1.2.11

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Find the slope of lines

1. Passing through the points $(3, -2)$ and $(-1, 4)$
2. Passing through the points $(3, -2)$ and $(7, -2)$
3. Passing through the points $(3, -2)$ and $(3, 4)$
4. Making inclination of $60°$ with the positive direction of x-axis

Theoretical Solution

We will use direction ratios. For two points $P(x_1, y_1)$ and $Q(x_2, y_2)$, a direction vector (column matrix) is

$$\mathbf{d} = \begin{pmatrix} x_2 - x_1 \\ y_2 - y_1 \end{pmatrix} = \begin{pmatrix} l \\ m \end{pmatrix},$$

so the direction ratios are (l, m) and the slope is

$$\frac{m}{l} \quad (l \neq 0).$$

1. $P(3, -2)$, $Q(-1, 4)$.

$$\mathbf{d} = \begin{pmatrix} -1 - 3 \\ 4 - (-2) \end{pmatrix} = \begin{pmatrix} -4 \\ 6 \end{pmatrix}.$$

Direction ratios $(l, m) = (-4, 6)$. Thus the slope is

$$m = \frac{6}{-4} = -\frac{3}{2}.$$

Theoretical Solution

1. $P(3, -2)$, $Q(7, -2)$.

$$\mathbf{d} = \begin{pmatrix} 7 - 3 \\ -2 - (-2) \end{pmatrix} = \begin{pmatrix} 4 \\ 0 \end{pmatrix}.$$

Direction ratios $(l, m) = (4, 0)$. Slope $= \dfrac{0}{4} = 0$. (horizontal line)

2. $P(3, -2)$, $Q(3, 4)$.

$$\mathbf{d} = \begin{pmatrix} 3 - 3 \\ 4 - (-2) \end{pmatrix} = \begin{pmatrix} 0 \\ 6 \end{pmatrix}.$$

Direction ratios $(l, m) = (0, 6)$. Here $l = 0$, so the slope is undefined (vertical line).

1. Line making inclination $\theta = 60°$ with positive x-axis.
   A unit direction vector for angle θ is $\begin{pmatrix} \cos\theta \\ \sin\theta \end{pmatrix}$. Thus direction ratios may be taken as

   $$\begin{pmatrix} l \\ m \end{pmatrix} = \begin{pmatrix} \cos 60° \\ \sin 60° \end{pmatrix} = \begin{pmatrix} \frac{1}{2} \\ \frac{\sqrt{3}}{2} \end{pmatrix},$$

   so the slope is

   $$m = \frac{\sin 60°}{\cos 60°} = \tan 60° = \sqrt{3}.$$

Equation

We will use direction ratios. For two points $P(x_1, y_1)$ and $Q(x_2, y_2)$, a direction vector (column matrix) is

$$\mathbf{d} = \begin{pmatrix} x_2 - x_1 \\ y_2 - y_1 \end{pmatrix} = \begin{pmatrix} l \\ m \end{pmatrix},$$

so the direction ratios are (l, m) and the slope is
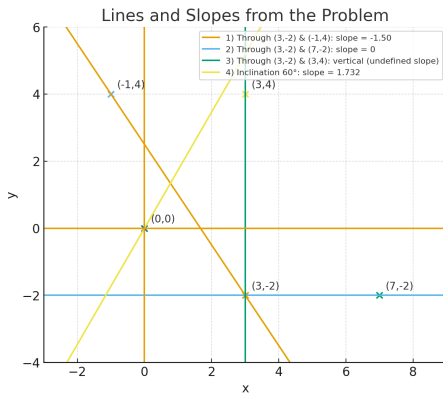
$$\frac{m}{l} \quad (l \neq 0).$$

Plot

Figure: fig1