SHRI VIDHYABHARATHI MATRIC HR.SEC.SCHOOL

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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 $\lvert\lvert z_1\rvert-\lvert z_2\rvert\rvert \leq \lvert z_1+z_2\rvert \leq \lvert z_1\rvert+\lvert z_2\rvert$ $\lvert 2-5\rvert \leq \lvert z+3+4i\rvert \leq 2+5$ $3 \leq \lvert z+3+4i\rvert \leq 7$		2

22.	$lx^2+nx+n=0 \Rightarrow \quad p+q=\frac{-n}{l}$ 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

38.

p	q	$p \to q$	$q \to p$
T	T	T	T
T	F	F	T
F	T	T	F
F	F	T	T

2

Last two columns are not equal

$p \to q \neq q \to p$ 1

39.

Z = (2+3i)(1-i) =5+i

$z^{-1} = \frac{1}{z} = \frac{1}{5+i} = \frac{10-24i}{52}$ 2

$z^{-1} = \frac{5}{26} - \frac{1}{26}i$ 1

40.

a+b+c=0 and b+c=-a,c+a=-b,a+b=-c

$(b+c-a)x^2 + (c+a-b)x + (a+b-c) = 0$

$(-2a)x^2 + (-2bx)x + (-2c) = 0$

$ax^2 + bx + c = 0$

$\Delta = b^2 - 4ac = (c-a)^2 > 0$ 2

The roots are rational 1

PART – IV

41.(a)

$z^3+8i=0 \Rightarrow z = [2^3(-i)]^{\frac{1}{3}}$

$= 2\left[cos\left(\frac{-\pi}{2}\right) + isin\left(\frac{-\pi}{2}\right)\right]^{\frac{1}{3}}$ 1

$= 2\left[cos\left(2k\pi - \frac{\pi}{2}\right) + isin\left(2k\pi - \frac{\pi}{2}\right)\right]^{\frac{1}{3}}$ 1

$= 2\left[cos(4k-1)\frac{\pi}{2} + isin(4k-1)\frac{\pi}{2}\right]^{\frac{1}{3}}$

$z = 2\left[cos(4k-1)\frac{\pi}{6} + isin(4k-1)\frac{\pi}{6}\right]$ k = 0,1,2 1

Put k = 0,1,2 $\Rightarrow$ z = $\sqrt{3}$- i , 2i , $-\sqrt{3}$-i 2

$\therefore$ The values of z are $\sqrt{3}$-i, 2i and $-\sqrt{3}$-i

Note: Any other method

41.(b)

$(1 + x + xy^2)\frac{dy}{dx} = -(y + y^3)$

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

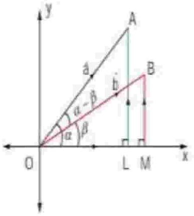
I.F = y 1

$\therefore$ The general solution is

$x(\text{I.F}) = \int Q(\text{I.F})dy + c$

$xy = \int \frac{-1}{y(1+y^2)} y\, dy + c$ 1

$\therefore xy = -\tan^{-1}y + c$ 2

42.(a)	Diagram  $\overrightarrow{OA} = \cos\alpha\vec{i} + \sin\alpha\vec{j}$; $\overrightarrow{OB} = \cos\beta\vec{j} + \sin\beta\vec{j}$ $\overrightarrow{OA} \cdot \overrightarrow{OB} = \cos\alpha\cos\beta + \sin\alpha\sin\beta)$ . . .(1) By definition $\overrightarrow{OA} \cdot \overrightarrow{OB} = \lvert\overrightarrow{OA}\rvert\lvert\overrightarrow{OB}\rvert\cos(\alpha - \beta) = \cos(\alpha - \beta)$ . . .(1) From (1) and (2) $\cos(\alpha - \beta) = \cos\alpha\cos\beta + \sin\alpha\sin\beta$	1 1 1 1 1
42.(b)	i)$k = \frac{1}{400}$ ii)$F(x) = \begin{cases} 0 & for \quad x < 200 \\ \frac{x}{400} - \frac{1}{2} & for\ 200 \le x \le 600 \\ 1 & for\ x > 600 \end{cases}$ 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) $\cos(\alpha + \beta) = \cos\alpha\cos\beta + \sin\alpha\sin\beta$ $\cos(\pi - \cos^{-1}z) = xy - \sqrt{1-x^2}\sqrt{1-y^2}$ $-\cos(\cos^{-1}z) = xy - \sqrt{1-x^2}\sqrt{1-y^2}$ $z + xy = \sqrt{1-x^2}\sqrt{1-y^2}$ 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) $[A\vert B] = \left[\begin{matrix} 36 & -6 & 1 \\ 4 & -2 & 1 \\ 9 & 3 & 1 \end{matrix}\right\vert\left.\begin{matrix} 8 \\ -12 \\ 8 \end{matrix}\right] \sim \left[\begin{matrix} 4 & -2 & 1 \\ 36 & -6 & 1 \\ 9 & 3 & 1 \end{matrix}\right\vert\left.\begin{matrix} -12 \\ 8 \\ 8 \end{matrix}\right] R_2 \leftrightarrow R_2$ $\sim \left[\begin{matrix} 1 & \frac{-1}{2} & \frac{1}{4} \\ 0 & 12 & -8 \\ 0 & 0 & 6 \end{matrix}\right\vert\left.\begin{matrix} -3 \\ 116 \\ -60 \end{matrix}\right] R_3 \to 12R_3 - R_2$ $\therefore$ 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

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

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

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

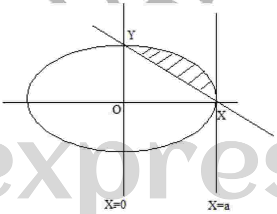
$\frac{1}{3}$	6	-5	-38	-5	6
	0	2	-1	-13	-6
3	6	-3	-39	-18	0
	0	18	45	18	
	6	15	6	0	

46.(a) p→(¬q∨r) ≡ ¬ p∨(¬q∨r) 5

p	q	r	¬ p	¬ q	(¬q∨r)	p→(¬q∨r)	¬ p∨(¬q∨r)
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

Last two columns are identical.

$\therefore$ p→(¬q∨r) ≡ ¬ p∨(¬q∨r)

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

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