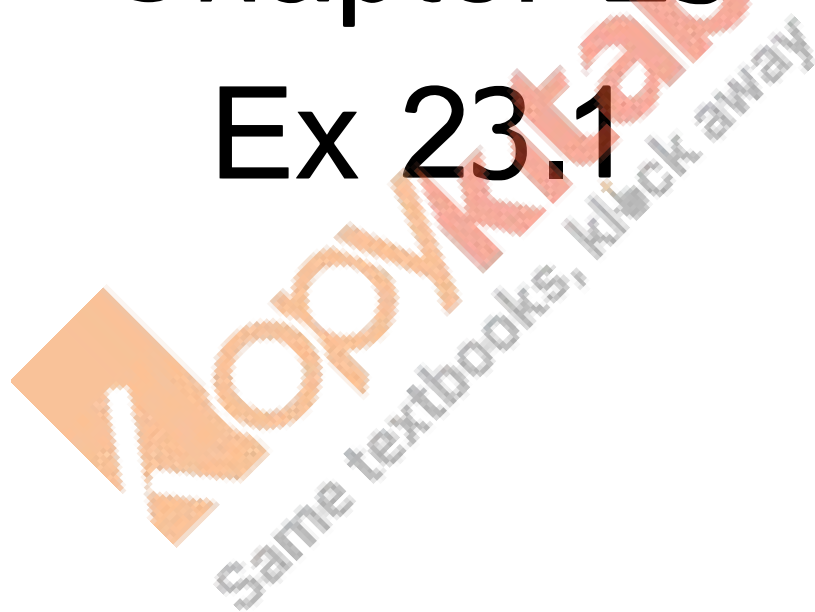


RD Sharma  
Solutions  
Class 11 Maths  
Chapter 23  
Ex 23.1



### Straight Lines Ex 23.1 Q1

(i) Angle made with positive x axis is  $\frac{-\pi}{4}$ .

$$\therefore m = \tan \theta = \tan\left(\frac{-\pi}{4}\right) = -1$$

(ii) Angle made with positive x axis is  $\frac{2\pi}{3}$

$$\therefore m = \tan \theta = \tan\left(\frac{2\pi}{3}\right) = -\sqrt{3}$$

(iii) Angle made with positive x axis is  $\frac{3\pi}{4}$

$$\therefore m = \tan \theta = \tan\left(\frac{3\pi}{4}\right) = \tan\left(\pi - \frac{\pi}{4}\right) = -1$$

(iv) Angle made with positive x axis is  $\frac{\pi}{3}$

$$\therefore m = \tan \theta = \tan\left(\frac{\pi}{3}\right) = \sqrt{3}$$

### Straight Lines Ex 23.1 Q2

(i)  $(-3, 2)$  and  $(1, 4)$

$$\text{slope of line} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{4 - 2}{1 - (-3)} = \frac{2}{4} = \frac{1}{2}$$

(ii)  $(at_1^2, 2at_1)$  and  $(at_2^2, 2at_2)$

$$\text{slope of line} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{2at_2 - 2at_1}{at_2^2 - at_1^2} = \frac{2}{t_2 + t_1}$$

(iii)  $(3, -5)$  and  $(1, 2)$

$$\text{slope of line} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{2 - (-5)}{1 - 3} = \frac{7}{-2} = \frac{-7}{2}$$

### Straight Lines Ex 23.1 Q3(i)

Slope of line joining  $(5, 6)$  and  $(2, 3)$

$$m_1 = \frac{y_2 - y_1}{x_2 - x_1} = \frac{3 - 6}{2 - 5} = \frac{-3}{-3} = 1$$

Slope of line joining  $(9, -2)$  and  $(6, -5)$

$$m_2 = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-5 - (-2)}{6 - 9} = \frac{-5 + 2}{-3} = 1$$

Here  $m_1 = m_2$

$\therefore$  The two lines are parallel.

### Straight Lines Ex 23.1 Q3(ii)

Slope of line joining  $(-1, 1)$  and  $(9, 5)$

$$m_1 = \frac{5 - 1}{9 - (-1)} = \frac{4}{10} = \frac{2}{5}$$

Slope of line joining  $(3, -5)$  and  $(8, -3)$

$$m_2 = \frac{-3 - (-5)}{8 - 3} = \frac{-3 + 5}{5} = \frac{2}{5}$$

Here  $m_1 = m_2$

$\therefore$  The two lines are parallel

### Straight Lines Ex 23.1 Q3(iii)

Slope of line joining  $(6, 3)$  and  $(1, 1)$

$$m_1 = \frac{1 - 3}{1 - 6} = \frac{-2}{-5} = \frac{2}{5}$$

Slope of line joining  $(-2, 5)$  and  $(2, -5)$

$$m_2 = \frac{-5 - 5}{2 - (-2)} = \frac{-10}{4} = \frac{-5}{2}$$

$$\text{Here } m_1 \times m_2 = \frac{2}{5} \times \frac{-5}{2} = -1$$

$\therefore$  The lines are perpendicular to each other.

### Straight Lines Ex 23.1 Q3(iv)

Slope of line joining  $(3, 15)$  and  $(16, 6)$

$$m_1 = \frac{6 - 15}{16 - 3} = \frac{-9}{13}$$

Slope of line joining  $(-5, 3)$  and  $(8, 2)$

$$m_2 = \frac{2 - 3}{8 - (-5)} = \frac{-1}{13}$$

Here, neither  $m_1 = m_2$  nor  $m_1 \times m_2 = -1$

$\therefore$  The lines are neither parallel nor perpendicular.

### Straight Lines Ex 23.1 Q4

(i) Line bisects first quadrant.

$$\begin{aligned} \Rightarrow \text{Angle between line and positive direction of } x\text{-axis} &= \frac{90^\circ}{2} \\ &= 45^\circ \end{aligned}$$

Slope of line ( $m$ ) =  $\tan \theta$

$$m = \tan 45^\circ$$

$$m = 1$$

(ii) Line makes angle of  $30^\circ$  with the positive direction of  $y$ -axis.

= Angle between line and positive side of axis =  $90^\circ + 30^\circ$

$$\theta = 120^\circ$$

$$m = \tan 120^\circ$$

$$m = -\sqrt{3}$$

### Straight Lines Ex 23.1 Q5(i)

$A(4, 8), B(5, 12)$  and  $C(9, 28)$

$$\text{slope of } AB = \frac{12 - 8}{5 - 4} = \frac{4}{1} = 4$$

$$\text{slope of } BC = \frac{28 - 12}{9 - 5} = \frac{16}{4} = 4$$

$$\text{slope of } CA = \frac{8 - 28}{4 - 9} = \frac{-20}{-5} = 4$$

Since all 3 line segments have the same slope, they are parallel.

Since they have a common point  $B$ , they are collinear.

### Straight Lines Ex 23.1 Q5(ii)

$A(16, -18), B(3, -6)$  and  $C(-10, 6)$

$$\text{slope of } AB = \frac{-6 - (-18)}{3 - 16} = \frac{12}{-13}$$

$$\text{slope of } BC = \frac{6 - (-6)}{-10 - 3} = \frac{12}{-13}$$

$$\text{slope of } CA = \frac{6 - (-18)}{-10 - 16} = \frac{12}{-13}$$

Since all 3 line segments have the same slope and share a common vertex  $B$ , they are collinear.

### Straight Lines Ex 23.1 Q6

Slope of line joining  $(-1, 4)$  and  $(0, 6)$  is

$$m_1 = \frac{6 - 4}{0 - (-1)} = 2$$

Slope of line joining  $(3, y)$  and  $(2, 7)$  is

$$m_2 = \frac{7 - y}{2 - 3} = y - 7$$

Since the two lines are parallel  $m_1 = m_2$

$$\Rightarrow 2 = y - 7$$

$$\Rightarrow y = 9$$

### Straight Lines Ex 23.1 Q7

(i) If  $\text{slope} = \tan \theta = 0 \Rightarrow \theta = 0$

When the slope of a line is zero then the line is parallel to x-axis.

(ii) If the slope is positive then  $\tan \theta = \text{positive} \Rightarrow \theta = \text{acute}$

Thus the line makes an acute angle  $\left(0 < \theta < \frac{\pi}{2}\right)$  with the positive x-axis.

(iii) When the slope is negative then  $\tan \theta = \text{negative} \Rightarrow \theta$  is obtuse

Thus the line makes an obtuse angle  $\left(\theta > \frac{\pi}{2}\right)$  with the positive x-axis.

### Straight Lines Ex 23.1 Q8

Slope of line joining  $(2, -3)$  and  $(-5, 1)$

$$m_1 = \frac{1 - (-3)}{-5 - 2} = \frac{4}{-7}$$

Slope of line joining  $(7, -1)$  and  $(0, 3)$

$$m_2 = \frac{3 - (-1)}{0 - 7} = \frac{4}{-7}$$

Since  $m_1 = m_2$ , the two lines are parallel.

### Straight Lines Ex 23.1 Q9

Slope of line joining  $(2, -5)$  and  $(-2, 5)$  is

$$m_1 = \frac{5 - (-5)}{-2 - 2} = \frac{-5}{2}$$

Slope of line joining  $(6, 3)$  and  $(1, 1)$

$$m_2 = \frac{1 - 3}{1 - 6} = \frac{2}{5}$$

$$m_1 \times m_2 = \frac{-5}{2} \times \frac{2}{5} = -1$$

$\therefore$  The two lines are perpendicular to each other

### Straight Lines Ex 23.1 Q10

$$\text{Slope of } AB = \frac{2 - 4}{1 - 0} = -2$$

$$\text{Slope of } BC = \frac{3 - 2}{3 - 1} = \frac{1}{2}$$

$$\text{slope of } AB \times \text{slope of } BC = -2 \times \frac{1}{2} = -1$$

$\therefore$  Angle between  $AB$  and  $BC = \frac{\pi}{2}$

$\therefore ABC$  are the vertices of a right angled triangle.

### Straight Lines Ex 23.1 Q11

Here  $A(-4, -1), B(-2, -4), C(4, 0), D(2, 3)$

$$\text{Slope of } AB = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-4 + 1}{-2 + 4}$$

$$M_{AB} = \frac{-3}{2}$$

$$\text{Slope of } BC = \frac{0 + 4}{4 + 2}$$

$$M_{BC} = \frac{2}{3}$$

$$\text{Slope of } AD = \frac{3 + 1}{2 + 4}$$

$$M_{AD} = \frac{2}{3}$$

$$\text{Slope of } CD = \frac{3 - 0}{2 - 4}$$

$$M_{CD} = \frac{-3}{2}$$

$$\Rightarrow M_{AB} = M_{CD} \text{ and } M_{BC} = M_{AD}$$

$$\Rightarrow AB \parallel CD \text{ and } BC \parallel AD$$

$$M_{AB} \times M_{BC} = \frac{-3}{2} \times \frac{2}{3}$$

$$M_{AB} \times M_{BC} = -1$$

$$\Rightarrow AB \perp BC$$

$$M_{BC} \times M_{CD} = \frac{2}{3} \times \frac{-3}{2}$$

$$M_{BC} \times M_{CD} = -1$$

$$\Rightarrow BC \perp CD$$

Thus,

$$AB \parallel CD \text{ and } BC \parallel AD$$

$$AB \perp BC, BC \perp CD, CD \perp AD$$

$$\Rightarrow ABCD \text{ is a rectangle}$$

### Straight Lines Ex 23.1 Q12

If 3 points lie on a line (ie they are collinear) lines joining these point have the same slope

$$\therefore \text{slope of } AP = \text{slope of } PB = \text{slope of } BA$$

$$\Rightarrow \frac{b - 0}{a - h} = \frac{k - b}{0 - a} = \frac{k - 0}{0 - h} \dots \dots \dots (i)$$

$$\Rightarrow \frac{k - b}{0 - a} = \frac{k - 0}{0 - h}$$

$$\Rightarrow -kh + bh = -ka$$

$$\Rightarrow -1 + \frac{b}{k} = \frac{-a}{h} \quad (\text{dividing by } kh)$$

$$\Rightarrow \frac{a}{h} + \frac{b}{k} = 1$$

Hence Proved

### Straight Lines Ex 23.1 Q13

Let  $m_1 = x$ ,  $m_2 = 2x$

$$\tan \theta = \left| \frac{m_1 - m_2}{1 + m_1 m_2} \right|$$

$$\frac{1}{3} = \left| \frac{x - 2x}{1 + 2x^2} \right|$$

Case I:

$$\frac{1}{3} = \frac{x - 2x}{1 + 2x^2}$$

$$2x^2 + 1 = -3x$$

$$2x^2 + 3x + 1 = 0$$

$$2x^2 + 2x + x + 1 = 0$$

$$2x(x + 1) + 1(x + 1) = 0$$

$$(x + 1)(2x + 1) = 0$$

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

Case II:

$$\frac{1}{3} = \left( \frac{-x}{1 + 2x^2} \right)$$

$$\frac{1}{3} = \frac{-x}{1 + 2x^2}$$

$$2x^2 + 1 = -3x$$

$$2x^2 - 3x + 1 = 0$$

$$2x^2 - 2x - x + 1 = 0$$

$$2x(x - 1) - 1(x - 1) = 0$$

$$(x - 1)(2x - 1) = 0$$

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

Slope of other line is

$$1, \frac{1}{2} \text{ or } -1, -\frac{1}{2}$$

### Straight Lines Ex 23.1 Q14

$$\text{Slope of } AB = \frac{97 - 92}{1995 - 1985} = \frac{5}{10} = \frac{1}{2}$$

Population ( $p$ ) in 2010 can be calculated using the slope of AC.

$$\text{Slope of } AC = \frac{p - 92}{2010 - 1985} = \frac{p - 92}{25} = \frac{1}{2} = \text{Slope of } AB$$

$$\Rightarrow p - 92 = \frac{25}{2}$$

$$\Rightarrow 2p - 184 = 25$$

$$\Rightarrow 2p = 209$$

$$\Rightarrow p = \frac{209}{2}$$

$$\therefore p = 104.50 \text{ crores}$$

### Straight Lines Ex 23.1 Q15

Let  $A(-2, -1)$ ,  $B(4, 0)$ ,  $C(3, 3)$  and  $D(-3, 2)$  be a quadrilateral.

$$\text{slop of } AB = \frac{0 - (-1)}{4 - (-2)} = \frac{1}{6}$$

$$\text{slop of } BC = \frac{3 - 0}{3 - 4} = -3$$

$$\text{slop of } CD = \frac{3 - 2}{3 - (-3)} = \frac{1}{6}$$

$$\text{slop of } DA = \frac{2 - (-1)}{-3 - (-2)} = -3$$

we observe that slope of opposite side of the quadrilateral  $ABCD$  are equal.  
Hence the quadrilateral  $ABCD$  is a parallelogram.

### Straight Lines Ex 23.1 Q16

Slope of the line segment joining the points  $(3, -1)$  and  $(4, -2)$  is

$$m_1 = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-2 - (-1)}{4 - 3} = \frac{-2 + 1}{4 - 3} = \frac{-1}{1} = -1$$

Slope of  $x$  axis is 0

$$\Rightarrow m_2 = 0$$

If  $\theta$  is the angle between  $x$ -axis and the line segment then

$$\begin{aligned}\tan \theta &= \left| \frac{m_1 - m_2}{1 + m_1 m_2} \right| \\ &= \left| \frac{-1 - 0}{1 + (-1)(0)} \right| \\ &= \frac{-1}{1} = -1\end{aligned}$$

$$\therefore \theta = 135^\circ$$

### Straight Lines Ex 23.1 Q17

The slope of the line joining  $(-2, 6)$  and  $(4, 8)$  is

$$m_1 = \frac{8 - 6}{4 - (-2)} = \frac{2}{6} = \frac{1}{3}$$

The slope of the line joining  $(8, 12)$  and  $(x, 24)$  is

$$m_2 = \frac{24 - 12}{x - 8} = \frac{12}{x - 8}$$

Since the lines are perpendicular to each other

$$m_1 \times m_2 = -1$$

$$\frac{1}{3} \times \frac{12}{x - 8} = -1$$

$$\Rightarrow 4 = 8 - x$$

$$\Rightarrow x = 4$$

### Straight Lines Ex 23.1 Q18



The given points are  $A(x, -1)$ ,  $B(2, 1)$  and  $C(4, 5)$

It is given that the points are collinear. So, the area of the triangle that they form must be zero.

Hence,

$$x_1(y_2 - y_3) + x_2(y_3 - y_1) + x_3(y_1 - y_2) = 0 \quad \text{--- (1)}$$

Putting the value of  $(x_1, y_1)$ ,  $(x_2, y_2)$ ,  $(x_3, y_3)$  in (1)

$$x(1 - 5) + (2)(5 - (-1)) + 4(-1 - 1) = 0$$

$$-4x + 2(5 + 1) + 4(-2) = 0$$

$$-4x + 12 - 8 = 0$$

$$-4x = -12 + 8$$

$$-4x = -4$$

$$x = 1$$

### Straight Lines Ex 23.1 Q19

Slope of the line segment joining the points  $(3, -1)$  and  $(4, -2)$  is

$$m_1 = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-2 - (-1)}{4 - 3} = \frac{-2 + 1}{4 - 3} = \frac{-1}{1} = -1$$

Slope of  $x$  axis is 0

$$\Rightarrow m_2 = 0$$

If  $\theta$  is the angle between  $x$ -axis and the line segment then

$$\begin{aligned} \tan \theta &= \left| \frac{m_1 - m_2}{1 + m_1 m_2} \right| \\ &= \left| \frac{-1 - 0}{1 + (-1)(0)} \right| \\ &= \frac{-1}{1} = -1 \end{aligned}$$

$$\therefore \theta = 135^\circ$$

### Straight Lines Ex 23.1 Q20

Let the vertices be  $A(-2, -1), B(4, 0), C(3, 3), D(-3, 2)$ .

Using slope formula,  $m = \frac{y_2 - y_1}{x_2 - x_1}$ , we get:

$$\text{Slope of } AB (m_1) = \frac{0 - (-1)}{4 - (-2)} = \frac{1}{6}$$

$$\text{Slope of } CD (m_2) = \frac{2 - 3}{-3 - 3} = \frac{-1}{-6} = \frac{1}{6}$$

$$\Rightarrow m_1 = m_2 \Rightarrow AB \parallel CD$$

Also

$$\text{Slope of } AD (m_3) = \frac{2 - (-1)}{-3 - (-2)} = \frac{3}{-1} = -3$$

$$\text{Slope of } BC (m_4) = \frac{3 - 0}{3 - 4} = \frac{3}{-1} = -3$$

$$\Rightarrow m_3 = m_4 \Rightarrow AD \parallel BC$$

Hence, ABCD is a parallelogram.

### Straight Lines Ex 23.1 Q21

Let ABCD be the given quadrilateral

E is mid point of AB

F is mid point of BC

G is mid point of CD

H is mid point of AD

Using mid point formula  $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$

$$\text{Coordinates of } E = \left(\frac{4+1}{2}, \frac{1+7}{2}\right) = \left(\frac{5}{2}, 4\right)$$

$$\text{Coordinates of } F = \left(\frac{1+6}{2}, \frac{7+0}{2}\right) = \left(\frac{7}{2}, \frac{7}{2}\right)$$

$$\text{Coordinates of } G = \left(\frac{-6-1}{2}, \frac{0-9}{2}\right) = \left(\frac{-7}{2}, \frac{-9}{2}\right)$$

$$\text{Coordinates of } H = \left(\frac{-1+4}{2}, \frac{-9+1}{2}\right) = \left(\frac{3}{2}, -4\right)$$

Now, EFGH is parallelogram if diagonals EG and FH have the same mid-point.

$$\text{Coordinates of mid-point of } EG = \left(\frac{\frac{5}{2} - 7}{2}, \frac{4 - \frac{9}{2}}{2}\right) = \left(\frac{-2}{4}, \frac{-1}{4}\right) = \left(\frac{-1}{2}, \frac{-1}{4}\right)$$

$$\text{Coordinates of mid-point of } FH = \left(\frac{\frac{-5}{2} + 3}{2}, \frac{\frac{7}{2} - 8}{2}\right) = \left(\frac{-2}{4}, \frac{-1}{4}\right)$$

$\Rightarrow$  EFGH is parallelogram