Example Find equations in general linear form for the two lines passing through the point $(3, -2)$ such that one is parallel to the line $y = 3x + 1$ and the other is perpendicular to it.

Solution Let ℓ_1 (respectively ℓ_2) be the line that passes through the point $(3, -2)$ and parallel (respectively perpendicular) to the given line. It is clear that the slope of the given line is 3. Thus the slope of ℓ_1 is 3 and the slope of ℓ_2 is $-\frac{1}{3}$. From these, we get the point-slope forms for ℓ_1 and ℓ_2:

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

respectively. Expanding and rearranging terms, we get the following linear forms

$$3x - y - 11 = 0 \qquad \text{and} \qquad x + 3y + 3 = 0$$

for ℓ_1 and ℓ_2 respectively. □

Exercise 0.7

1. For each of the following, find an equation of the line satisfying the given conditions. Give your answer in general linear form.
   (a) Passing through the origin and $(-2, 3)$.
   (b) With slope 2 and passing through $(5, -1)$.
   (c) With slope -3 and y-intercept $(0, 7)$.
   (d) Passing through $(-3, 2)$ and parallel to $2x - y - 3 = 0$.
   (e) Passing through $(1, 4)$ and perpendicular to $x + 3y = 0$.
   (f) Passing through $(1, -1)$ and perpendicular to the y-axis.

0.8 Pythagoras Theorem, Distance Formula and Circles

Pythagoras Theorem *Let a, b and c be the (lengths of the) sides of a right-angled triangle where c is the hypotenuse. Then we have*

$$a^2 + b^2 = c^2.$$

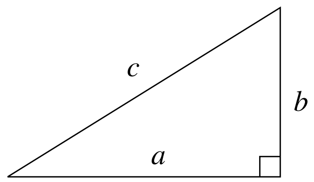

Figure 0.2

Distance Formula Let $P = (x_1, y_1)$ and $Q = (x_2, y_2)$. Then the distance PQ between P and Q is

$$PQ = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}.$$

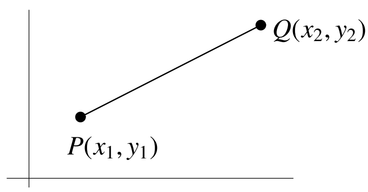

Figure 0.3