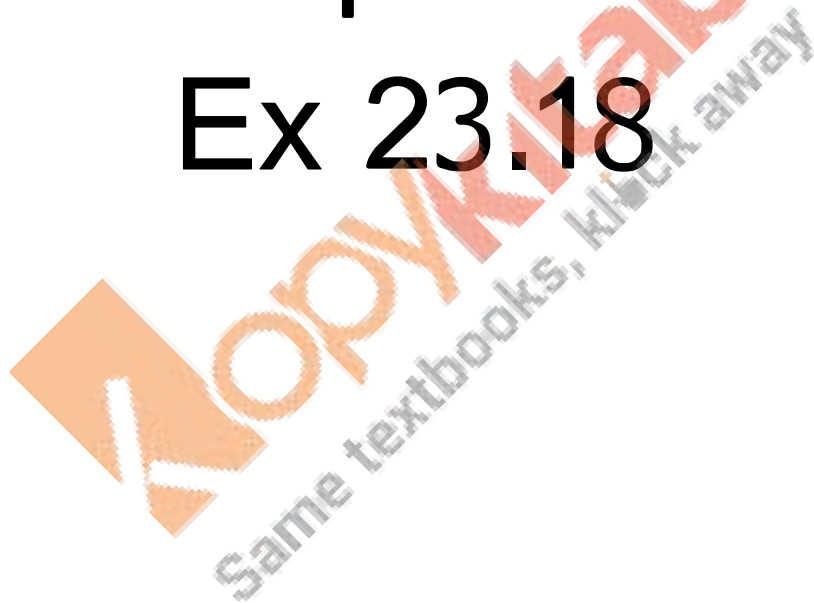


RD Sharma  
Solutions  
Class 11 Maths  
Chapter 23  
Ex 23.18



### Straight lines Ex 23.18 Q1

Let the required equation be  $ax + by = c$  but here it passes through origin  $(0, 0)$ .

$$\therefore c = 0$$

$\therefore$  Equation is  $ax + by = 0$

Slope of the line  $(m_1) = \frac{-a}{b}$  and  $m_2 = \frac{-\sqrt{3}}{1}$

$\Rightarrow$  Angle between  $\sqrt{3}x + y = 11$  and  $ax + by = 0$  is  $45^\circ$

$$\therefore \tan 45^\circ = \frac{m_1 \pm m_2}{1 \mp m_1 m_2}$$

$$1 = \frac{\frac{-a}{b} \pm (-\sqrt{3})}{1 \mp \frac{a}{b} \times \sqrt{3}}$$

$$1 - \frac{\sqrt{3}a}{b} = \frac{-a}{b} - \sqrt{3} \text{ and } 1 + \frac{a}{b}\sqrt{3} = \frac{-a}{b} + \sqrt{3}$$

$$b - \sqrt{3}a = -a - \sqrt{3}b \text{ and } b + a\sqrt{3} = -a + b\sqrt{3}$$

$$a(1 - \sqrt{3}) = b(-\sqrt{3} - 1) \text{ and } a(\sqrt{3} + 1) = b(\sqrt{3} - 1)$$

$$\frac{a}{b} - \frac{1 - \sqrt{3}}{\sqrt{3} - 1} = \frac{(\sqrt{3} - 1)^2}{2} = 2 - \sqrt{3}$$

or

$$\frac{a}{b} = \frac{\sqrt{3} - 1}{\sqrt{3} + 1} = -2 - \sqrt{3}$$

$\therefore$  Required lines are  $\frac{y}{x} = \sqrt{3} \pm 2$  or  $y = (\sqrt{3} \pm 2)x$

### Straight lines Ex 23.18 Q2

Let the required equation be  $y = mx + c$

But,  $c = 0$  as it passes through origin  $(0, 0)$

$\therefore$  Equation of the lines is  $y = mx$ .

Slope of  $x + y + \sqrt{3}y = \sqrt{3}x = a$

or  $(\sqrt{3} + 1)x + (1 - \sqrt{3})y = a$  is

$$\frac{\sqrt{3} + 1}{\sqrt{3} - 1} = \frac{4 - 2\sqrt{3}}{2} = 2 - \sqrt{3}.$$

The angle between  $x + y + \sqrt{3}y - \sqrt{3} = a$  and  $y = mx$  is  $75^\circ$

$$\tan(75^\circ) = \frac{m_1 \pm m_2}{1 \mp m_1 m_2}$$

$$\tan(30^\circ + 45^\circ) = \frac{m \pm (2 - \sqrt{3})}{1 - m(2 - \sqrt{3})}$$

$$\frac{\frac{1}{\sqrt{3}} + 1}{1 - \frac{1}{\sqrt{3}} \times 1} = \frac{m \pm 2 - \sqrt{3}}{1 - m(2 - \sqrt{3})}$$

$$2 + \sqrt{3} = \frac{m + 2 - \sqrt{3}}{1 + m(\sqrt{3} - 2)} \quad \text{and} \quad 2 + \sqrt{3} = \frac{m + \sqrt{3} - 2}{1 + m(2 - \sqrt{3})}$$

$$\therefore \frac{1}{m} = 0 \quad \text{or} \quad m = -\sqrt{3}$$

$$\therefore y = mx \quad y = -\sqrt{3}x \quad \text{and} \quad x = 0 \quad \text{are the required equations.}$$

### Straight lines Ex 23.18 Q3

Given equation is  $6x + 5y - 8 = 0$ .

Slope of given line =  $m = -\frac{6}{5}$

Equations of required line is,

$$y + 1 = \frac{-\frac{6}{5} - 1}{1 + \frac{6}{5}}(x - 2)$$

$$y+1 = \frac{-11}{11}(x-2)$$

$$y+1 = -x+2$$

$$x+y-1=0$$

$$y+1 = \frac{-\frac{6}{5}+1}{1-\frac{6}{5}}(x-2)$$

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

$$y+1 = x-2$$

$$x-y=3$$

### Straight lines Ex 23.18 Q4

The required equation is

$$y - k = m'(x - h)$$

And this line is inclined at  $\tan^{-1} m$  to straight line  $y = mx + c$ .

$$\text{Slope} = m = \tan \theta$$

Passing through  $(h, k)$   
 $(x_1, y_1)$

$\therefore$  Equation of line is

$$y - y_1 = m(x - x_1) \quad \text{--- (i)}$$

$$\text{Also, } \tan \theta = \left| \frac{m - m'}{1 + mm'} \right|$$

$$\text{Here, } m = m'$$

$$\therefore \tan \theta = \frac{m - m}{1 + m^2} \text{ or } \frac{-m - m}{1 - m^2}$$

$$= 0 \text{ or } \frac{+2m}{1 - m^2}$$

Substituting in (i)

$$y - k = 0$$

$$\Rightarrow y = k \quad \text{or}$$

$$y - k = \frac{+2m}{1 - m^2}(x - h)$$

$$(1 - m^2)(y - k) = +2m(x - h)$$

## Straight lines Ex 23.18 Q5

Here,  $x_1 = 2$ ,  $y_1 = 3$ ,  $\alpha = 45^\circ$

$m =$  slope of line  $3x + y - 5 = 0$

$$= \frac{-\text{coeff of } x}{\text{coeff of } y} = -3$$

The equations of the required line are

$$y - y_1 = \frac{-3 - \tan 45^\circ}{1 + (-3) \tan 45^\circ} (x - 2)$$

$$y - 3 = \frac{-3 - 1}{1 + (-3)(1)} (x - 2)$$

$$y - 3 = \frac{-4}{2} (x - 2) = 2x - 4$$

$$2x - y - 1 = 0$$

Also,  $y - 3 = \frac{-3 + \tan 45^\circ}{1 - (-3) \tan 45^\circ} (x - 2)$

$$y - 3 = \frac{-3 + 1}{1 + 3} (x - 2)$$

$$y - 3 = \frac{-2}{4} (x - 2) = \frac{-x}{2} + 1$$

$$x + 2y - 8 = 0$$

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## Straight lines Ex 23.18 Q6

Let the isosceles right triangle be.

$$AC = 3x + 4y = 4$$

$$c(2, 2)$$

Then, slope of  $AC = \frac{-3}{4}$

$$AB = BC$$

[ $\because$  It is an isosceles right triangle]

Then, angle between  $(AB$  and  $AC)$  and  $(BC$  and  $AC)$  is  $45^\circ$ .

$$\tan \frac{\pi}{4} = \frac{m_1 - \left(\frac{-3}{4}\right)}{1 + \left(\frac{-3}{4}\right)m_1} \quad [\text{when } m_1 = \text{slope of } BC]$$

$$1 = \frac{m_1 + \frac{3}{4}}{1 - \frac{3}{4}m_1}$$

$$4 - 3m_1 = 4m_1 + 3$$

$$7m_1 = 1 \quad m_1 = \frac{1}{7}$$

and,  $AB \perp BC$

$\therefore$  (slope of  $AB$ )  $\times$  (slope of  $BC$ ) =  $-1$

$$m_2 \times \frac{1}{7} = -1$$

$$m_2 = -7.$$

The equation of  $BC$  is

$$(y - 2) = \frac{1}{7}(x - 2)$$

$$7y - 14 = x - 2$$

$$x - 7y + 12 = 0$$

and

The equation of  $AB$  is

$$(y - 2) = -7(x - 2)$$

$$y - 2 = -x + 14$$

$$y + 7x - 16 = 0$$

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### Straight lines Ex 23.18 Q7

Let  $C(2 + \sqrt{3}, 5)$  be one vertex and  $x = y$  be the opposite side of equilateral triangle  $ABC$ .

The other two sides makes an angle of  $60^\circ$  with other two sides.

slope of  $x - y = 0$  is 1.

$$\therefore y - 5 = \frac{1 \pm \tan 60^\circ}{1 \mp \tan 60^\circ} (x - 2 - \sqrt{3})$$

$$y - 5 = \frac{1 + \sqrt{3}}{1 - \sqrt{3}} (x - 2 - \sqrt{3}) \text{ and } y - 5 = \frac{1 - \sqrt{3}}{1 + \sqrt{3}} (x - 2 - \sqrt{3})$$

$$y - 5 = (\sqrt{3} - 2)(x - 2 - \sqrt{3}) \text{ and } y - 5 = (\sqrt{3} + 2)(x - 2 - \sqrt{3})$$

$$y + (2 + \sqrt{3})x = 12 + 4\sqrt{3} \text{ and } y + (2 - \sqrt{3})x = 6$$

Hence proved the 2<sup>nd</sup> side of  $\triangle ABC$  is  $y + (2 - \sqrt{3})x = 6$

and the 3<sup>rd</sup> side is  $y + (2 + \sqrt{3})x = 12 + 4\sqrt{3}$ .

### Straight lines Ex 23.18 Q8

Let  $ABCD$  be a square whose diagonal  $BD$  is  $4x + 7y = 12$

$$\text{Then, slope of } BD = \frac{-4}{7}$$

Let slope of  $AB = m$

$$\text{Then, } \tan 45^\circ = \frac{m + \frac{4}{7}}{1 - \frac{4}{7}m}$$

$$7 - 4m = 7m + 4$$

$$11m = 3$$

$$\therefore m = \frac{3}{11}$$

$$\therefore \text{Slope of } BC = \frac{-1}{\text{slope of } AB}$$

$$= \frac{-11}{3}$$

$\therefore$  Equation of  $BC$  is

$$(y - 2) = \frac{3}{11}(x - 1)$$

$$11y - 22 = 3x - 3$$

$$3x - 11y + 19 = 0$$

and

Equation of  $BC$  is

$$(y - 2) = \frac{-11}{3}(x - 1)$$

$$11x + 3y - 17 = 0$$

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