MARKING SCHEME
SAMPLE PAPER CLASS XI
MATHEMATICS 2023-24

Q. No.	Key points	Value Point	Total
1.	(c) { x: x = $\frac{1}{2^n}$, n ϵ Z and n ≥ -1 }	1	1
2.	(a) 7	1	1
3.	(c) breadth≥ 20	1	1
4.	(c) 300	1	1
5.	(c) 12	1	1
6.	(d) (3,4,-5)	1	1
7.	(c)x + y = 5	1	1
8.	(d) 0	1	1
9.	(c) 2	1	1
10.	(b)$\frac{2}{11}$	1	1
11.	(c) {I,A,T,E}	1	1
12.	(d) 2^{pq} - 1	1	1
13.	(b) 6 π	1	1
14.	(a)(10, ∞)	1	1
15.	(b) a = 2, b = -3	1	1
16.	(c)51	1	1
17.	(c) -1	1	1
18.	(d)$\frac{1}{25}$	1	1
19.	(a)Both A and R are true and R is the correct explanation of A	1	1

20.	(d) A is false but R is true.	1	1
21.	Φ, {K}, {I}, {T}, {E}, {K,I}, {K,T}, {K,E},{I,T},{I,E},{T,E},{K,I,T}, {K,I,E},{I,T,E},{K,T,E},{K,I,T,E} Or Let x ∈ P - R ⇒ x ∈ P but x ∉ R ⇒ x ∈ P but x ∉ Q (Q ⊂ R) ⇒ x ∈ P- Q ⇒ P - R ⊂ P - Q.	2 ½ ½ ½ ½	2 2
22.	$\lim_{x\to 0} \frac{\sqrt{9+x}-3}{x}$ $= \lim_{x\to 0} \frac{\sqrt{9+x}-3}{x} \times \frac{\sqrt{9+x}+3}{\sqrt{9+x}+3}$ $= \lim_{x\to 0} \frac{(9+x)-9}{x(\sqrt{9+x}+3)}$ $= \lim_{x\to 0} \frac{1}{(\sqrt{9+x}+3)}$ $= \frac{1}{6}$	½ ½ ½ ½	2
23.	AB = $\sqrt{(2-0)^2+(3-4)^2+(-1-1)^2}$ = $\sqrt{2^2+(-1)^2+(-2)^2}$ = 3 BC = $\sqrt{(4-2)^2+(5-3)^2+(0+1)^2}$ = $\sqrt{2^2+2^2+1}$ = 3 AC = $\sqrt{(4-0)^2+(5-4)^2+(0-1)^2}$ = $\sqrt{4^2+(1)^2+(-1)^2}$ = $\sqrt{18}$ $AB^2+BC^2=3^2+3^2=18=AC^2$ Hence, A, B and C are the vertices of a right angled triangle.	½ ½ ½ ½	2

24.	a = 18, r = -⅔ Using nth term of G.P., $18 \times \left(-\frac{2}{3}\right)^{n-1} = \frac{512}{729}$ $\Rightarrow \left(-\frac{2}{3}\right)^{n-1} = \frac{256}{6561}$ $\Rightarrow \left(-\frac{2}{3}\right)^{n-1} = \left(-\frac{2}{3}\right)^{8}$ $\Rightarrow$ n = 9 Or $2.2^{\frac{2}{3}}.2^{\frac{4}{9}}.\ 2^{\frac{8}{27}}$………… $\infty = 2^{1+\frac{2}{3}+\frac{4}{9}+\frac{8}{27}+\dots\dots}$ Using sum of infinite GP, $1 + \frac{2}{3} + \frac{4}{9} + \frac{8}{27} + \dots\dots$ $= \frac{1}{1-\frac{2}{3}}$ = 3 Therefore, $2^{1+\frac{2}{3}+\frac{4}{9}+\frac{8}{27}+\dots\dots} = 2^3 = 8$	½ ½ ½ ½ ½ ½ ½ ½	2 2
25.	$4^n = (1+3)^n$ $= nc_0 1^n 3^0 + n_{C_1} 1^{n-1} 3^1 + n_{C_2} 1^{n-2} 3^2 + n_{C_3} 1^{n-3} 3^3 \dots\dots\dots n_{C_n} 3^n$ $4^n = n_{C_0} 3^0 + n_{C_1} 3^1 + n_{C_2} 3^2 + n_{C_3} 3^3 \dots\dots\dots n_{C_n} 3^n$ $4^n = \sum_{r=0}^{n} 3^r\, nC_r$	1 1	2
26.	For x = 0, y = $\pm$ 8 Therefore, R = {(0, 8), (0, -8), (8, 0), (-8, 0)} Domain of R = {-8, 0, 8} Range of R = {-8, 0, 8}	1 1 1	3
27.	Let water added be = x lt.		

	pure acid = $\frac{35}{100} \times 1350 = \frac{47250}{100} = 472.50$ $\frac{15}{100}(1350 + x) < \frac{47250}{100} < \frac{30}{100}(1350 + x)$ $15(1350 + x) < 47250 < 30(1350 + x)$ $1350 + x < 3150 < 2700 + 2x$ $1350 + x < 3150$ $x < 3150 - 1350$ $x < 1800$-------(1) $3150 < 2700 + 2x$ $3150 - 2700 < 2x$ $450 < 2x$ $225 < x$------(2) from eq(1) and eq(2) $225 < x < 1800$ Amount of water to be added should be more than 225ml but less than 1800ml.	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	3
28.	(1+i)(1+2i)(1+3i)......(1+ni) = a+ib .... (1) Taking conjugate on both sides, we get (1-i)(1-2i)(1-3i)......(1-ni) = a-ib ....(2) Multiplying (1) and (2), we get 2.5.10.....(1+ n^2) = $a^2 + b^2$	½ 1 1½	3
29.	(1 + tanA)(1 + tanB) = 2 ⇒ 1 + tan A + tan B + tan A tan B = 2 ⇒ tan A + tan B + tan A tan B = 1 ⇒ tan A + tan B = 1- tan A tan B ⇒ $\frac{\tan A + \tan B}{1 - \tan A \tan B}$ = 1 ⇒ tan(A+ B) = 1 ⇒ A + B = $\frac{\pi}{4}$	½ ½ 1 ½ ½	3
30.	Let f(x) = $\frac{1 + \tan x}{1 - \tan x}$ **Differentiate w.r.t. x** **f'(x) =** $\frac{(1 - \tan x)\frac{d}{dx}(1 + \tan x) - (1 + \tan x)\frac{d}{dx}(1 - \tan x)}{(1 - \tan x)^2}$ = $\frac{(1 - \tan x)(\sec^2 x) - (1 + \tan x)(-\sec^2 x)}{(1 - \tan x)^2}$ = $\frac{2\sec^2 x}{(1 - \tan x)^2}$	1 1 ½	3

	$= \frac{2}{(\cos x - \sin x)^2}$ $= \frac{2}{(1 - \sin 2x)}$ **Or** f(x) = $x \cos x$ f'(x) = $\lim_{h\to 0} \frac{f(x+h) - f(x)}{h}$ $= \lim_{h\to 0} \frac{(x+h)\cos(x+h) - x\cos x}{h}$ $= \lim_{h\to 0} \frac{x[\cos(x+h) - \cos x]}{h} + \lim_{h\to 0} \frac{(h)\cos(x+h)}{h}$ $= \lim_{h\to 0} \frac{x[-2\sin\frac{(2x+h)}{2}\sin\frac{h}{2}]}{h} + \lim_{h\to 0} \cos(x+h)$ $= \lim_{h\to 0} \frac{x[-2\sin\frac{(2x+h)}{2}\sin\frac{h}{2}]}{2h/2} + \lim_{h\to 0} \cos(x+h)$ = -x sinx + cos x	½ 1 ½ ½ ½ ½	3
31.	Let (a,b) be a moving point. Distance between (a,b) and the point(3,-2) $= \sqrt{(a-3)^2 + (b+2)^2}$ And the distance of (a,b) from the line 5x-12y=3 $= \left\lvert\frac{5a-12b-3}{\sqrt{25+144}}\right\rvert = \left\lvert\frac{5a-12b-3}{13}\right\rvert$ According to the question, $\left[\sqrt{(a-3)^2 + (b+2)^2}\right]^2 = \left\lvert\frac{5a-12b-3}{13}\right\rvert$ $13\left[(a-3)^2 + (b+2)^2\right] = \lvert 5a - 12b - 3\rvert$ Hence the equation of locus is $13\left[(x-3)^2 + (y+2)^2\right] = \lvert 5x - 12y - 3\rvert$ OR Given equations are 4x+y-1= 0 .... (1) 7x-3y-35 = 0 .... (2)	½ ½ 1 ½ ½ 1 ½	3

	Solving (1) and (2) X = 2 and y = -7 Equation of line joining the point (3,5) to the point (2,-7) is y-5 = $\frac{-7-5}{2-3}$ (x-3) 12x-y-31=0 ………….. (3) Distance of (3) from origin is $\left\|\frac{-31}{\sqrt{12^2+(-1)^2}}\right\| = \frac{31}{\sqrt{145}}$	½ 1	3
32.	tan $x = -\frac{4}{3}$. x is in IV quadrant ⇒ secx = $\frac{5}{3}$ and cos x = $\frac{3}{5}$ Since, $\frac{3\pi}{2} \leq x \leq 2\pi$ ⇒ $\frac{3\pi}{4} \leq \frac{x}{2} \leq \pi$ sin $\frac{x}{2} = \sqrt{\frac{1-cosx}{2}} = \frac{1}{\sqrt{5}}$ cos $\frac{x}{2} = \sqrt{\frac{1+cosx}{2}} = \frac{-2}{\sqrt{5}}$ tan $\frac{x}{2} = \frac{sin\frac{x}{2}}{cos\frac{x}{2}}$ = - $\frac{1}{2}$ Or $\sin^2 x + \sin^2 (x + \frac{\Pi}{3}) + \sin^2 (x - \frac{\Pi}{3})$ $= \frac{1-cos2x}{2} + \frac{1-cos2(x+\frac{\Pi}{3})}{2} + \frac{1-cos2(x-\frac{\Pi}{3})}{2}$ $= \frac{3}{2} - \frac{1}{2}$[cos 2x + cos 2(x + $\frac{\Pi}{3}$) + cos 2(x - $\frac{\Pi}{3}$)] $= \frac{3}{2} - \frac{1}{2}$[cos2x + 2cos2x cos $\frac{2\Pi}{3}$] $= \frac{3}{2} - \frac{1}{2}$[cos2x - cos2x] $= \frac{3}{2}$	1 1 1 1 1 1½ 1 1 1 ½	5 5
33.			

x	f	$d_i = x_i - 23$	d_i^2	$f_i d_i$	$f_i d_i^2$
18	3	-5	25	-15	75
19	7	-4	16	-28	102

20	11	-3	9	-33	99		
21	14	-2	4	-28	56		
22	18	-1	1	-18	18		
23	17	0	0	0	0		
24	13	1	1	13	13	3	5
25	8	2	4	16	32		
26	5	3	9	15	45		
27	4	4	16	16	64		
	100			-62	514		

1

$\sigma^2 = \frac{1}{N}(\Sigma fi\, d_i^2) - (\frac{1}{N}\Sigma fi d_i)^2 = \frac{514}{100} - (\frac{-62}{100})^2 = \frac{47556}{10000} = 4.7556$ 1

Hence, $\sigma = \sqrt{4.7556} = 2.1807$

34. Let centre be O(h, k) and point on circle be A(20, 3), B(19, 8), C(2,-9)

OA=OB (radii of same circle)

$OA^2=OB^2$

$$(h - 20)^2 + (k - 3)^2 = (h - 19)^2 + (k - 8)^2$$

$\Rightarrow h = 5k - 8$ -----(1) 1

OA=OC (radii of same circle)

$OA^2=OC^2$

$$(h - 20)^2 + (k - 3)^2 = (h - 2)^2 + (k + 9)^2$$

$3h + 2k = 27$ .... (2)

Putting value of h from equation (1) in equation (2), we get 1

$$3[5k - 8] + 2k = 27$$

$\Rightarrow k = 3$

$\therefore h = 5\times(3) - 8 = 15 - 8$

$\Rightarrow h = 7$ $\therefore$centre is O(7,3) 1

$$r = OC = \sqrt{(7 - 2)^2 + (3 + 9)^2}$$ 1

	$r = \sqrt{25 + 144} = \sqrt{169}$ $r = 13.$ Centre = (7,3) and Radius(r) = 13 units OR $Foci = (\pm 1, 0) \quad \therefore c = 1$ $e = \frac{1}{2} = \frac{c}{a}$ $\Rightarrow \frac{1}{2} = \frac{1}{a}$ ⇒ a = 2 $a^2 = b^2 + c^2$ $2^2 = b^2 + 1^2$ $4 = b^2 + 1$ $b^2 = 4 - 1$ $b^2 = 3$ $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1,\ equation\ of\ ellipse$ $\frac{x^2}{4} + \frac{y^2}{3} = 1$ is the required equation.	1 1 1/2 1 1/2 1 1	5 5
35.	The word MATHEMATICS has 2Ms,2Ts,2As and 1 each of H,E,I,CandS. Thus 4 letters can be chosen in 3 ways. CaseI. 2 alike of one kind and 2 alike of the second kind. Number of words = C(3,2) x $\frac{4!}{2!2!}$ =18 Case II. 2 alike of one kind and 2 different. Number of words = C(3,2) x C(7,2) $\frac{4!}{2!}$ = 756	½ 1½ 1	5

	Case III. All different letters. Number of words = C(8,4) ×4!=1680 So total number of words =2454	1½ ½	
36.	(i) 5 (ii) 50 - 40 = 10 (iii) 35 Or (iii) 17	1 1 2	4
37.	(i)P(blue or white slip)= $\frac{3}{8}$ (ii)P(slip numbered 1,2,3,4 or 5)= $\frac{1}{4}$ (iii)P(red or yellow slip numbered 1,2,3 or 4)= $\frac{1}{10}$ Or (iii)P(slip numbered 20,30 or 40)=$\frac{3}{80}$	1 1 2	4
38.	(i) Distance travelled by the snail forms a G.P. 1, $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, ... a = 1, r = $\frac{1}{2}$ distance travelled in 5th hour, a_5 = 1/16 (ii) a = 1, r = $\frac{1}{2}$ S_n = 3 ⇒ S_n = 1 $\frac{(1-(\frac{1}{2})^n)}{(1-\frac{1}{2})}$ ⇒ $3 = 2\left(1 - (\frac{1}{2})^n\right)$ ⇒ $\frac{3}{2} = 1 - (\frac{1}{2})^n$ ⇒ $(\frac{1}{2})^n$ = - $\frac{1}{2}$	1 1 $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	4

	Which is not possible. Hence, it will never reach its target.	$\frac{1}{2}$	