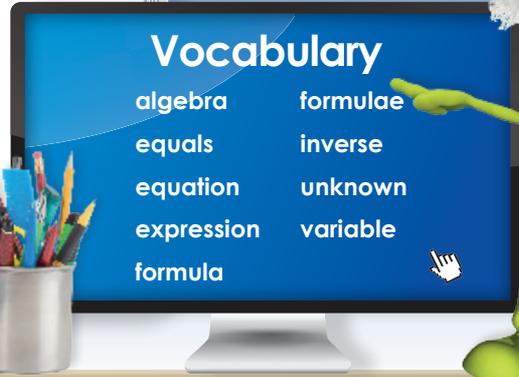


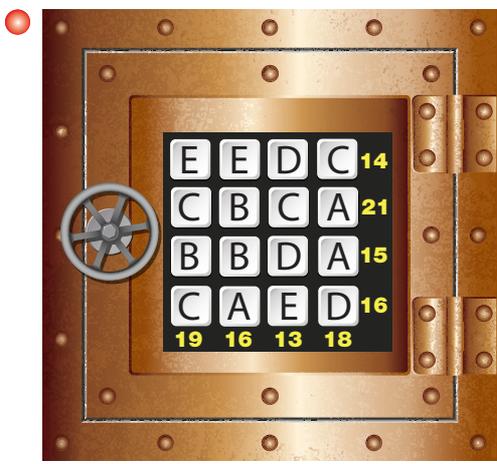
8 Expressions, formulae and equations

We are learning to...

- Use a letter to represent a variable in an expression or formula
- Model real-life situations with formulae
- Solve simple equations



Getting started



This square keypad is on the door of a vault. The letters **A, B, C, D** and **E** stand for whole numbers.

The yellow numbers show the sum of each row and column.

E = 3

To unlock the vault you must know what number the other letters stand for. What do they stand for?

This keypad is on another vault door. The letters **P, Q, R, S** and **T** stand for whole numbers. The yellow numbers show the sum of each row and column.

T = 4

What numbers do the other letters stand for?



Check up on level 3 and book 4A

If you can answer all of these questions, you are ready for this chapter.



1 Write an expression for how much each person has now.

- a Olive had $\$n$. She found $\$5$.
- b Reuben had $\$y$. He spent $\$12$ to buy a game.
- c Ben had $\$g$. He got another $\$25$ from his after school job.
- d Sai had $\$m$. He was given another $\$10$ but then he lost $\$n$.



Olive

I had $\$n$ and found $\$5$ more.
I now have $\$n + \underline{\hspace{2cm}}$

2 Samantha made these patterns with pictures of Norman  and Spice .



Pattern 1



Pattern 2



Pattern 3

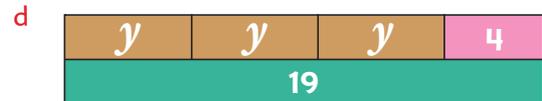
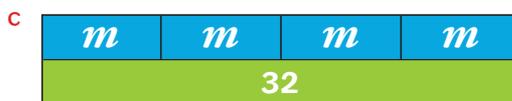
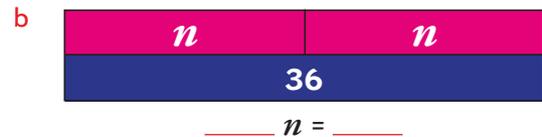
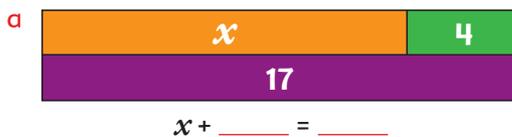
She used this formula to find the number of pictures of Spice in each pattern.

Number of pictures of Spice = $2 \times$ number of pictures of Norman + 2

How many pictures of Spice will there be in a picture which has these?

- a 5 pictures of Norman
- b 35 pictures of Norman
- c 125 pictures of Norman

3 Write an equation for each of these. The first two have been started.



4 What is the number?

- a I think of a number, add 4 and the answer is 11.
- b I think of a number, multiply by 3 and the answer is 39.
- c I think of a number, divide by 6 and the answer is 8.
- d When I multiply a number by 6 then add 2 the answer is 26.
- e When I divide a number by 3 and then add 5 the answer is 16



Rich tasks for this chapter

You might do these at the start, middle or end of the chapter or as homework or extension.



1 Temperature trouble

The formula for converting temperatures in degrees centigrade ($^{\circ}\text{C}$) to degrees Fahrenheit ($^{\circ}\text{F}$) is

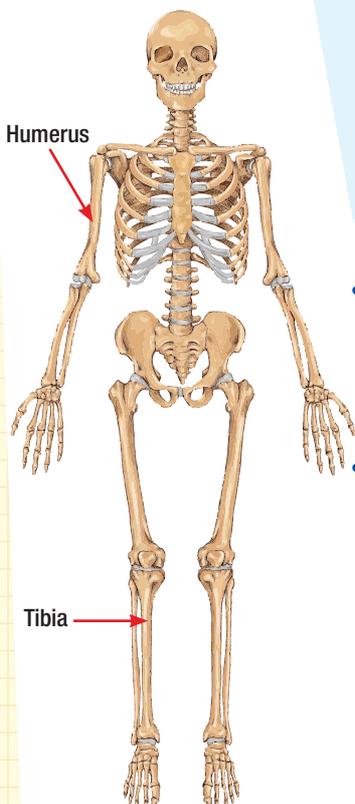
$$F = \frac{9}{5} C + 32$$

- Use the formula to make a double-sided thermometer showing the $^{\circ}\text{F}$ and $^{\circ}\text{C}$ equivalences for some temperatures, such as the temperature at which water freezes and boils.
- There is a temperature at which $^{\circ}\text{C}$ and $^{\circ}\text{F}$ are the same. Use the formula to find this temperature.



2 How tall was she or he?

When a human skeleton is found, either as a result of a crime or at an archeological site, these formulae can be used to work out the probable height of a person when they were alive.



For a male skeleton

$$\text{Height in cm} = 3.08 \times \text{length of humerus bone} + 70.45$$

$$\text{Or Height in cm} = 2.52 \times \text{length of the tibia bone} + 75.79$$

For a female skeleton

$$\text{Height in cm} = 3.38 \times \text{length of humerus bone} + 57.97$$

$$\text{Or Height in cm} = 2.9 \times \text{length of the tibia bone} + 59.24$$

- If the tibia bone from a female skeleton was 38.6 cm, what was her probable height?

How much difference does it make if you round the numbers in the formula to the nearest whole number? One decimal place?

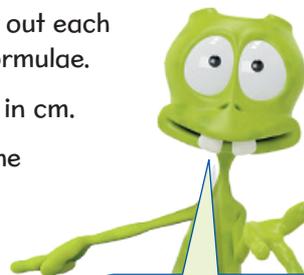
- Ask five to ten people in your class to measure the approximate lengths of their humerus and tibia bones.

Make a chart of these and then work out each person's probable height using the formulae.

Measure each person's actual height in cm.

Compare the probable heights with the actual heights.

You could use a scatter plot to help you decide if the formulae give a good estimate of height.



For more on scatter plots see page 316.

Solving equations using basic facts and estimation and improvement

Sometimes you can use basic facts to work out what number a letter stands for in an equation. The letter is called an **unknown** or a **variable**.

Example

$$x + 4 = 12$$

$$8 + 4 = 12$$

$$\text{so } x = 8$$



Activity 2

1 Find the unknown using basic facts.

a $x + 7 = 16$

b $y - 8 = 12$

c $4s = 24$

d $\frac{n}{3} = 4$

e $y - 11 = 13$

f $w + 14 = 30$

g $7x = 35$

h $\frac{r}{6} = 5$

i $t - 9 = 21$

j $9w = 45$

k $y + 7 = 29$

l $18 = g + 5$

m $17 = p - 4$

n $4 = \frac{x}{2}$

o $32 = 8p$

p $9a = 72$

q $8 = \frac{z}{8}$

r $15 + x = 31$

s $\frac{40}{x} = 8$

t $31 = 46 - y$

Sometimes it is not obvious what the value of the unknown is.

One way of working out the value of the unknown is to make a good guess and then substitute your guess into the equation to see if it gives the correct answer.

If not, then a better guess can be made.

Example

What is the value of x that makes $4x - 3 = 7$ true?

I think I will try 2 first.



Try $x = 2$

Put 2 instead of x in the equation

$$4x - 3 = 4 \times 2 - 3 = 5 \quad 5 \text{ is too small}$$

Try $x = 3$

$$4x - 3 = 4 \times 3 - 3 = 9 \quad 9 \text{ is too big}$$

Try $x = 2.5$

$$4x - 3 = 4 \times 2.5 - 3 = 10 - 3 = 7 \quad \text{Correct}$$

$$x = 2.5$$

Remember

$4x$ means 4 times x .

