

# Perpendicular lines

Lines are *perpendicular* to each other if the angle between them is a right angle.

Two lines in the plane with gradients  $m_1$  and  $m_2$  are perpendicular if and only if  $m_1 m_2 = -1$ . (Vertical and horizontal lines are also perpendicular, but vertical lines do not have a gradient.)

Two lines in the plane with equations  $a_1 x + b_1 y + c_1 = 0$  and  $a_2 x + b_2 y + c_2 = 0$  are perpendicular if and only if  $a_1 a_2 + b_1 b_2 = 0$ .

If the direction vectors of two lines are  $\mathbf{d}_1$  and  $\mathbf{d}_2$ , then the lines are perpendicular if and only if the **dot product**  $\mathbf{d}_1 \cdot \mathbf{d}_2 = 0$ .