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Straight Lines - Lesson 2

Parallel and Perpendicular Lines

LI

- Know the 3 different ways of writing equations of straight lines.
- Find equations of parallel and perpendicular lines.

SC

- Calculate gradients.
- Rearrange equations.

Equations of Lines

Slope - Intercept Form

$$y = mx + c$$

General Form

$$Ax + By + C = 0$$

Point - Slope Form

$$y - b = m(x - a)$$

<u>Example 1</u>

A line has gradient $-\dfrac{1}{2}$ and passes through the point $(4, -7)$.

Find the equation of the line in general form.

$$y - b = m(x - a)$$

$$y - (-7) = -\dfrac{1}{2}(x - 4)$$
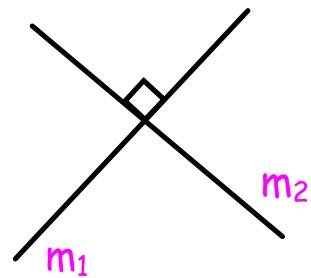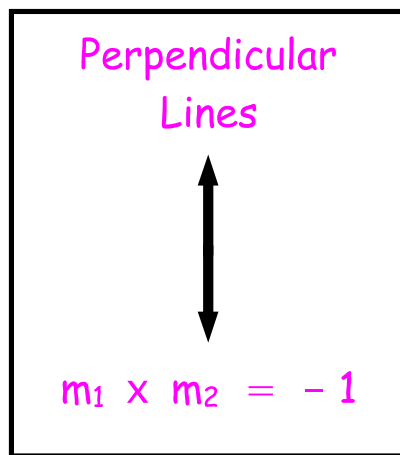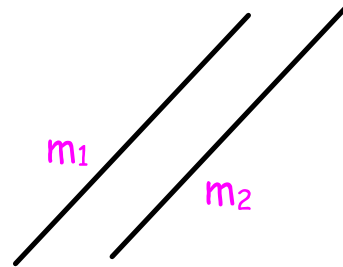
$$y + 7 = -\dfrac{1}{2}(x - 4)$$

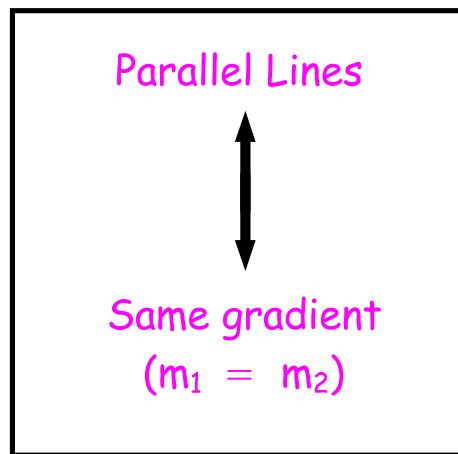$$2y + 14 = -(x - 4)$$

$$2y + 14 = -x + 4$$

$$\boxed{x + 2y + 10 = 0}$$

$$m = -\dfrac{1}{2}$$

$$(\underset{a}{4}, \underset{b}{-7})$$

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Parallel Lines

$\updownarrow$

Same gradient
$(m_1 = m_2)$

m_1 m_2

Perpendicular
Lines

$\updownarrow$

$m_1 \times m_2 = -1$

m_2

m_1

<u>Example 2</u>

A line L has equation $2x + 5y - 1 = 0$.

Find the equation of the line parallel to L and passing through $(2, 3)$.

$2x + 5y - 1 = 0$

$$\Rightarrow \quad y = -\frac{2}{5}x + \frac{1}{5}$$

$$\therefore \quad m_L = -\frac{2}{5}$$

$$\therefore \quad m_{PARA.} = -\frac{2}{5}$$

$$y - b = m(x - a)$$

$$y - 3 = -\frac{2}{5}(x - 2)$$

$$5y - 15 = -2(x - 2)$$

$$5y - 15 = -2x + 4$$

$$\boxed{2x + 5y = 19}$$

$$m = -\frac{2}{5}$$

$$(\underset{a}{2}, \underset{b}{3})$$

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<u>Example 3</u>

A line L has equation $3y - 3 - 2x = 0$.

Find the equation of the line perpendicular to L and passing through $(-1, 5)$.

$3y - 3 - 2x = 0$

$$\Rightarrow \quad y = \frac{2}{3}x + 1$$

$$\therefore \quad m_L = \frac{2}{3}$$

$$\therefore \quad m_{PERP.} = -\frac{3}{2}$$

$$y - b = m(x - a)$$

$$y - 5 = -\frac{3}{2}(x - (-1))$$

$$2y - 10 = -3(x + 1)$$

$$2y - 10 = -3x - 3$$

$$\boxed{3x + 2y = 7}$$

$$m = -\frac{3}{2}$$

$$\underset{a \quad b}{(-1, 5)}$$

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<u>Example 4</u>
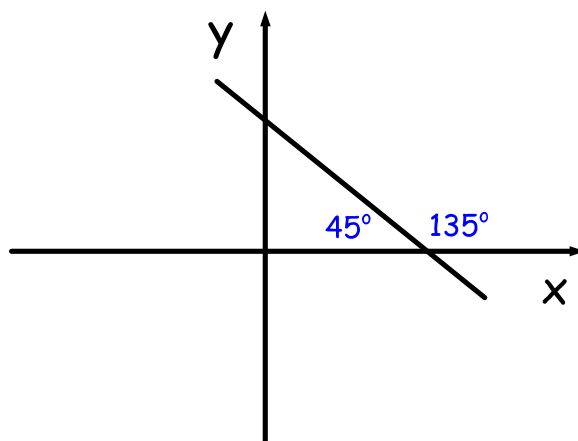
A line L makes an angle of 45° with the negative x-axis.

Find the equation of the line perpendicular to L and passing through (2, 2).

$m_L = \tan 135°$

$\therefore \quad m_L = -1$

$\therefore \quad m_{PERP.} = 1$

$y - b = m(x - a)$

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

$\boxed{y = x}$

$m = 1$

$(2, 2)$
$a \quad b$

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<u>Example 5</u>

For which values of k are the lines
$2x - ky + 3 = 0$ and $4x + y - 1 = 0$
perpendicular ?

$2x - ky + 3 = 0 \Rightarrow y = \dfrac{2}{k}x + \dfrac{3}{k}$

$$\therefore \quad \underline{m_1 = \dfrac{2}{k}}$$

$4x + y - 1 = 0 \Rightarrow y = -4x + 1$

$$\therefore \quad \underline{m_2 = -4}$$

For lines to be perpendicular,

$$m_1 \, m_2 = -1$$

$$\therefore \quad \dfrac{2}{k}(-4) = -1$$

$$\Rightarrow \quad -\dfrac{8}{k} = -1$$

$$\Rightarrow \quad \boxed{k = 8}$$

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