SAMPLE QUESTION PAPER
CLASS – XI
MATHEMATICS

General Instructions
Time Allowed: 3 Hours **Maximum**
marks: 100

1. All questions are compulsory.
2. The question paper consists of 30 questions divided into four sections A, B, C and D.
3. Section A contains 6 questions of 1 mark each, which are multiple choice type questions. Section B contains 6 questions of 2 marks each, Section C contains 13 questions of 4 marks each and Section D contains 5 questions of 6 marks each.
4. There is no overall choice in the paper. However, internal choice is provided in one questions of 2 marks, three questions of 4 marks each and one questions of 6 marks each. In questions with choices, only one of the choices is to be attempted.
5. Use of calculators is not permitted.

Section – A

Question numbers 1 to 6 carry 1 mark each. *In each question, four options are provided, out of which only one is correct. Select the correct option.*

1. The Set $A = \{x : x \in R, -4 \leq x < 9\}$ written as an interval is
(A) $[-4, 9]$ (B) $(-4, -9)$ (C) $[-4, 9)$ (D) $(-4, 9]$

2. If $\left[\frac{1+i}{1-i}\right]^x = 1$ and n is any natural number then the value of x is
(A) 2n + 1 (B) 4n (C) 4n + 1 (D) 2n – 1

3. The co-efficient of middle term in the expansion of $(1-x)^6$ is:
(A) ${}^6C_3$ (B) $-{}^6C_3$ (C) ${}^6C_4$ (D) $-{}^6C_4$

4. The length of the major axis of the ellipse $2x^2 + 3y^2 = 6$ is
(A) $2\sqrt{2}$ (B) $2\sqrt{3}$ (C) $\sqrt{6}$ (D) $\sqrt{3}$

5. The positive value of k for which the distance between the points P (3, –2, 4) and Q (5, 3, k) is $3\sqrt{6}$ units, is
(A) 1 (B) 5 (C) 4 (D) 9

6. A card is drawn at random from a well shuffled pack of playing cards. The probability of getting a king or a red card is
(A) $\frac{17}{52}$ (B) $\frac{4}{3}$ (C) $\frac{7}{13}$ (D) $\frac{15}{26}$

Section – B

Question numbers 7 to 12 carry two marks each.

7. Draw the graph of the function $f(x) = |2x - 1|, x \in R$.

8. Find the domain and range of the function $g(x) = \frac{1}{(x^2 - 2x)}$

9. Draw the graph of $f(x) = \cos 2x, -\pi \leq x \leq \pi$

10. The product of three numbers in AP is 1155, and the largest number is 1 more than twice the smallest number. Find the numbers.

11. Evaluate : $\lim_{x \to 0} \frac{\sin ax + bx}{ax + \sin bx}$ $a, b, a + b \neq 0$

12. The variance of 20 observations is 5. If each observation is multiplied by 2, find the new variance of the resulting observations.

OR

The mean and variance of eight observations are 9 and 9.25 respectively. If six of the observations are 6,7,10,12,12 and 13, find the remaining two observations.

Section – C

Question numbers 13 to 25 carry 4 marks each.

13. Give A= {1,2,3,4}, B = {3,4,5,6,} and C = {1,3,5} Verify that $A - (B \cup C) = (A-B) \cap (A-C)$

14. If in a triangle ABC, acosA = bcosB, prove that either the triangle is isosceles or right angled.

OR

If $\tan x = \frac{3}{4}, \pi < x < \frac{3\pi}{2}$, find the value of the $\tan \frac{x}{2}$.

15. Find the value of $\theta \in R$ such that $\frac{3+2i\sin\theta}{1-2i\sin\theta}$ is purely real.

OR

Solve for x: $2x^2 - (3+7i)x + (9i - 3) = 0$

16. Solve the following system of inequalities graphically:

$2x + y \geq 4,\ x + y \leq 3, 2x - 3y \leq 6$

17. In how many ways 5 girls and 4 boys can be seated in a row, so that no two boys are together?

18. If ${}^nC_r : {}^nC_{r+1} = 1:2$ and ${}^nC_{r+1} : {}^nC_{r+2} = 2:3$, find n and r.

19. Determine whether the expansion of $\left(x^2 - \frac{2}{x}\right)^{18}$ will contain a term containing x^{10} ?

OR

Find numerically the greatest term in the expansion of $(2+3x)^9$, where $x = \frac{3}{2}$.

20. If p and q are the lengths of perpendiculars from the origin to the lines $x\cos\theta - y\sin\theta = k\cos 2\theta$ and $x\sec\theta + y\operatorname{cosec}\theta = k$, respectively, prove that $p^2 + 4q^2 = k^2$.

21. A circle of radius 2 units lies in the first quadrant and touches both the axes. Find the equation of another circle with centre at (6, 5) and touching the first circle externally.

22. A point R with x coordinate 4, lies on the line segment joining the points P (2, -3, 4) and Q (8, 0, 10). Find the coordinates of the point R.

23. Using first principle, find the derivative of $\cos(2x+3)$ w.r.t. x.

24. Check whether the following statement is true or not: If $x, y \in Z$ (the set of integers) are such that x and y are odd, then xy is odd.

25. Two students Anil and Ashima appeared in an examination. The probability that Anil will qualify the examination is 0.05 and that Ashima will qualify the examination is 0.10. The probability that both will qualify the examination is 0.02. Find the probability that both will not qualify the examination.

Section-D

Question numbers 26 to 30 carry 6 marks each.

26. Prove that

$$\cos^2 x + \cos^2\left(x + \frac{\pi}{3}\right) + \cos^2\left(x - \frac{\pi}{3}\right) = \frac{3}{2}$$

27. Using the Principle of Mathematical Induction, prove that $3^{2n+2} - 8n - 9$ is divisible by 8, for all $n \in N$.

OR

Prove the following by using the Principle of Mathematical Induction for all $n \in N$

$$1+\frac{1}{(1+2)}+\frac{1}{(1+2+3)}+ \cdots\cdots + \frac{1}{(1+2+3+....+n)}=\frac{2n}{n+1}$$

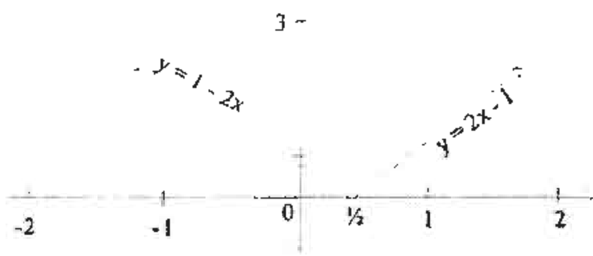
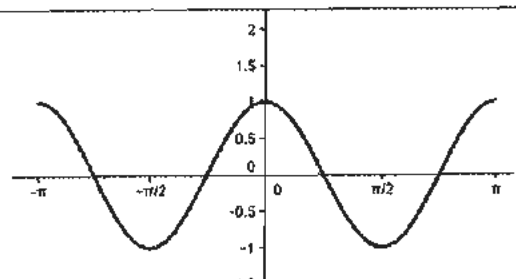
28. If a and b are the roots of $x^2-3x+p=0$ and c and d are the roots of $x^2-12x+q=0$, where a, b, c, d form a GP, prove that $(q+p):(q-p)=17:15$.

29. A person standing at the crossing of two straight paths represented by the equations $2x-3y+4=0$ and $3x+4y-5=0$ wants to reach the path whose equation is $6x-7y+8=0$ in the least time. Find the equation of the path he should follow.

30. Calculate the mean and standard deviation of the following distribution:

Classes	0 – 10	10 – 20	20 – 30	30 – 40	40 – 50	50 – 60
Frequency	15	40	20	15	5	5

Sample paper (Marking Scheme)
Class XI Maths
SECTION – A

Q. No.	Value points and solution	Marks
1 – 6	1. (C), 2. (B) 3. (B). 4. (B) 5. (D) 6. (C)	1×6 = 6
7	**SECTION – B**  (Correct Graph) $\|2x-1\| \begin{cases} = 2x-1, & x > \frac{1}{2} \\ = 0, & x = \frac{1}{2} \\ = 1-2x, & x < \frac{1}{2} \end{cases}$	1 1
8	$g(x) = \frac{1}{x^2 - 2x} = \frac{1}{x(x-2)} \Rightarrow \text{domain} : R - \{0, 2\}$ $\text{Range} : (-\infty, -1) \cup (0, \infty)$	1 1
9		2
10	Let the three numbers be a-d, a, a+d $\Rightarrow \quad a(a-d)(a+d) = 1155$ ....(1) And $\quad a + d = 2(a-d) + 1$ or $a = 3d - 1$ (1) $\quad \Rightarrow (2d-1)(3d-1)(4d-1) = (7)(11)(15)$ $\Rightarrow \quad d = 4$ and $a = 11$ $\Rightarrow \quad$ Numbers are : 7, 11, 15	½ ½ ½ ½

11	$\lim\limits_{x\to 0} \dfrac{\sin ax + bx}{ax + \sin bx} = \lim\limits_{x\to 0} \dfrac{a\dfrac{\sin ax}{ax} + b}{a + b\dfrac{\sin bx}{bx}}$ $= \dfrac{a+b}{a+b} = 1$	1 1
12	$\dfrac{\Sigma x_i^2}{20} - \left(\dfrac{\Sigma x_i}{20}\right)^2 = 5$ New $\Sigma x'_i = \Sigma(2x_i) = 2\Sigma x_i$ $\Sigma x_i'^2 = \Sigma(2x_i)^2 = 4\Sigma x_i^2$ New variance: $\dfrac{\Sigma x_i'^2}{20} - \left(\dfrac{\Sigma x'_i}{20}\right)^2 = \dfrac{4\Sigma x_i^2}{20} - 4\left(\dfrac{\Sigma x_i}{20}\right)^2 = 4(5) = 20$ **OR** Let two numbers be x and y $\Rightarrow \dfrac{6+7+10+12+12+13+x+y}{8} = 9$ $\Rightarrow x + y = 72 - 60 = 12$ ....(i) $\Rightarrow \dfrac{36+49+100+144+144+169+x^2+y^2}{8} = 9^2 = 9.25$ $\Rightarrow x^2 + y^2 = 80$ ....(ii) Solving (i) and (ii) to get x = 4, y = 8	½ ½ 1 ½ ½ 1
13	$B \cup C = \{1,3,4,5,6\} \Rightarrow A - (B \cup C) = \{2\}$ $A - B = \{1,2\}$ $A - C = \{2,4\}$ $\Rightarrow (A - B) \cap (A - C) = \{2\}$ Hence proved.	1 1+1 1
14	$a\cos A = b\cos B \Rightarrow \cancel{k}.\sin A\cos A = \cancel{k}.\sin B\cos B$ $\Rightarrow \sin 2A = \sin 2B \Rightarrow 2A = n\pi + (-1)^n.2B$ $A = n\dfrac{\pi}{2} + (-1)^n B$ for $n = 0$ $A = B$ and for $n = 1$ $\Rightarrow A + B = \dfrac{\pi}{2} \Rightarrow \angle C = 90^0$ **OR**	½ 1 ½ 1+1

Q. No.	Solution	Marks
	$\tan x = \frac{3}{4} \Rightarrow \cos x = -\frac{4}{5}$	1
	$\tan\frac{x}{2} = -\sqrt{\frac{1-\cos x}{1+\cos x}} = -\sqrt{\frac{1+\frac{4}{5}}{1-\frac{4}{5}}}$	1+1
	$\{\because \frac{x}{2}$ lies in 2^{nd} quadrant$\}$	1
	$= -\sqrt{\frac{9}{1}} = -3$	
15	$z = \frac{3+2i\sin\theta}{1-2i\sin\theta} \times \frac{1+2i\sin\theta}{1+2i\sin\theta} = \frac{(3-4\sin^2\theta)+i(8\sin\theta)}{1+4\sin^2\theta}$	2
	$\therefore$ If z is purely real, $\sin\theta = 0 \Rightarrow \theta = n\pi$	1+1
	OR	
	$x = \frac{(3+7i) \pm \sqrt{(3+7i)^2 - 8(9i-3)}}{4}$ ....(i)	1
	$\sqrt{(3+7i)^2 - 8(9i-3)} = \sqrt{-16-30i} = a+ib, \quad a,b \in R$	1
	Finding $a \pm 3$ and $b = \pm 5$	
	(i) $\Rightarrow \quad x = \frac{(3+7i) \pm (3-5i)}{4} = \frac{3}{2} + \frac{1}{2}i$ or $\quad 3i$	1+1
16	$2x + y \geq 4$ for $2x + y = 4$	

x	0	2	1
y	4	0	2

½

$x + y \leq 3$, let $x + y = 3$

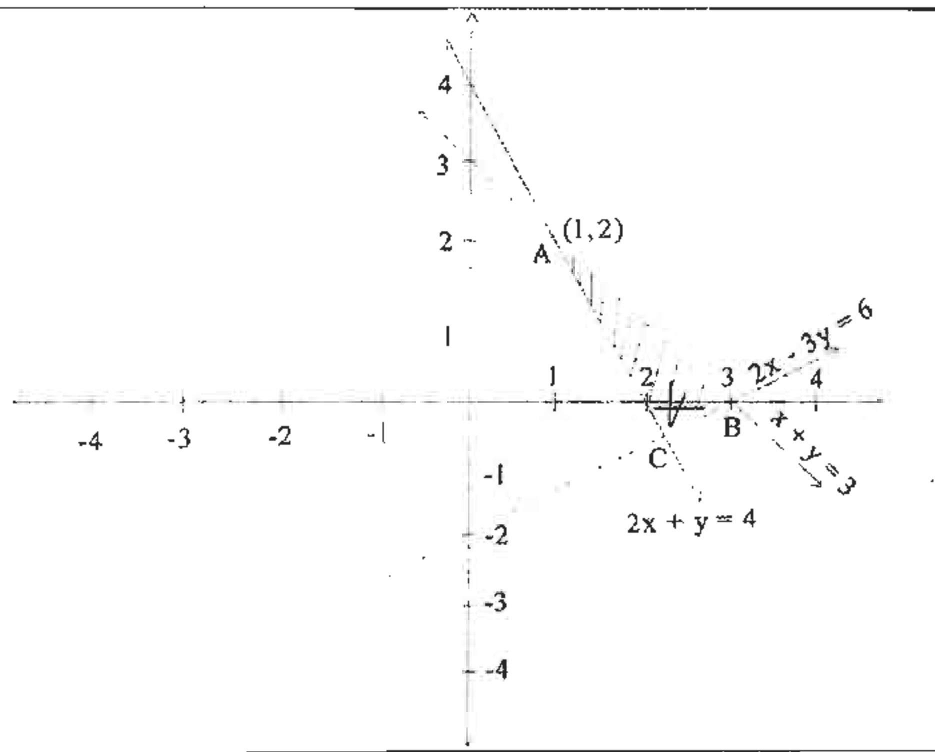
x	0	3	1
y	3	0	2

½

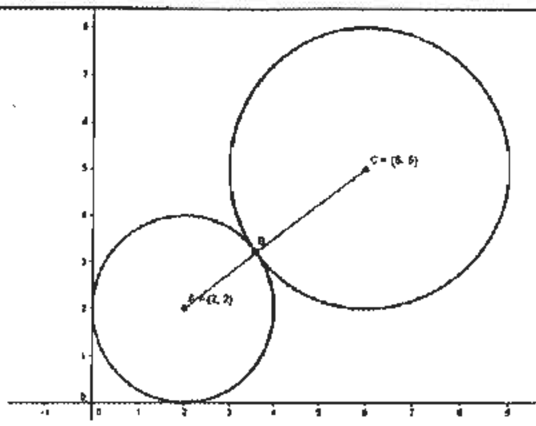
$2x - 3y \leq 6$, let $2x - 3y = 6$

x	0	3	-3
y	-2	0	-4

½

		2½
17	5 girls can sit in 5! = 120 ways In between girls, there are 6 places $\therefore$ Boys can sit in ${}^6P_4 = \frac{6!}{2!} = 360$ ways $\therefore$ Total no. of ways = 120×360 $= 43200$	1 1 1 1
18	$2.{}^nC_r = 1.{}^nC_{r+1} \Rightarrow 2.\frac{n!}{(n-r)!r!} = \frac{n!}{(n-r-1)!(r+1)!}$ $\Rightarrow \frac{2}{n-r} = \frac{1}{r+1} \Rightarrow n - 3r - 2 = 0$ ....(i) $3.{}^nC_{r+1} = 2.{}^nC_{r+2} \Rightarrow \frac{3.n!}{(n-r-1)!(r+1)!} = \frac{2n!}{(n-r-2)!(r+2)!}$ $3(r+2) = 2(n-r-1) \Rightarrow 2n - 5r - 8 = 0$ ....(ii) Solving to get n = 14, r = 4	1 1 1 1
19	For $\left(x^2 - \frac{2}{x}\right)^{18}$, $T_{r+1} = {}^{18}C_r (x^2)^{18-r}.\left(\frac{-2}{x}\right)^r$ $= {}^{18}C_r (-2)^r . x^{36-3r}$ For x^{10}, $36 - 3r = 10 \Rightarrow 3r = 26 \Rightarrow r = \frac{26}{3}$ $\therefore$ There will be no term containing x^{10}.	1 1 1 1

	OR $(2+3x)^9 = 2^9.\left(1+\frac{3x}{2}\right)^9$ $\frac{T_{r+1}}{T_r} = \frac{2^9\left[{}^9C_r\left(\frac{3x}{2}\right)^r\right]}{2^9\left[{}^9C_{r-1}\left(\frac{3x}{2}\right)^{r-1}\right]} = \frac{\frac{9!}{r!(9-r)!}}{\frac{9!}{(r-1)!(9-r+1)!}}\ \frac{3x}{2}$ $= \frac{9-r+1}{r}.\left(\frac{9}{4}\right) \qquad Q\ x=\frac{3}{2}$ $= \frac{90-9r}{4r}$ $\frac{T_{r+1}}{T_r} \geq 1 \Rightarrow \frac{90-9r}{4r} \geq 1 \Rightarrow 90-9r \geq 4r$ $r \leq \frac{90}{13}$ $\leq 6\frac{12}{13}$ $\therefore$ For Max. value r = 6 $\Rightarrow T_7 = 2^9.{}^9C_6.\left(\frac{9}{4}\right)^6 = \frac{7\times 3^{13}}{2}$	½ 1 ½ 1 1
20	Here $p = \frac{k\cos 2\theta}{\sqrt{\cos^2\theta + \sin 2\theta}} = k\cos 2\theta$ $q = \frac{k}{\sqrt{\sec^2\theta + \operatorname{cosec}^2\theta}} = k\sin\theta\cos\theta = \frac{k}{2}\sin 2\theta$ $p^2+4q^2 = k^2\cos^2 2\theta + 4.\frac{k^2}{4}\sin^2 2\theta = k^2(\cos^2 2\theta + \sin^2 2\theta)$ $= k^2$	1 1 1+1

21		1
	Centre A is at (2,2) $\Rightarrow AC = \sqrt{(3)^2 + (4)^2} = 5$	1
	$BC = 5 - 2 = 3$	1
	∴ Equation of Circle is $(x-6)^2 + (y-5)^2 = 9$	1
22	P ———— R ———— Q (2, -3, 4) (4, y, z) (8, 0, 10) let R divider $\overline{PQ}$ in $k:1 \Rightarrow 4 = \frac{8k+2}{k+1}$	1
	$\Rightarrow 4k + 4 = 8k + 2 \Rightarrow 2 = 4k, \quad k = \frac{1}{2}$ $y = \frac{0.k + (-3)}{k+1} = \frac{-3}{\frac{1}{2}+1} = \frac{-3}{\frac{3}{2}} = -2$	1
	$z = \frac{10k+4}{k+1} = \frac{5+4}{\frac{3}{2}} = \frac{18}{3} = 6$	1
	$\Rightarrow R(4, -2, 6)$	1
23	$f(x) = \cos(2x+3) \qquad f'(x) = \lim_{h\to 0} \frac{f(x+h) - f(x)}{h}$	1
	$f'(x) = \lim_{h\to 0} \frac{\cos(2x+2h+3) - \cos(2x+3)}{h}$	2
	$= \lim_{h\to 0} \frac{-2\sin\left[\frac{4x+6+2h}{2}\right]\sin h}{h} = -2\sin(2x+3)$	1

24	Let p: $x, y \in z$ such that x and y are odd $q: xy$ is odd Assume that if p is true, then q is true p is true means $x = 2m+1,\ m \in z$ and $y = 2n+1,\ n \in z$ $xy = (2m+1)(2n+1)$ $= 2(2mn+m+n)+1\ \therefore xy$ is odd. $\therefore$ given statement is true. Assume that q is not true. $\therefore \sim q : xy$ is even $\therefore$ either x or y is even $\Rightarrow$ p is not true $\therefore \sim q \Rightarrow \sim p$	1 1 1 1
25	. P(Anil) = 0.05 P(Ashima) = 0.10 P(Anil & Ashima) = 0.02 Let P(E) = 0.05 P(F) = 0.10 $P(E \cap F) = 0.02$ P (both will not qualify) = $P(E' \cap F') = P(E \cup F)' = 1 - P(E \cup F)$ $= 1 - [P(E) + P(F) - P(E \cap F)]$ $= 1 - [0.05 + 0.10 - 0.02]$ $= 1 - [0.15 - 0.02] = 1 - 0.13 = 0.87$	1 1 1 1
26	$LHS = cos^2 x + cos^2\left(x + \frac{\pi}{3}\right) + cos^2\left(x - \frac{\pi}{3}\right)$ $= \frac{1}{2}\left[1 + \cos 2x + 1 + cos\left(2x + \frac{2\pi}{3}\right) + 1 + \cos\left(2x - \frac{2\pi}{3}\right)\right]$ $= \frac{1}{2}\left[3 + \cos 2x + 2cos\left(\frac{2x + \frac{2\pi}{3} + 2x - \frac{2\pi}{3}}{2}\right)\cos\left(\frac{2x + \frac{2\pi}{3} - 2x + \frac{2\pi}{3}}{2}\right)\right]$ $= \frac{1}{2}\left[3 + \cos 2x + 2\cos 2x . \cos(\frac{2\pi}{3})\right]$ $= \frac{1}{2}\left[3 + \cos 2x + 2\cos 2x . (-\frac{1}{2})\right] = \frac{3}{2}$	1 1 2 1 1
27	Let P(n): " $3^{2n+2} - 8n - 9$ is divisible by 8" $n = 1 \Rightarrow 3^4 - 8 - 9 = 81 - 17 = 64$ which is divisible by 8 $\Rightarrow$ P(1) is true ....(i)	1

	let P(k) is true $\Rightarrow 3^{2k+2+2}-8k-9=8a,\ a\in z$ ....(ii) $n=k+1\Rightarrow 3^{2k+2+2}-8(k+1)-9$ $=3^2.\,3^{2k+2}-8k-8-9$ $=9[8a+8k+9]-8k-17$ $=72a+72k-8k+81-17$ $=72a+64k+64=8(b)\ b\in z$ $\Rightarrow$ P(K+1) is true Hence P(n) is true $\forall n\in N$ OR $P(n):1+\frac{1}{1+2}+\frac{1}{1+2+3}+.........+\frac{1}{1+2+3+...+n}=\frac{2n}{n+1}$ For n = 1 LHS = 1 RHS = $\frac{2}{2}=1$ $\Rightarrow p(1)$ is true ....(i) Let P(k) be true $\Rightarrow 1+\frac{1}{1+2}+\frac{1}{1+2+3}+........\frac{1}{1+2+......+k}=\frac{2k}{5+1}$..................(ii) For P(k+1) LHS $=1+\frac{1}{1+2}+\frac{1}{1+2+3}+.........+\frac{1}{1+2+......+k}+\frac{1}{1+2+......+(k+1)}$ $=\frac{2k}{k+1}+\frac{2}{(k+1)(k+2)}=2\frac{k(k+2)+1}{(k+1)(k+2)}$ $=2\frac{(k+1)^2}{(k+1)(k+2)}=\frac{2(k+1)}{k+1}\Rightarrow$ P(k+1) is true $\Rightarrow$ P(n) is true $\forall$ n $\in$ N	1 1 1 1 1 1 1 1 1 1 1
28	Here a+b = 3, ab = p, c+d = 12, cd = q and $\frac{b}{a}=\frac{c}{b}=\frac{d}{c}=k\Rightarrow b=ak, c=ak^2, d=ak^3$ $\frac{c+d}{a+b}=\frac{4}{1}\Rightarrow\frac{ak^2(1+k)}{a(1+k)}=4\Rightarrow k=2$ $\frac{q}{p}=\frac{cd}{ab}\Rightarrow\frac{q+p}{q-p}=\frac{cd+ab}{cd-ab}=\frac{a^2k^5+a^2k}{a^2k^5-a^2k}$ $=\frac{k^4+1}{k-1}=\frac{16+1}{16-1}=\frac{17}{15}$	1 1 1 2 1
29	Equation of line through the intersection of two given lines is	

$2x-3y+4+k(3k+4y-5)=0$ — 1

$or\ (2+3k)x+(-3+4k)y+4-5k=0$ ....(i) — 1

$line\ (i)\ is \perp to\ 6x-7y+8=0$

$\Rightarrow +\frac{2+3k}{-3+4k}=+\frac{7}{6} \Rightarrow 12+18k=-21+28k \Rightarrow k=\frac{33}{10}$ — 2, 1

$\therefore$ Putting in (i) we get $119x+102y-125=0$ — 1

30

Classes	x_i	Freq.	d_i	f_id_i	$f_id_i^2$
0-10	5	15	-2	-30	60
10-20	15	40	-1	-40	40
20-30	25	20	0	0	0
30-40	35	15	1	15	15
40-50	45	5	2	10	20
50-60	55	5	3	15	45
		100		-30	180

— 2

Mean = $25-\frac{30}{100}\times 10 = 25-3 = 22$ — 1

$\sigma^2 = 100\left(\frac{180}{100}-\left(\frac{30}{100}\right)^2\right) = 100\left(\frac{180}{100}-\frac{9}{100}\right) = 171$ — 2

SD = $\sigma = 13.08$ — 1