MATHS

Lesson 7

Year 9

Topic: Linear and non-linear relationships

Calculating gradients 1

Today you will:

- revise describing slopes
- explore the rule for calculating gradient.

Resources

Digital

Video — Gradient (3:08)

Video — Linear functions (1:18)

Find and prepare

Sheet 6 — Grid paper: 1 cm

Spreadsheet software (optional)

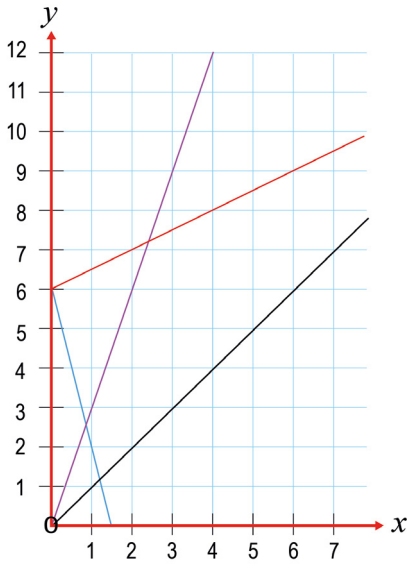
Key terms

For definitions and explanations of terms, please see the Glossary.

Lesson

Revise describing slope

1. Look at the slopes in the graph and describe the lines with sentences (like in Lesson 6) by writing:
   - whether the slope is going up or down
   - how much the graph goes up/down and across
   - where the slope crosses the y-axis.



Note

Make sure you have a look at the scale of each axis before you begin.

Line 1 (black)

Line 2 (blue)

Line 3 (purple)

Line 4 (red)



In this lesson, we will be developing a mathematical way to describe the slope of a line.

Hot tip

Whether we use words or numbers and symbols to describe a line, the description must cover the three attributes (properties):

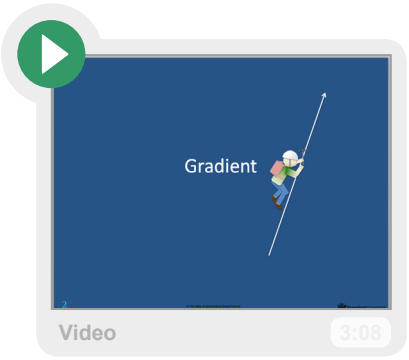
- whether the slope is going up or down (if it is positive or negative)
- how steep the slope is
- where the slope crosses the y-axis.

Changing any one of these three attributes will change the line.

Today, we are going to focus on whether the slope is going to be positive or negative and the **steepness**. This is known as the **gradient**. We use a ratio to calculate the gradient of a line.



2. Watch the **Video — Gradient**.



The mathematical term for steepness is **gradient** and it is represented by the letter m.

Gradient is calculated by how much the line rises vertically over a horizontal distance (called the **run**).

We use the following formula to calculate the gradient:

$$m = \frac{\text{rise}}{\text{run}}$$

The gradient of a straight line stays constant, which means it will be the same value no matter where you measure it along the line.

Investigating gradient (slope) and y-intercept

3. Explore the relationship between slope (gradient), rise and run using the lines marked as A, B and C on the Cartesian plane shown. Work through the following steps and answer the questions.

   a. Graph A has a gradient of 1. The rise = ☐ and the run = ☐

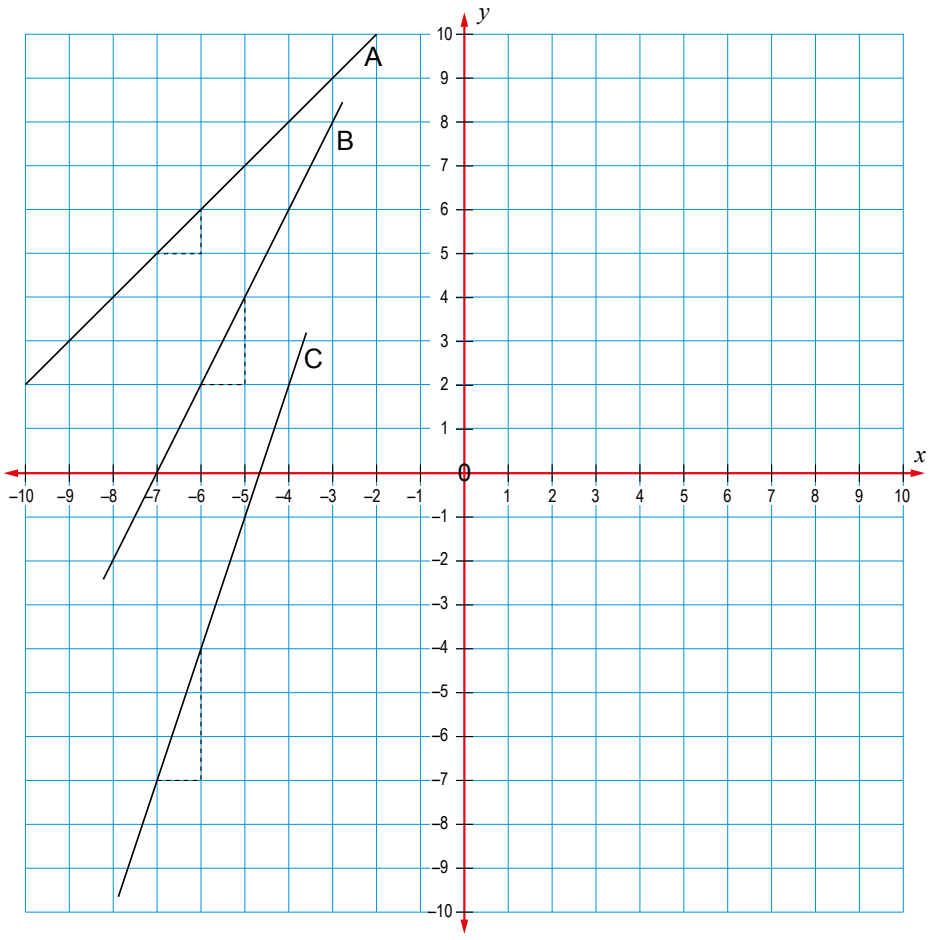
   b. Graph B has a gradient of 2. The rise = ☐ and the run = ☐

   c. Graph C has a gradient of 3. The rise = ☐ and the run = ☐

d. What do you notice about the run for each graph?

e. How does the gradient change as the rise increases?

f. What type of line will you get if the rise = 0? (Try drawing the line on the Cartesian plane to help, if necessary).



4. a. Mark the point (2, –4) on the previous Cartesian plane.

b. Draw a horizontal line that starts at (2, –4) and ends at (5, –4).

c. Draw a vertical line that starts at (5, –4) and ends at (5, 2).

d. Draw a line joining (2, –4) and (5, 2).

e. Write the value of the rise (for this right-angled triangle) on the Cartesian plane.

f. Write the value of the run (for this right-angled triangle) on the Cartesian plane.

g. Use the rule: gradient = $\frac{\text{rise}}{\text{run}}$ to find the gradient of the hypotenuse in the right-angled triangle.

Department of Education and Training
C2C Independent Learning Materials

Queensland Government

5. Calculate the gradient, in your Maths notebook, for the following. Show full setting out for each calculation.
   a. rise = 4 and run = 2
   b. rise = 1 and run = 2
   c. rise = –2 and run = 2
6. Calculate the gradients of the four lines in the following graph using $m = \frac{\text{rise}}{\text{run}}$

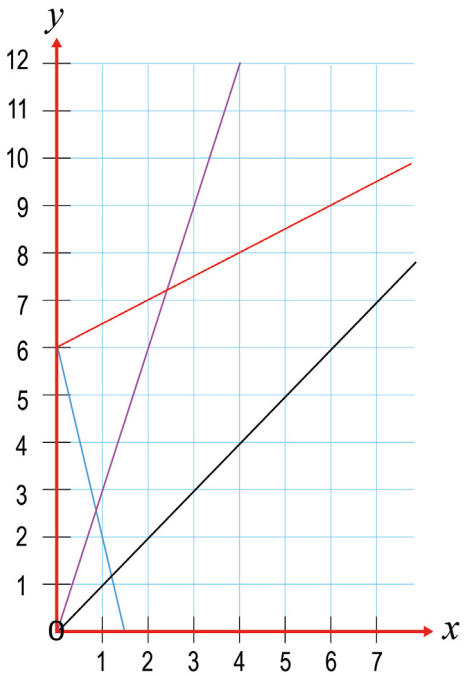


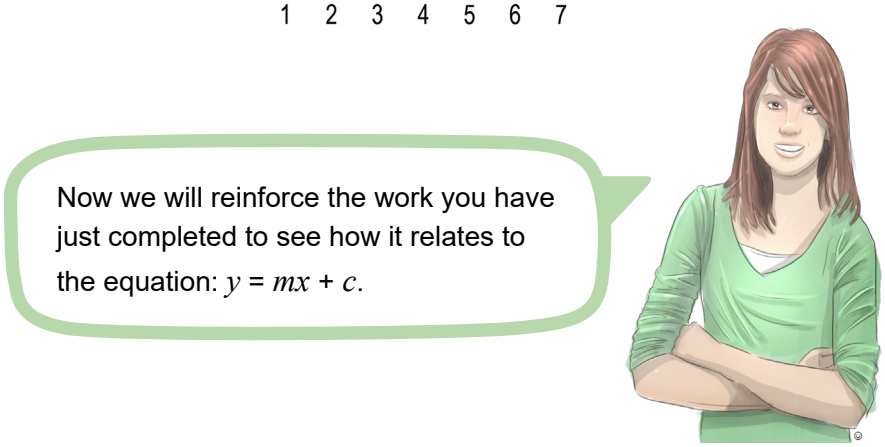
Hot tip

Remember:

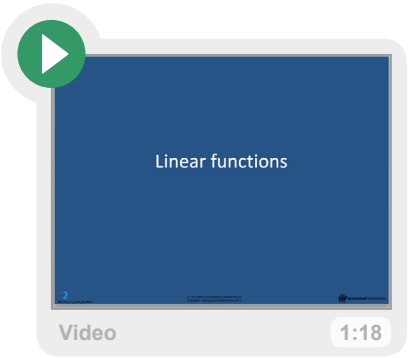
- m represents the gradient or slope
- the rise is the change in the y-axis (the vertical distance between the points)
- the run is the change in the x-axis (the horizontal distance between the points).

a. Line 1 (black)
b. Line 2 (blue)
c. Line 3 (purple)
d. Line 4 (red)





7. Watch the **Video — Linear functions**.

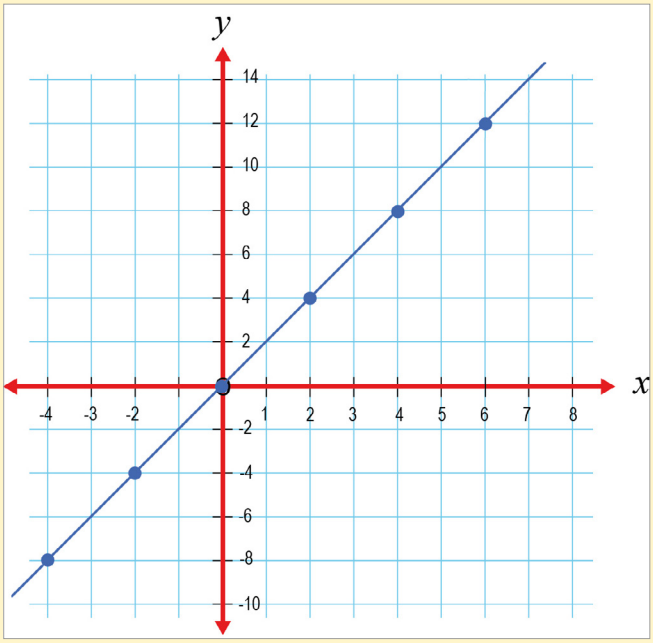


A linear function is the mathematical way to describe a line.

The function, $y = 2x$, is represented graphically in the following.
The 'y' represents the y value of a coordinate point and the 'x' represents the x value of the coordinate point. The 2 is the coefficient of the 'x'.
In this case, the 2 indicates the gradient (m) of the line.

$$y = 2x$$

x	−4	−2	0	2	4
y	−8	−4	0	4	8



Hot tip

A coefficient is a number used to multiply a variable. In a linear function, the variable x is multiplied by the gradient (m). The gradient is referred to as the coefficient of x.

Department of Education and Training
C2C Independent Learning Materials
Queensland Government

8. Complete the following table by substituting x into the formula. The first one is done for you: $y = 3 \times -3$ so $y = -9$. Graph the values (using spreadsheet software, graph paper or **Sheet 6 —** Grid paper: 1 cm).

   $y = 3x$

x	−3	−2	0	2	4
y	−9		0		

9. Complete the following table for the function $y = 2.5x$. Graph the function.

x	−3	−1	0	3	4
y	−7.5				

10. Use your table of values and graph of $y = 2.5x$ to answer the following questions:

    a. What is the gradient of the line?

    b. What is the point where it crosses the y-axis?

    c. The gradient of the line is commonly represented by the letter m. What is the value of m in this function?

    d. If we change the value of m in the function to 5, what happens to the line?

    e. How can we determine the gradient by using only the information provided on a graph of a linear equation?



Think back to the language you identified with slope at the beginning of the lesson. Can you see how the terms you listed are linked to the mathematical calculations you did?