Mathletics

Series F Student

Patterns and Algebra

My name

First edition printed 2009 in Australia.

A catalogue record for this book is available from 3P Learning Ltd.

ISBN 978-1-921860-80-5

Published 3P Learning Ltd

For more copies of this book, contact us at: www.3plearning.com/contact

Designed 3P Learning Ltd

Series F – Patterns and Algebra

Contents

Series Authors:

Rachel Flenley
Nicola Herringer

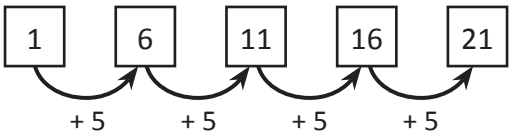
Patterns and functions – recursive number patterns

Look around you, can you see a pattern? A pattern is an arrangement of shapes, numbers or objects formed according to a rule. Patterns are everywhere, you can find them in nature, art, music and even in dance!

In this topic, we are looking at number patterns. A number pattern is a sequence or list of numbers that is formed according to a rule.

Number patterns can use any of the four operations (+, –, ×, ÷) or even a combination.

In the example below, if we follow this instruction: "starting at 1 add 5 each time" we get this number pattern:



1 **Write the next 3 numbers in each sequence by following the rule:**

a Rule: add 6 5 → 11 → 17 → ☐ → ☐ → ☐

b Rule: subtract 10 100 → 90 → 80 → ☐ → ☐ → ☐

c Rule: multiply by 2 2 → 4 → 8 → ☐ → ☐ → ☐

2 **Figure out the missing numbers in each pattern and write the rule. Circle the ascending patterns.**

a 14 21 ☐ 35 42 ☐

Rule _____

b 17 37 57 ☐ ☐ ☐

Rule _____

c 75 ☐ ☐ 30 15 ☐

Rule _____

d ☐ 16 24 ☐ 40 ☐

Rule _____

e 63 54 ☐ 36 27 ☐

Rule _____

f 63 56 ☐ 42 35 ☐

Rule _____

3 **Complete these grid patterns. Look closely at the numbers in the grid and follow the patterns.**

a

		32	
40		42	
50		52	

b

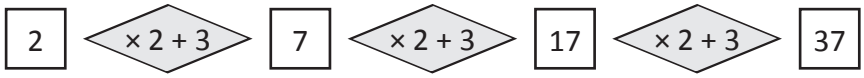
		66	
		76	
84			
		96	

c

3			
		17	
23	25		

Patterns and functions – recursive number patterns

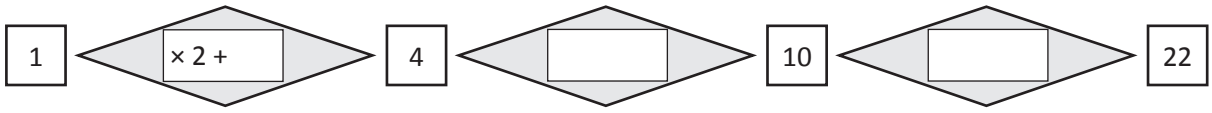
Some number patterns can be formed with 2 operations each time. For example:



The rule is multiply by 2 and add 3 each time.

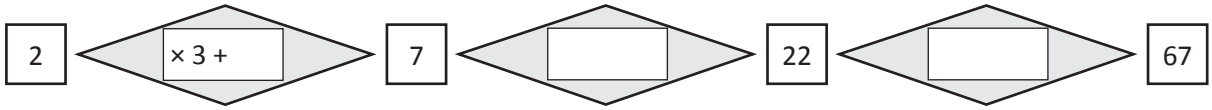
4 **With these number patterns, write the rule as 2 operations in the diamond shapes and describe it underneath.**

a



The rule is _____

b



The rule is _____

5 **Lena and Max were asked to show a number pattern for different rules. Check each sequence and put a circle around any errors. You may use a calculator.**

a Start at 2, add 1 and multiply by 2

Lena	2	6	14	30	62	126	254	510	1022

b Start at 3, add 1 and multiply by 2

Max	3	8	18	38	78	158	320	640	1280

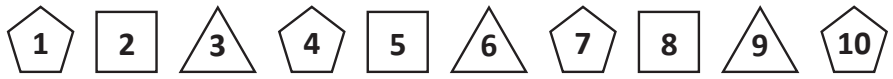
6 **Look at each pattern of shapes and see if you can predict the following:**

a

What will shape number 20 look like? Draw it here:

What will shape number 33 look like? Draw it here:

b



What will shape number 15 look like? Draw it here:

What will shape number 26 look like? Draw it here:

Patterns and functions – function number patterns

There are 2 different types of rules that a number pattern can be based upon:

1 A recursive rule – used to continue the sequence by doing something to the **number** before it.

2 A function rule – used to predict any number by applying the rule to the **position** of the number.

A function rule is a rule based on the position of a number.

Consider this. Lucia was given this number pattern: 5 10 15 20 25

Her teacher asked her to work out what the 20th number would be without continuing the sequence. Lucia used a table to work out the rule between the position of a number and the number in the pattern. She worked out the rule to be × 5.

Position of number	1	2	3	4	5	20
Function rule	× 5	× 5	× 5	× 5	× 5	× 5
Number pattern	5	10	15	20	25	100

So, following the rule based on the position of a number, the 20th number is 100.

This is a function rule.

1 **Use the function rule and then apply the rule to position 20.**

a

Position of number	1	2	3	4	5	20
Function rule						
Number pattern	6	12	18	24	30	

b

Position of number	1	2	3	4	5	20
Function rule						
Number pattern	4	8	12	16	20	

c

Position of number	1	2	3	4	5	20
Function rule						
Number pattern	8	16	24	32	40	

d

Position of number	1	2	3	4	5	20
Function rule	× 4 +					
Number pattern	7	11	15	19	23	

Patterns and functions – function number patterns

Function rules with 2 operations are easy to work out when we look at how they are linked to the multiplication tables.

Position of number	1	2	3	4	5
2 times table + 3	**2 + 3**	**4 + 3**	**6 + 3**	**8 + 3**	**10 + 3**
Number pattern	5	7	9	11	13
Function rule	Multiply by 2 and then add 3				

This table shows that the number pattern is the same as the 2 times table with 3 added to each answer.

2 **Complete each table to show how function rules with 2 operations can be linked to multiplication tables.**

a

Position of number	1	2	3	4	5
3 times table + _____	**3 + _____**	**6 + _____**	**9 + _____**	**12 + _____**	**15 + _____**
Number pattern	7	10	13	16	19
Function rule	Multiply by 3 and then add _____				

b

Position of number	1	2	3	4	5
6 times table + _____	**6 + _____**	**12 + _____**	**18 + _____**	**24 + _____**	**30 + _____**
Number pattern	8	14	20	26	32
Function rule	Multiply by 6 and then add _____				

c

Position of number	1	2	3	4	5
____ times table + ____					
Number pattern	11	19	27	35	43
Function rule					

3 **Complete this table to show the 4 times tables with 2 added.**

a

Position of number	1	2	3	4	5
4 times table + 2					
Number pattern					
Function rule					

b What would the number in the 20th position be? _____

Patterns and functions – matchstick patterns

Use the function rule to predict geometric patterns with matchsticks. Here is an example.
Mia made this sequence of shapes with matchsticks:

Shape 1 **Shape 2** **Shape 3** **Shape 4**

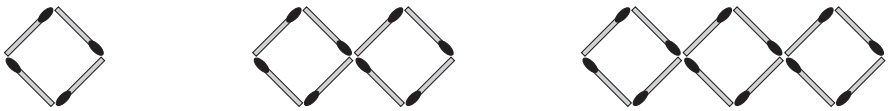
If Mia followed this sequence, how many matchsticks will she need for shape 20?

Shape number	1	2	3	4	5	**20**
Number of matchsticks	3	6	9	12	15	*60*
Function rule	Number of matchsticks = Shape number × *3*					

1 **Complete the table for each sequence of matchstick shapes. Use the function rule for finding the number of matchsticks needed for the shape in the 20th position.**

a

Shape 1 Shape 2 Shape 3

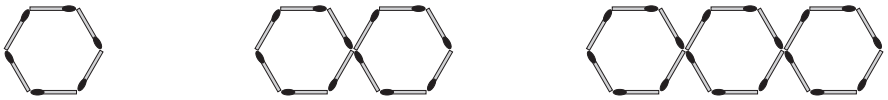


Shape number	1	2	3	4	5	**20**
Number of matchsticks	4	8	12			
Function rule	Number of matchsticks = Shape number × _____					

.....

b

Shape 1 Shape 2 Shape 3

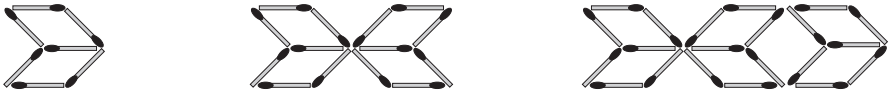


Shape number	1	2	3	4	5	**20**
Number of matchsticks	6	12	18			
Function rule	Number of matchsticks = Shape number × _____					

.....

c

Shape 1 Shape 2 Shape 3

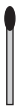


Shape number	1	2	3	4	5	**20**
Number of matchsticks	7	14	21			
Function rule	Number of matchsticks = Shape number × _____					

Patterns and functions – matchstick patterns

This time the rule for this matchstick pattern has 2 operations. Can you see why?
Look for a multiplication pattern and how many extra there are in each shape.

Look for a repeating element. 

Then look to see what is added.
These are circled in the sequence below. 

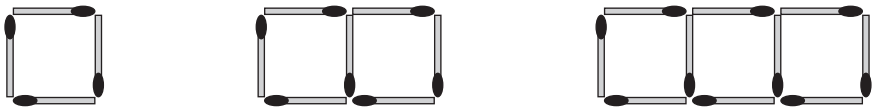
Shape 1 Shape 2 Shape 3

Shape 1 has 3 matchsticks $1 \times 2 + 1 = 3$
Shape 2 has 5 matchsticks $2 \times 2 + 1 = 5$
Shape 3 has 7 matchsticks $3 \times 2 + 1 = 7$

Shape number	1	2	3	4	5	20
Number of matchsticks	3	5	7	9	11	41
Function rule	Number of matchsticks = Shape number × 2 + 1					

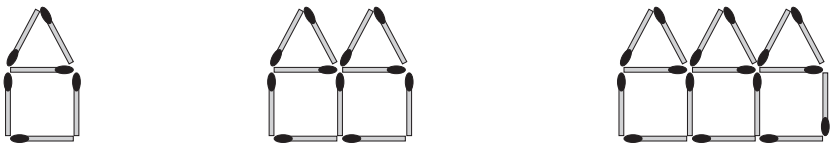
2 **In each of these patterns, look for the repeating element and then what is added each time:**

a Shape 1 Shape 2 Shape 3



Shape number	1	2	3	4	5	20
Number of matchsticks	4	7	10			
Function rule	Number of matchsticks = Shape number × _____ + _____					

b Shape 1 Shape 2 Shape 3



Shape number	1	2	3	4	5	20
Number of matchsticks						
Function rule	Number of matchsticks = Shape number × _____ + _____					

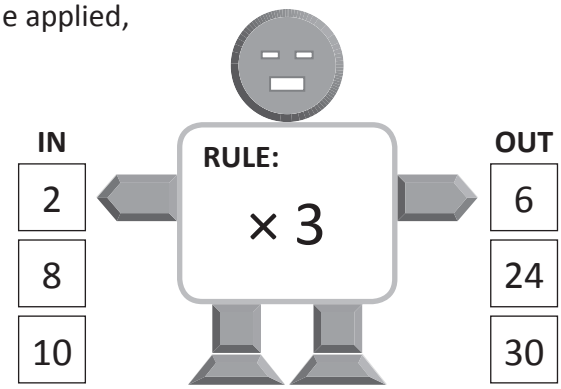
c Shape 1 Shape 2 Shape 3

Shape number	1	2	3	4	5	20
Number of matchsticks						
Function rule	Number of matchsticks = Shape number × _____ + _____					

Patterns and functions – function machines

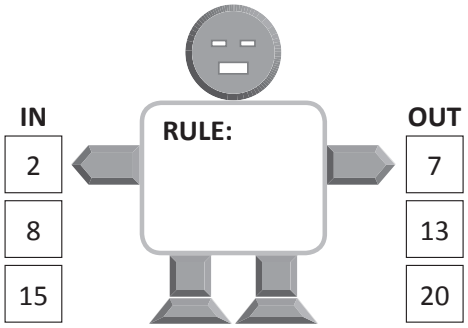
This is a function machine.

Numbers go in, have the rule applied, and come out again.

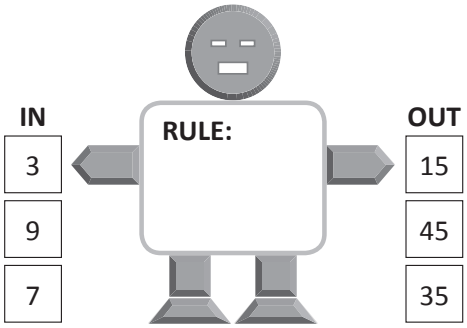


1 **Look carefully at the numbers going *in* these function machines and the numbers coming *out*. What rule are they following each time?**

a

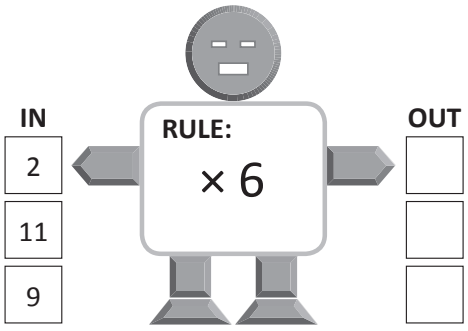


b

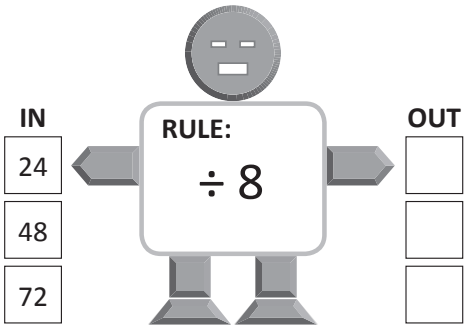


2 **What numbers will come *out* of these function machines?**

a

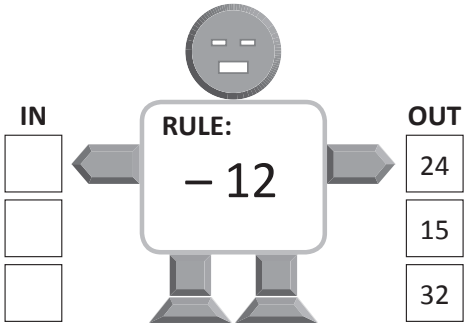


b

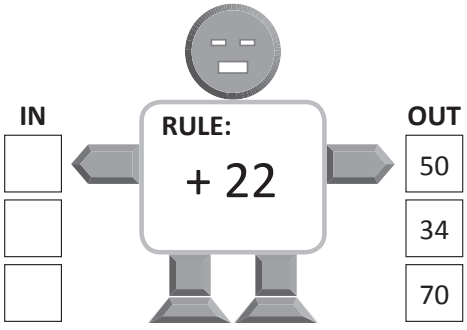


3 **What numbers go *in* to these number function machines?**

a



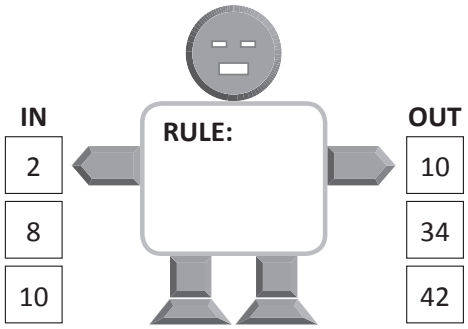
b



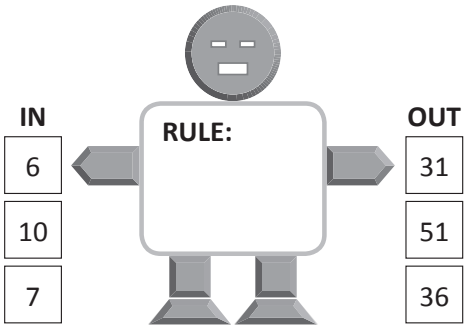
Patterns and functions – function machines

4 **Write the rule in each double function machine. Each rule is made up of 2 operations (× then +).**

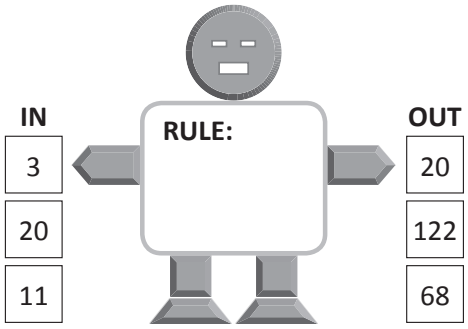
a



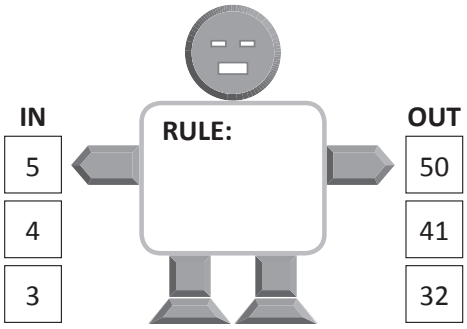
b



c

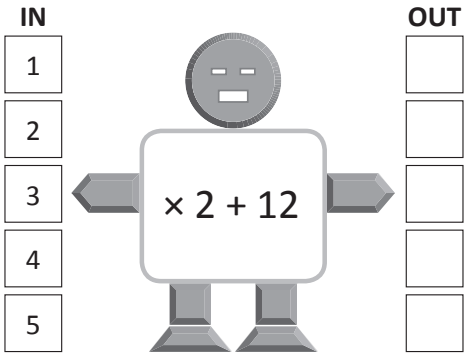


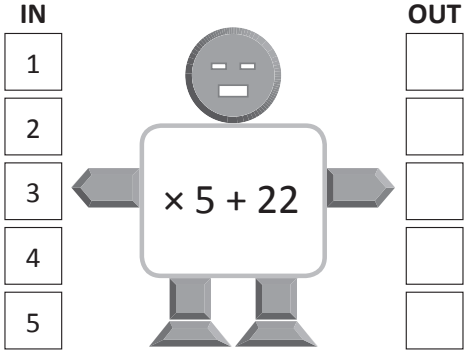
d



5 **Which function machine will win this game of bingo? Write the numbers that come out and colour each machine's numbers in a different colour. Check which machine has 3 numbers in a line in any direction.**

MATHS x÷ BINGO +−				
27	16	45	12	17
42	32	22	18	23
47	68	FREE SPACE	18	29
15	20	37	15	32
14	30	43	16	35





Patterns and functions – function tables with addition and subtraction

The function machines showed us that when a number goes in, it comes out changed by the rule or the function. There are many function patterns in real life.

Look at this example:

At their Christmas fair, Middle Street Primary School charges $1.50 for a gift wrapping service. This table shows the total cost of each wrapped gift and shows the rule.

Cost of unwrapped gift	$7	$10	$15	$18
Cost of wrapped gift	$8.50	$11.50	$16.50	$19.50
Rule	Cost of unwrapped gift + $1.50 = Cost of wrapped gift			

1 **Complete the function table for the total cost of a day out at a fun park. You must pay an entry fee of $12 and purchase a wrist band for the amount of rides that you want to go on.**

Wrist band	5 rides for $20	6 rides for $25	7 rides for $30	8 rides for $35
Total admission				
Rule	Wrist band + $12 = Total cost			

2 **Complete the function table for the total cost of lunch at a school canteen. Students pay $2.40 for a sandwich and then choose what else they would like. Work out the total cost of lunch for each option.**

Lunch option	Drink: 80¢	Fruit: 95¢	Yoghurt: $1.10	Ice block: $1.50
Total cost of lunch				
Rule	Lunch option + $2.40 = Total cost of lunch			

3 **5F have fitness every Thursday afternoon for 30 minutes. Each week they complete a fitness activity and then play running games. Work out how much time is left for games after each activity.**

Activity	Skipping 10 minutes	Star jumps 12 minutes	Push ups 15 minutes	Sit ups 16 minutes
Time left for games				
Rule	30 minutes – length of time of activity = Time left for games			

Patterns and functions – function tables with multiplication

Let's look at more real life function tables, this time based on multiplication.

By working out the function, you can extend the pattern to find out unknowns.

For example:

A bakery makes 10 cupcakes an hour.

The rule to work out the number of cupcakes this bakery produces within a certain amount of time is:

Number of hours × 10 = Number of cupcakes

Hours	1	2	3	4	5	6	7	8
Cupcakes	10	20	30	40	50	60	70	80

How many cupcakes will it make in 1 day?

This table only goes up to 8 hours but we can use the function to answer this question:

24 hours × 10 cupcakes = 240 cupcakes

1 **Complete the function tables, write the rule and answer the question.**

a

A dry cleaner charges $2 to iron a shirt.

Number of shirts	1	2	3	4	5	6	7	8
Cost	$2	$4	$6					

Write the rule for finding out the cost of ironing shirts when you know how many shirts:

How much does it cost to have 12 shirts ironed?

b

Monica and Anna have a lemonade stand outside their house. For every litre of lemonade they make 4 cups to sell.

Litres	1	2	3	4	5	6	7	8
Cups	4	8						

Write the rule for finding out how many cups are needed when you know how many litres have been made:

How many cups will be needed if they have enough to make 12 litres of lemonade?

c

At a cinema, the lollies are sold by weight. 1 scoop costs 50¢.

Scoops of lollies	1	2	3	4	5	6	7	8
Cost	50¢	$1						

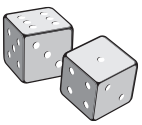
Write the rule to find out the cost of the lollies when you know how many scoops:

How many scoops of lollies can I get for $10?

Rows and columns apply

Getting ready

This is a game for 2 players. For this game you will need 2 dice, this page and 12 counters each, in 2 different colours. A calculator is optional.



What to do

Roll both dice, add them together and put this value in the function rule.

For example, if I roll 3 and 5, I add these and get 8. I put 8 into the first rule and get 8 × 7 – 3 = 53. I place one of my counters on 53.

If the answer is already taken, you lose a turn.

The winner is the player with the most counters in any row or column after 3 rounds of each function rule. (The numbers do not have to be next to each other, although you could play like that if you wanted a longer game.)

Function Rule 1	**Function Rule 2**	**Function Rule 3**
◈ × 7 – 3	6 × ⊙	(8 × ▣) – 5

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

What to do next

Change the object of the game. For example, the winner might be the person who has their counters on the most even numbers.

Pizza Pizzazz

solve

Getting ready

Pizza Pizzazz is the name of a pizza delivery company that you work for on the weekends. You drive all around town delivering hot and tasty pizzas in record time.

To encourage you to uphold the company guarantee of delivering pizzas in record time, your boss has given you a choice of bonus scheme.

What to do

Which scheme pays the best bonus?

Use the tables below to work out which payment system is best.

Payment System 1 For each pizza that you deliver, you will get $2.	
Number of pizzas	**Bonus**
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Payment System 2 For each pizza that you deliver, your bonus will double, starting at 50¢.	
Number of pizzas	**Bonus**
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Which bonus scheme would you choose and why?

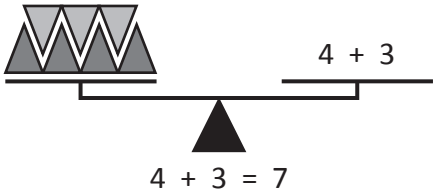
What to do next

Can you think of when the other bonus scheme would be better?

Which bonus scheme do you think your boss would prefer you to choose?

Equations and equivalence – understanding equivalence

An equation is like a set of balanced scales. Both sides are equal.
Look at the scale on the right.



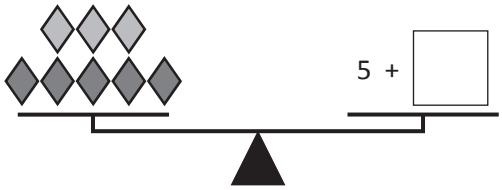
On one side are 4 black triangles and 3 grey triangles.
On the other side is the problem 4 + 3.
Is this a balanced equation?
Yes, because they both represent 7.

Sometimes, we haven't been given all the information and we have to work it out. This is what algebra is – solving missing number puzzles.

1 **Make these scales balance by adding the missing value:**

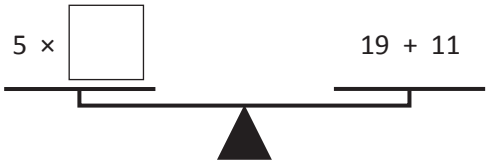
a

b



2 **These scales have number problems on each side. One side has a complete problem. On the other side, you need to work out the missing value. Write the value in the box so that the scales balance:**

a

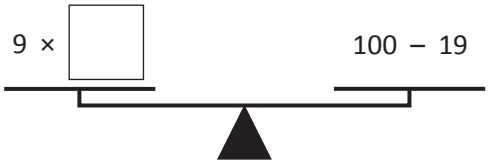


b

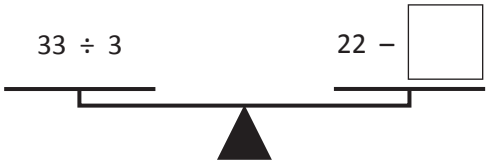
c

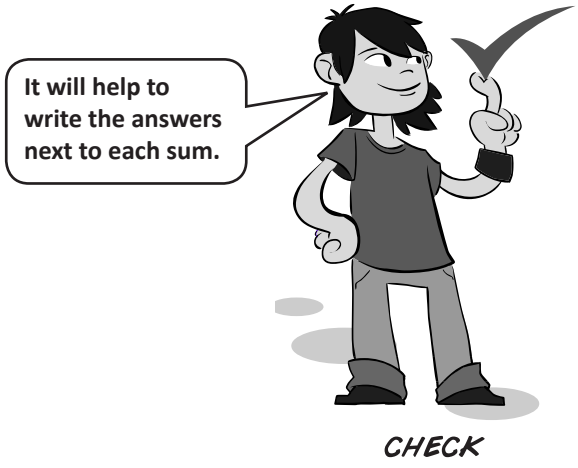
d

e



f





Equations and equivalence – understanding equivalence

If the sides are not balanced, we say the equation is unequal.

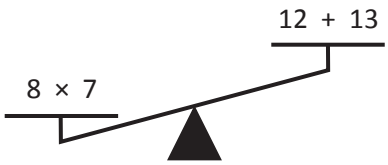
Look at these scales:
5 × 4 is greater than 5 + 4

So instead of an equals sign, we use the greater than sign:

5 × 4 > 5 + 4

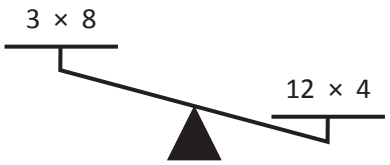
3 **Complete the following scales and inequalities by adding greater than (>) or less than (<):**

a



8 × 7 ☐ 12 + 13

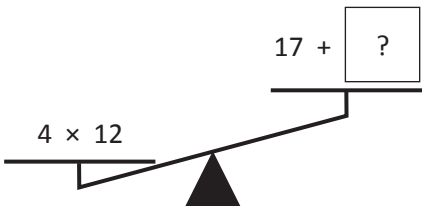
b



3 × 8 ☐ 12 × 4

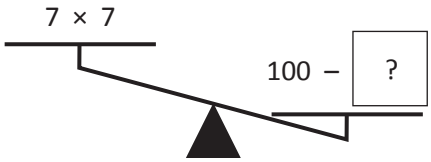
4 **In these problems, you have to add both the symbol *and* a value that would make the equation true. Remember, just like with ordinary scales, the bigger value will be lower down.**

a



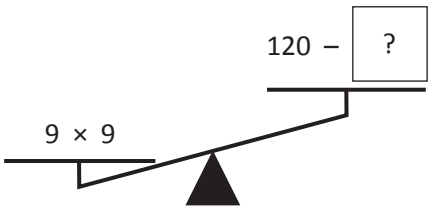
4 × 12 > 17 + ☐

b



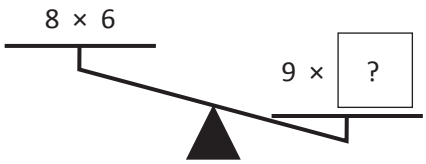
7 × 7 ☐ 100 – ☐

c



9 × 9 ☐ 120 – ☐

d



8 × 6 ☐ 9 × ☐

Equations and equivalence – using symbols

Symbols help us when we have more than one number to find.
A symbol can be any shape and stands for any unknown numbers.

1 **Work out the value of the diamond in each question. Notice the same symbol is added 3 times. Your 3 times tables will help here.**

a

□ + □ + □ = 12

b

□ + □ + □ = 36

c

□ + □ + □ = 45

2 **Find the value of the symbols. Remember that if a symbol is used more than once, it means it is the same value again.**

Guess, check and improve strategy will help here.

a ☆ + ☆ + ☆ = 9 ☆ = □

b ♡ × ♡ = 36 ♡ = □

c ☺ × ☺ = 49 ☺ = □

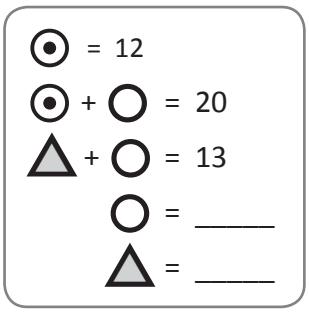
3 **Find the value of the symbols and then check if you are right by using the same value in the question alongside it.**

a ◇ × ◇ = 81 ◇ = □ × △ = 36 △ = □

b ○ + ✶ + ✶ = 29 ○ = □ × ✶ = 60 ✶ = □

Equations and equivalence – using symbols

Known values can help us work out the values of the secret symbols.
Your knowledge of inverse operations will also come in handy.



By knowing the value of ⊙ we can work out ○

12 + ○ = 20, so ○ = 8

By knowing the value of ○, we can work out △

△ + 8 = 13, so △ = 5

4 **Look carefully at the example above and follow the steps to find out the values of these secret symbols:**

a ✱ = 15

✱ + ○ = 40

△ + ○ = 65

○ = _____

△ = _____

b ◈ = 54

◈ ÷ ○ = 9

△ ÷ ○ = 3

○ = _____

△ = _____

5 **This time you must find the value of 3 different symbols △ ☆ ○ using the clues in each step:**

a ☆ × ☆ = 16

○ + ☆ = 100

○ − ☆ = △

☆ = ☐

○ = ☐

△ = ☐

b △ + △ = 50

△ ÷ ○ = 5

○ + △ = ☆

☆ = ☐

○ = ☐

△ = ☐

c ☆ + ○ = 20

☆ × △ = 72

13 − △ = 5

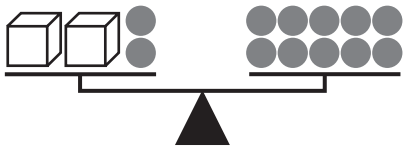
☆ = ☐

○ = ☐

△ = ☐

Equations and equivalence – keeping balance

We can work out how many counters are in each box by keeping balance.



Here is our equation. How do we work out how many counters are in each box? We use a symbol to represent the unknown.

$2 \times \square + 2 = 10$

If we take away 2 from each side, we maintain the balance and make the problem easier. We now have to work out the value of $\square$

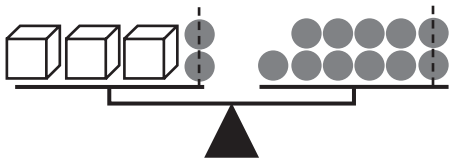
$2 \times \square = 8$

$2 \times 4 = 8$

This works because $2 \times 4 + 2 = 10$

1 **Find out how many counters are in each of the boxes. Remember to take away the same amount on both sides so the balance is kept.**

a



I will take away ☐ from each side. This leaves me with:

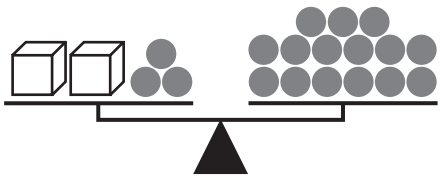
$3 \times \square = \square$

$\square = \square$

This works because $3 \times \square + 2 = 11$

.....

b



I will take away ☐ from each side. This leaves me with:

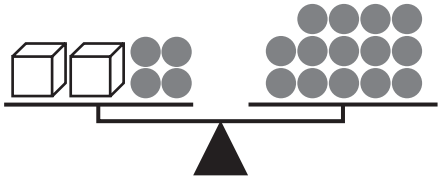
$2 \times \square = \square$

$\square = \square$

This works because $2 \times \square + \square = \square$

.....

c



I will take away ☐ from each side. This leaves me with:

$\square \times \square = \square$

$\square = \square$

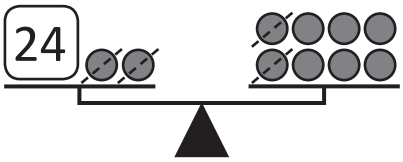
This works because $2 \times \square + \square = \square$

Equations and equivalence – keeping balance

In this activity you need to find out what each counter is worth.

Step 1 Make the number stand alone by keeping balance.

Step 2 Write an equation to solve.

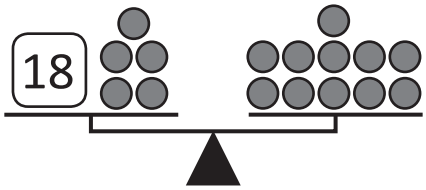


24 = ● × 6

● = 4

2 **Look carefully at each balanced scale and work out what the symbols equal:**

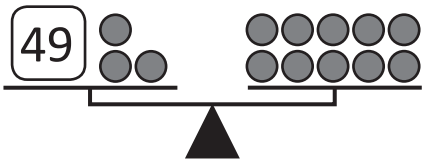
a



18 = ● × ☐

● = ☐

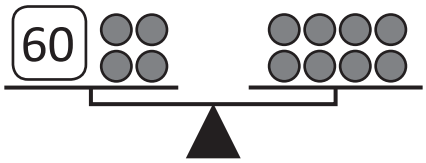
b



49 = ● × ☐

● = ☐

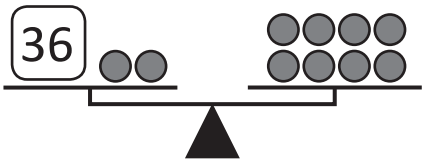
c



60 = ● × ☐

● = ☐

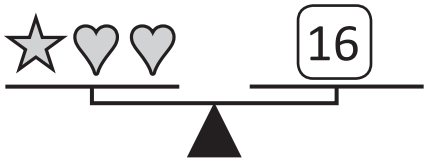
d

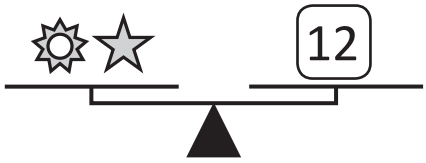


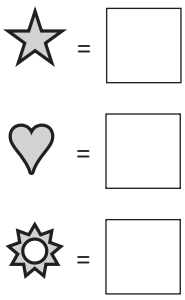
36 = ● × ☐

● = ☐

3 **This time use guess, check and improve to work out what the value of the symbols could be. The symbols have the same value on both scales.**







= ☐

= ☐

= ☐

Magician's hat trick — solve

Getting ready

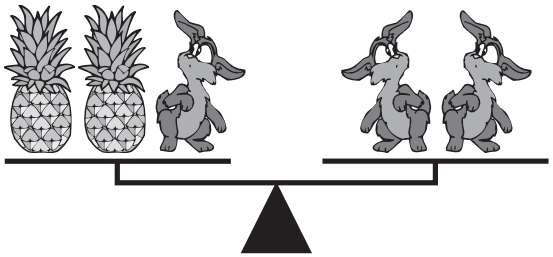
Mandana the magician is the master of optical illusions, magic tricks and disappearing acts.

One of his favourite tricks, is the disappearing act where he waves his wand and things disappear … or do they?

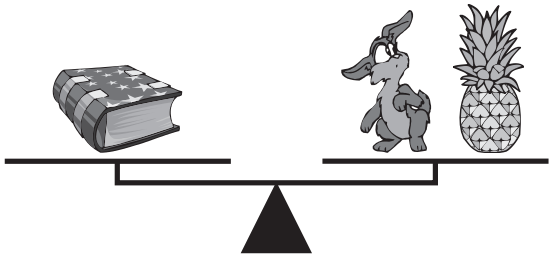
Work out what he has hidden under his top hat.

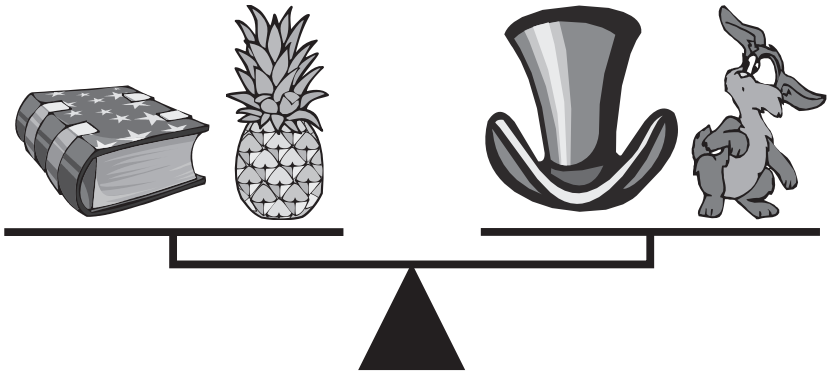
Clue: It is only one thing – either a rabbit, a book or a pineapple.

CLUE 1



CLUE 2





What to do

Underneath Mandana the magician's hat is:

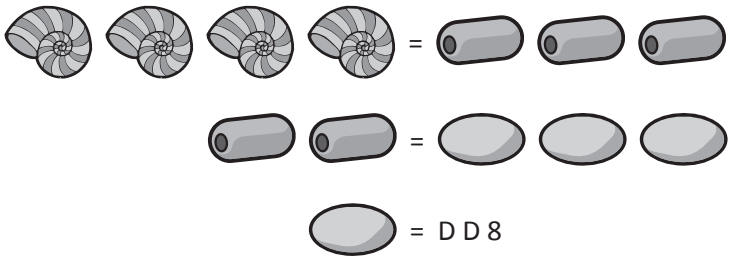
Dhiffushi island currency — solve

Getting ready

On the holiday island of Dhiffushi, instead of money, they use shells, beads and pebbles. Instead of a dollar sign they have this: D D, which stands for Dhiffushi Dollars.

What to do

Work out what this currency is equal to by looking at these clues:



= D D 8

Key
Shell =
Bead =
Pebble =

Using the symbol D D, convert the price of each of the following :

1 pebble = _____ so 3 pebbles = _____

1 bead = _____ so 2 beads = _____

1 shell = _____ so 4 shells = _____

Using Dhiffushi currency, draw what I could use to pay for the following:

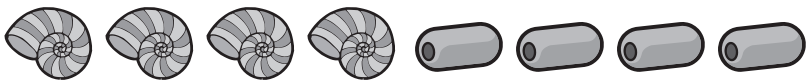
Snorkeling = D D 36

Rainforest trip = D D 40

Turtle watching = D D 54

Diving = D D 72

In Dhiffushi currency, how much was my accommodation if I paid:



My accommodation would be _____

Using equations – balance strategy using inverse operations

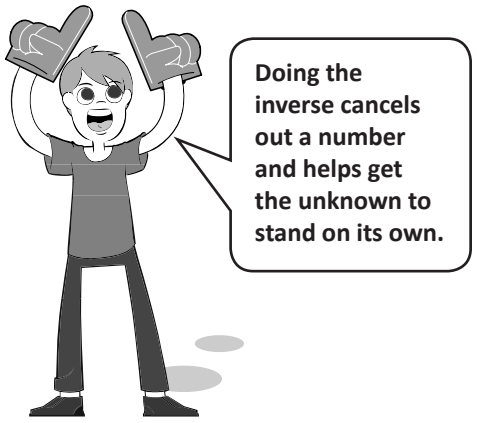
How can we find out the value of the symbol in this equation? We need to make it stand on its own while keeping the equation balanced. This is called the *balance strategy*.

We do this by performing the inverse operation to both sides. Can you see why?

☆ × 5 = 20

☆ × 5 ÷ 5 = 20 ÷ 5

☆ = 4



1 **Practise performing inverse operations by getting back to the first number. The first one has been done for you:**

a 20 [÷ 5] = 4 [× 5] = 20

b 35 [ ] = 5 [ ] = 35

c 64 [ ] = 8 [ ] = 64

d 72 [ ] = 8 [ ] = 72

e 54 [ ] = 9 [ ] = 54

f 18 [ ] = 6 [ ] = 18

2 **Find out the value of each symbol by performing inverse operations:**

a ◯ × 8 = 64

◯ × 8 ÷ _____ = 64 ÷ _____

◯ = _____

b ☆ × 7 = 56

☆ × 7 ÷ _____ = 56 ÷ _____

☆ = _____

3 **Find out the value of each symbol again. Perform the inverse operation in fewer steps.**

a ☺ ÷ 9 = 5

☺ = 5 × _____

☺ = _____

b ☺ ÷ 12 = 5

☺ = 5 × _____

☺ = _____

4 **Find out the value of each symbol by following the same steps as above. Set your work out neatly:**

a ◯ × 6 = 54

b ◯ × 5 = 125

Using equations – balance strategy using inverse operations

Sometimes the symbol is not at the beginning so you have to rearrange the equation by performing an inverse operation. This is because it is easier to solve when the symbol is on the left hand side of the equals sign.

$$12 = 78 - \blacktriangle$$

Step 1 Move the symbol to the left with an inverse operation. The inverse of $+ \blacktriangle$ is $- \blacktriangle$:

$$12 + \blacktriangle = 78 - \blacktriangle$$

Step 2 Make the symbol stand alone with an inverse operation. To do this, subtract 12 from both sides:

$$12 + \blacktriangle = 78 - 12$$

Step 3 Now we can perform a simple subtraction to find out the value of the symbol:

$$\blacktriangle = 78 - 12$$
$$\blacktriangle = 66$$

5 **Follow the steps outlined above to find the value of the symbol.**

a $23 = 56 - \blacktriangle$

$\square + \blacktriangle = \square$

$\blacktriangle = \square - \square$

$\blacktriangle = \square$

b $32 = 78 - \blacktriangle$

$\square + \blacktriangle = \square$

$\blacktriangle = \square - \square$

$\blacktriangle = \square$

c $36 = 112 - \blacktriangle$

$\square + \blacktriangle = \square$

$\blacktriangle = \square - \square$

$\blacktriangle = \square$

d $52 = 105 - \blacktriangle$

$\square + \blacktriangle = \square$

$\blacktriangle = \square - \square$

$\blacktriangle = \square$

e $26 = 78 - \blacktriangle$

f $14 = 92 - \blacktriangle$

Using equations – word problems

If you can solve equations with one unknown number using the balance strategy, you will be able to solve word problems with ease!

A large group of friends signed up to participate in a fun run. 56 of them got food poisoning the day before so had to pull out. How many people signed up if a total of 84 people ran the race?

☆ – 56 = 84

☆ – 56 = 84 + 56

☆ = 140

1 **Solve the following word problems using inverse operations. Start by choosing the matching equation from the box below.**

$50 + △ = $130	△ – 70 m = 38 m	$83 + $100 + △ = $300

a Jack had a piece of rope and cut off 70 metres. He was left with 38 metres. How long was the rope?

b Tom found $50 on the bus on Monday and was given birthday money by his Gran on Wednesday. How much did his Gran give him if he ended up with $130?

c Matilda saved $83 towards a trip to the snow and her parents gave her $100. How much more money does she need if the trip costs $300?

Using equations – word problems

Kate saved each week for 5 weeks and then spent $25.

How much was she saving each week if she had $100 left at the end of 5 weeks and after spending $25?

Step 1 Set up the equation. The triangle stands for the amount Kate was saving each week.

▲ × 5 – 25 = $100

Step 2 Cancel out the – 25 with the inverse operation: + 25

▲ × 5 = 100 + 25

▲ × 5 = 125

Step 3 Cancel out × 5 with the inverse operation: ÷ 5

▲ = 125 ÷ 5

▲ = $25

Kate was saving $25 each week.

2 **Solve the following word problems using inverse operations. The equations are partially set up. You may like to use a calculator.**

a For my school fete I baked 3 batches of cookies, realised that wasn't enough and so I bought a dozen more. How many were in one batch if I had 84 cookies altogether?

3 × ▲ + 12 = 84

3 × ▲ = 84 – ☐

▲ = ☐ ÷ ☐

▲ = ☐

There were ☐ cookies in each batch.

b 8 same sized Year 5 classes assembled in the playground for photo day. There were 11 students absent. How many students are there in each class if there were 213 there on the day?

☐ × ▲ – 11 = 213

☐ × ▲ = 213 + 11

▲ = ☐ ÷ ☐

▲ = ☐

There were ☐ students in each class.

c Trin went on a holiday for 15 days. She collected 3 postcards a day for the first 10 days. By the end of her holiday she had 73 postcards. How many did she collect over the last 5 days?

3 × ☐ + ▲ = 73

Trin collected ☐ postcards over the last 5 days.

Using equations – think of a number

Lim thinks of a number, adds 3 to it and then multiplies it by 4.

The answer is 20. What is Lim's number?

To answer this, first we need to write an equation with the unknown:

Step 1 Set up the equation. The heart shape stands for the unknown number.

♥ + 3 × 4 = 20

Step 2 Cancel out the × 4 with the inverse operation: ÷ 4

♥ + 3 = 20 ÷ 4

Step 3 Cancel out the + 3 with the inverse operation: – 3

♥ + 3 = 5

♥ = 5 – 3

♥ = 2

1 **Work out the numbers these children are thinking of:**

a Jamila says: *"I'm thinking of a number. I divide it by 7 and then add 6. My answer is 13."*

♥ ÷ 7 + 6 = 13

♥ ÷ 7 = 13 – 6

♥ ÷ 7 = ☐

♥ = ☐ × ☐

♥ = ☐

b Pablo says: *"I'm thinking of a number. I multiply it by 6 and then add 7. My answer is 55."*

♥ × 6 + 7 = 55

♥ × 6 = 55 – 7

♥ × 6 = ☐

♥ = ☐ ÷ ☐

♥ = ☐

c Mikaela says: *"I'm thinking of a number. I multiply it by 4 then subtract 12. My answer is 20."*

♥ ☐☐☐☐ = ☐

♥ ☐☐ = ☐☐☐

♥ ☐☐ = ☐

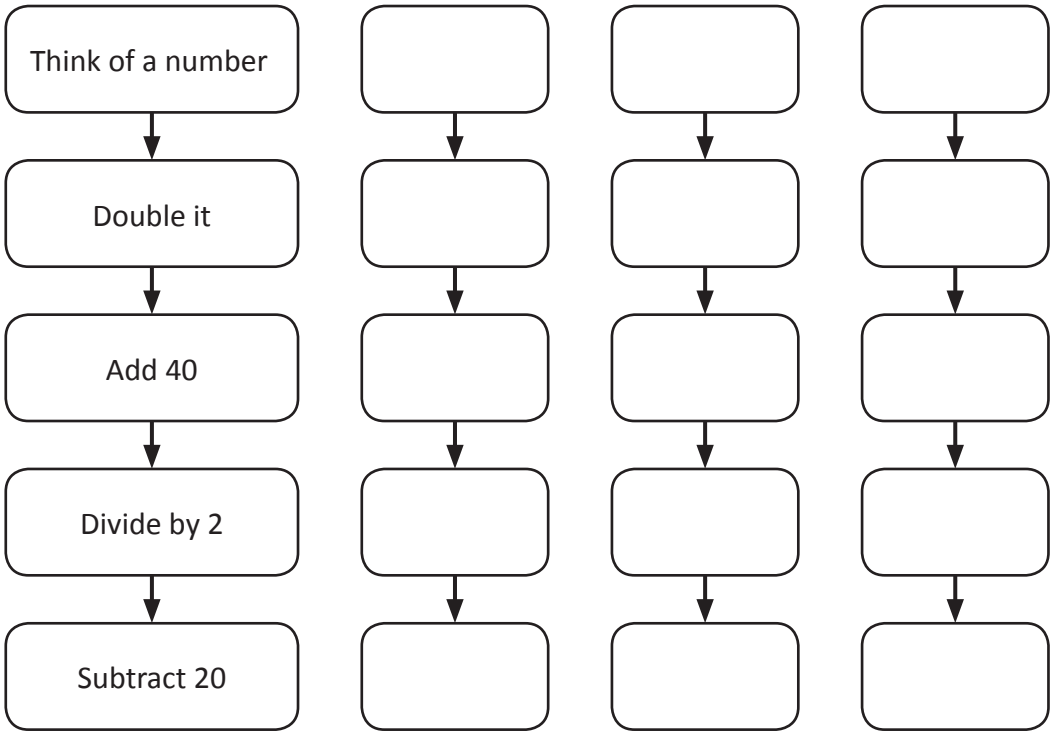
♥ = ☐☐☐

♥ = ☐

d Linh says: *"I'm thinking of a number. I divide it by 8 and then add 11. My answer is 19."*

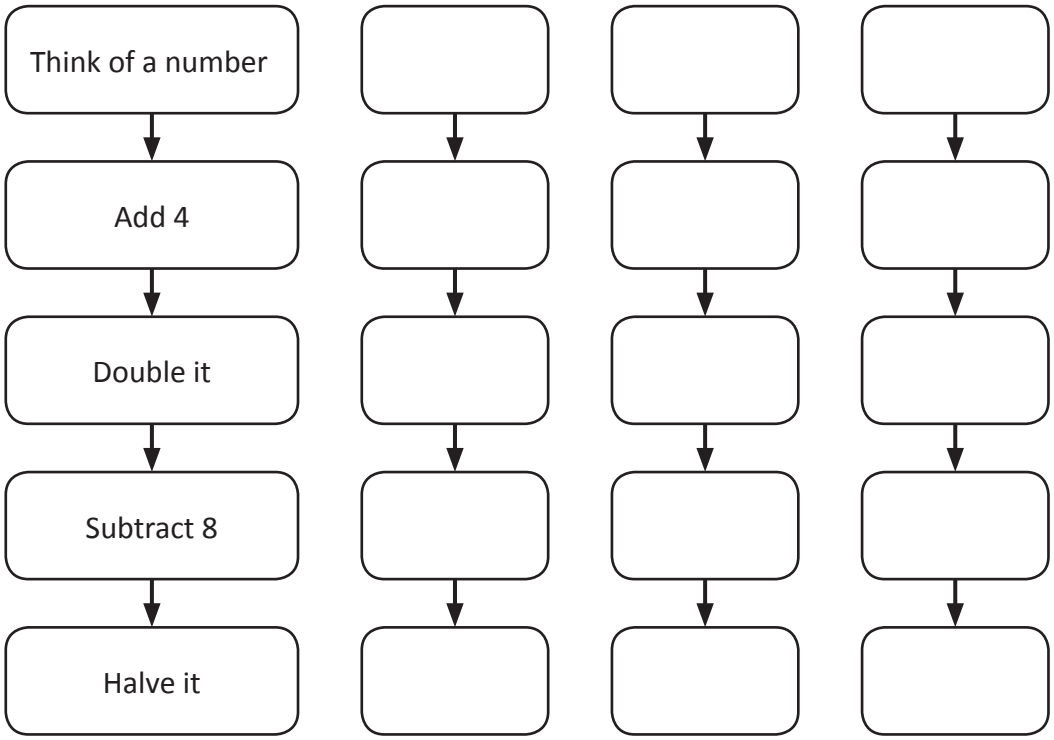
Using equations – think of a number

2 **Follow the steps for 3 different numbers.**



What happens each time? _____

3 **Follow the steps for 3 different numbers.**



What happens each time? _____

Number tricks 1

solve

What to do

Try this number puzzle by testing it out in the blank boxes.

Think of a number	✱	
Add 2	✱ + 2	
Add first number	✱ + ✱ + 2	
Divide by 2	✱ + 1	
Subtract 1	✱	

What do you notice? _____

What to do next

This number puzzle uses the same trick. This time complete the column of boxes with the number sentences using symbols. Then test it in the last column.

Think of a number	✱	
Double it		
Add 6		
Divide by 2		
Subtract 3		

Why does this work for any number?

Number tricks 2

solve

What to do

Write the symbols for this puzzle in column 2 and test it out.

What number is left?

Think of a number	✱	
Add 4		
Double it		
Take away 2		
Add the first number		
Add 6		
Divide by 3		
Subtract the first number		
You would be left with _____		