Delta= b^2-4ac=(c-a)^2>0$
The roots are rational</td><td>2
1</td></tr>
<tr><td colspan="3">PART – IV</td></tr>
<tr><td>41.(a)</td><td>$z^3+8i=0 \Rightarrow z =[2^3(-i)]^{\frac{1}{3}}$
$= 2\left[\cos\left(\frac{-\pi}{2}\right)+i\sin\left(\frac{-\pi}{2}\right)\right]^{\frac{1}{3}}$
$= 2\left[\cos\left(2k\pi-\frac{\pi}{2}\right)+i\sin\left(2k\pi-\frac{\pi}{2}\right)\right]^{\frac{1}{3}}$
$= 2\left[\cos(4k-1)\frac{\pi}{2}+i\sin(4k-1)\frac{\pi}{2}\right]^{\frac{1}{3}}$
$z= 2\left[\cos(4k-1)\frac{\pi}{6}+i\sin(4k-1)\frac{\pi}{6}\right]$ k = 0,1,2
Put k = 0,1,2 ⇒ $z = \sqrt{3}$- i , 2i , $-\sqrt{3}$-i
∴ The values of z are $\sqrt{3}$-i, 2i and $-\sqrt{3}$-i
Note: Any other method</td><td>1
1
1
2</td></tr>
<tr><td>41.(b)</td><td>$(1+x+xy^2)\frac{dy}{dx} = -(y+y^3)$
$\frac{dx}{dy} + \frac{1}{y}x = -\frac{1}{y(1+y^2)}$
I.F = y
∴The general solution is
x(I.F)=$\int Q(\text{I. F})dy + c$
$xy = \int \frac{-1}{y(1+y^2)} y\, dy$ +c
$\therefore xy = -\tan^{-1}y$+c</td><td>1
1
1
2</td></tr>
</table>

42.(a)	Diagram  $\vec{OA}$ = cos $\alpha\vec{i}$+sin $\alpha\vec{j}$; $\vec{OB}$ = cos β$\vec{j}$+sin β$\vec{j}$ $\vec{OA}$. $\vec{OB}$ = cos αcos β + sin α sin β) . . .(1) By definition $\vec{OA}$. $\vec{OB}$ = $\lvert\vec{OA}\rvert\lvert\vec{OB}\rvert$cos ($\alpha$- β) = cos ($\alpha$- β) . . .(1) From (1) and (2) cos ($\alpha -$ β) = cos α cos β + sin α sin β	1 1 1 1 1
42.(b)	i)k = $\frac{1}{400}$ ii)F(x) = $\begin{cases} 0 \quad for \quad x < 200 \\ \frac{x}{400} - \frac{1}{2} \; for \; 200 \le x \le 600 \\ 1 \; for \; x > 600 \end{cases}$ iii) P$(300 < x < 500) = \frac{1}{2}$	1 3 1
43.(a)	$18x^2 + 12y^2 - 144x + 48y + 120 = 0$ $\frac{(x-4)^2}{12} + \frac{(y+2)^2}{18} = 1 \Rightarrow \frac{X^2}{12} + \frac{Y^2}{18} = 1$ $a^2 = 18 \Rightarrow a = 3\sqrt{2}$; $b^2 = 12 \Rightarrow b = 2\sqrt{3}$ $(ae)^2 = a^2 - b^2 = ae = \sqrt{6}$ and $e = \frac{1}{\sqrt{3}}$; $\frac{a}{e} = 3\sqrt{6}$ Center : (4,-2) , Vertex : A(4,$3\sqrt{2}$ -2), A^1(4,-$3\sqrt{2}$ -2) Focus :S(4,$\sqrt{6}$-2), S^1(4,-$\sqrt{6}$-2) Equation of diectrices Y = $\pm\frac{a}{e} \Rightarrow$ y = -2 $\pm 3\sqrt{6}$	1 2 1 1
43.(b)	$\cos^{-1} x + \cos^{-1} y + \cos^{-1} z = \pi$ $\alpha + \beta + \cos^{-1} z = \pi \Rightarrow \alpha + \beta = \pi - \cos^{-1} z$ ---------(1) cos(α + β) = cosα cosβ+ sinαsinβ cos $(\pi - \cos^{-1} z)$ = xy-$\sqrt{1-x^2}\sqrt{1-y^2}$ -cos$(\cos^{-1} z)$= xy-$\sqrt{1-x^2}\sqrt{1-y^2}$ z+ xy = $\sqrt{1-x^2}\sqrt{1-y^2}$ Squaring on bothsides, we get, $(z+xy)^2 = (1-x^2)(1-y^2)$ $z^2+x^2y^2+2xyz=1-y^2-x^2+x^2y^2$ $x^2+y^2+z^2+2xyz = 1$	1 2 2
44.(a)	36a-6b+c=8 ------ (1) , 4a-2b+c=-12 ----- (2), 9a+3b+c=8 ---------- (3) $[A\|B] = \left[\begin{array}{ccc\|c} 36 & -6 & 1 & 8 \\ 4 & -2 & 1 & -12 \\ 9 & 3 & 1 & 8 \end{array}\right] \sim \left[\begin{array}{ccc\|c} 4 & -2 & 1 & -12 \\ 36 & -6 & 1 & 8 \\ 9 & 3 & 1 & 8 \end{array}\right] R_2 \leftrightarrow R_2$ $\sim \left[\begin{array}{ccc\|c} 1 & \frac{-1}{2} & \frac{1}{4} & -3 \\ 0 & 12 & -8 & 116 \\ 0 & 0 & 6 & -60 \end{array}\right] R_3 \rightarrow 12R_3 - R_2$ ∴ a=1, b=3 and c = -10	1 2

$y = x^2+3x-10$

$60=60$

Yes, he meet his friend 2

44.(b) $x^2+4y^2 = 8$ ……….(1) and $x^2-2y^2 = 4$ ……….(2)

$y^2 = \frac{4}{6}$ and $x^2 = \frac{16}{3}$ 1

$m_1=-\frac{x}{4y}$ and $m_2=-\frac{x}{2y}$ 2

$m_1 \times m_2=\left(-\frac{x}{4y}\right)\times\left(\frac{x}{2y}\right)=\frac{x^2}{8y^2}$ 1

$m_1 \times m_2=-\frac{16/3}{8(2/3)} = -1$

So, the given curves cut orthogonally. 1

45.(a) $\vec{a}=\hat{\imath}-\hat{\jmath}+3\hat{k}$; $\vec{u}=2\hat{\imath}-\hat{\jmath}+4\hat{k}$; $\vec{v}=\hat{\imath}+2\hat{\jmath}+\hat{k}$ 2

Parametric form

$\vec{r}=(\hat{\imath}-\hat{\jmath}+3\hat{k})+s(2\hat{\imath}-\hat{\jmath}+4\hat{k})+t(\hat{\imath}+2\hat{\jmath}+\hat{k})$ 1

Cartesian form

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

$9x-2y-5z+4=0$ 2

45.(b) Given $\frac{1}{3}$ is a solution.

This is reciprocal equation 1

$\therefore$ 3 is an other root.

$6x^2+15x+6=0$ is another factor. 1

$2x^2+5x+2=0$

$x=\frac{-1}{2}, x=-2$ 2

$\frac{1}{3}$	6	-5	-38	-5	6
	0	2	-1	-13	-6
3	6	-3	-39	-18	0
	0	18	45	18	
	6	15	6	0	

$\therefore$ The solutions of the given equation are $\frac{1}{3}$, 3, $\frac{-1}{2}$, -2 1

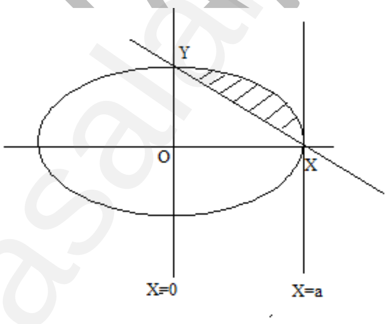
46.(a) p→(¬qVr) ≡ ¬ pV(¬qVr)

p	q	r	¬ p	¬ q	(¬qVr)	p→(¬qVr)	¬ pV(¬qVr)
T	T	T	F	F	T	T	T
T	T	F	F	F	F	F	F
T	F	T	F	T	T	T	T
T	F	F	F	T	T	T	T
F	T	T	T	F	T	T	T
F	T	F	T	F	T	T	T
F	F	T	T	T	T	T	T
F	F	F	T	T	T	T	T

5

Last two columns are identical.

$\therefore$ p→(¬qVr) ≡ ¬ pV(¬qVr)

46.(b)	Let A be amount at time t	
	$\frac{dA}{dt}\, \alpha\, A \Rightarrow \frac{dA}{dt} = kA$	1
	$\Rightarrow \frac{dA}{dt} = 0.05A \Rightarrow A = Ce^{0.05t}$	1
	When t = 0,A = 10,000 $\Rightarrow$ C=10,000	1
	When t =1.5 $\Rightarrow$ A = 10,000 $e^{0.075}$	2
47.(a)	y = $\frac{logx}{x}$	
	$\frac{dy}{dx}$= $\frac{1-logx}{x^2}$ and $\frac{d^2y}{dx^2}$= $\frac{-3+2logx}{x^3}$	2
	$\frac{dy}{dx}$ = 0$\Rightarrow x = e$	1
	If x= e $\Rightarrow \frac{d^2y}{dx^2} = \frac{-1}{e^3} < 0$ (It has local maximum)	1
	When x= e $\Rightarrow$ y =$\frac{1}{e}$	
	The local max value is: $\frac{1}{e}$	1
47.(b)	Diagram 	1
	$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$---------(1)	
	$\frac{x}{a} + \frac{y}{b} = 1$--------(2)	
	Point of intersectionis:	
	(0,b) and (a,0)	1
	(1)$\Rightarrow y = \frac{b}{a}\sqrt{a^2 - x^2}$	
	(2)$\Rightarrow$y=$\frac{b}{a}$(a-x)	
	Required area A=$\int_0^a \left[\frac{b}{a}\sqrt{a^2 - x^2} - \frac{b}{a}(a - x)\right]$ dx	2
	$= \frac{ab}{4}(\pi - 2)$sq units.	1

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