# Quadratic Functions

## Exercise 7.3 - Modelling and Problem Solving

## Question 8:

The total resistance R of two resistors $R_1$ and $R_2$ in parallel is given by

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$

A particular resistor is placed in parallel with one 20 ohms greater in resistance. The total resistance is 24 ohms. What are the resistances of two resistors?

## Solution

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$

Re - writing the equation given:

$$\frac{1}{24} = \frac{1}{R_1} + \frac{1}{R_1 + 20}$$

Substituting $R = 24$ and $R_2 = R_1 + 20$

$$\frac{1}{R_1} + \frac{1}{R_1 + 20} - \frac{1}{24} = 0$$

Re- arrange the equation so the right side is Zero.

Writing the fractions with the same denominator (L.C.D)

$$\frac{24(R_1 + 20) + 24R_1 - R_1(R_1 + 20)}{24\,R_1(R_1 + 20)} = 0$$

Expanding the brackets

$$\frac{24R_1 + 480 + 24R_1 - R_1^2 - 20R_1}{24\,R_1(R_1 + 20)} = 0$$

$$\frac{-R_1^2 + 28R_1 + 480}{24\,R_1(R_1 + 20)} = 0$$

Collecting like terms

$$-R_1^2 + 28R_1 + 480 = 0$$

Writing the numerator equal zero

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Using the quadratic formula to the equation above

$$a = -1,\ b = 28,\ c = 480$$

Stating values for a, b and c

Substituting the relevant values into the formula

$$x = \frac{-28 \pm \sqrt{(28)^2 - 4 \times -1 \times 480}}{2 \times -1}$$

$$x = \frac{-28 \pm \sqrt{2704}}{-2}$$

$$x = \frac{-28 \pm 52}{-2}$$

$$x = \frac{-28 + 52}{-2}$$

$= -12$ Negative resistance does not make sense

OR

$$x = \frac{-28 - 52}{-2}$$

$= 40$

So:

$R_1 = 40$ ohms

$R_2 = R_1 + 20$ Using the information given
$= 40 + 20$ Substituting 40 for $R_1$
$= 60$ ohms

**Answer:** The resistance of the two resistors are $R_1 = 40$ ohms and $R_2 = 60$ ohms.