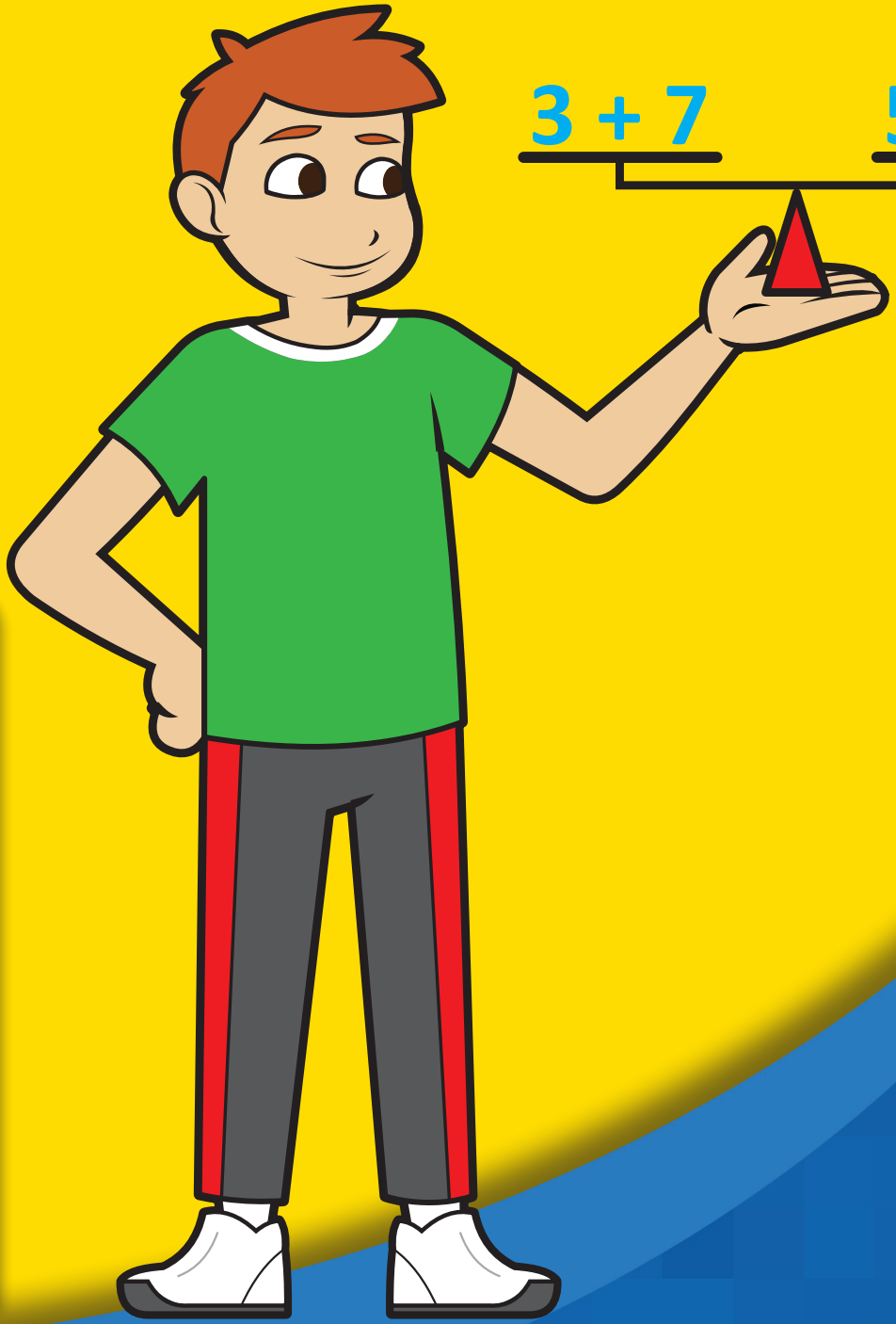
MATHLETICS

E SERIES Student Book

Patterns and Algebra



Name _____

Series E – Patterns and Algebra

Contents

Series Author:

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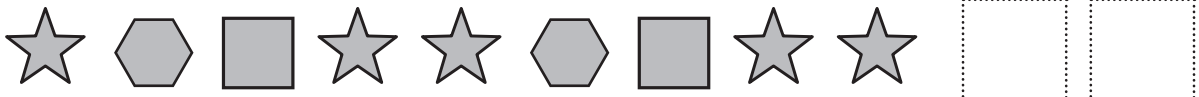
Patterns and functions – identifying and creating patterns

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

Recognising number patterns is an important part of feeling confident in maths. In this topic we will look at different number patterns but first let's look at shape patterns.

1 **Look at these repeating shape patterns. Draw the last two shapes:**

a



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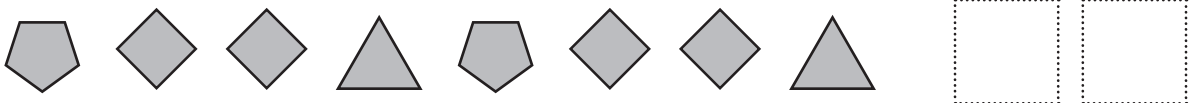
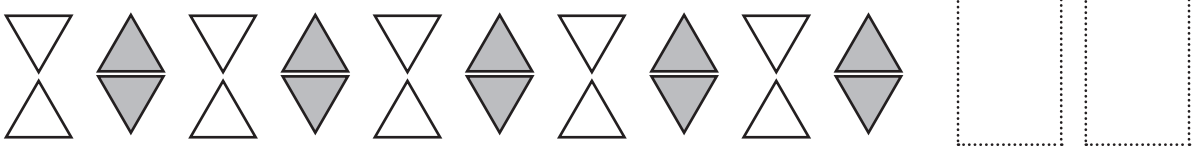
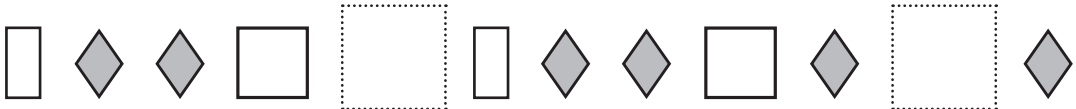


c



2 **In these repeating shape patterns, draw the missing shapes:**

a



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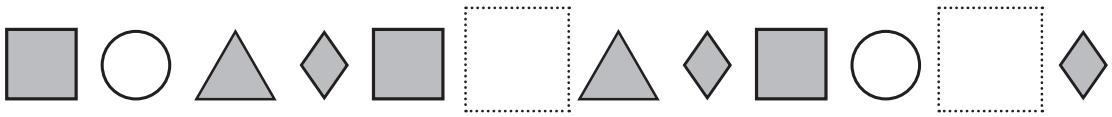
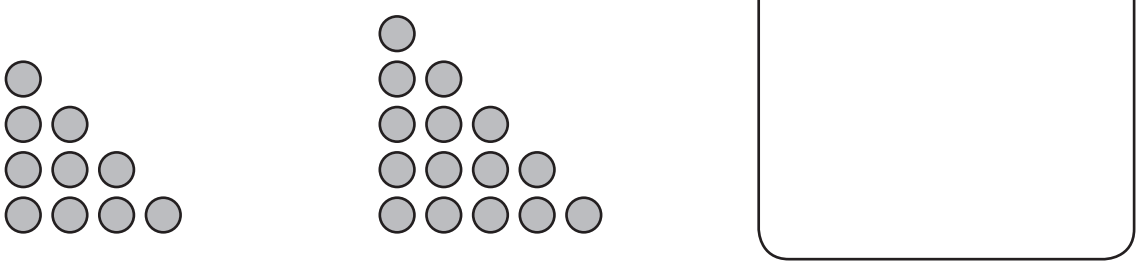
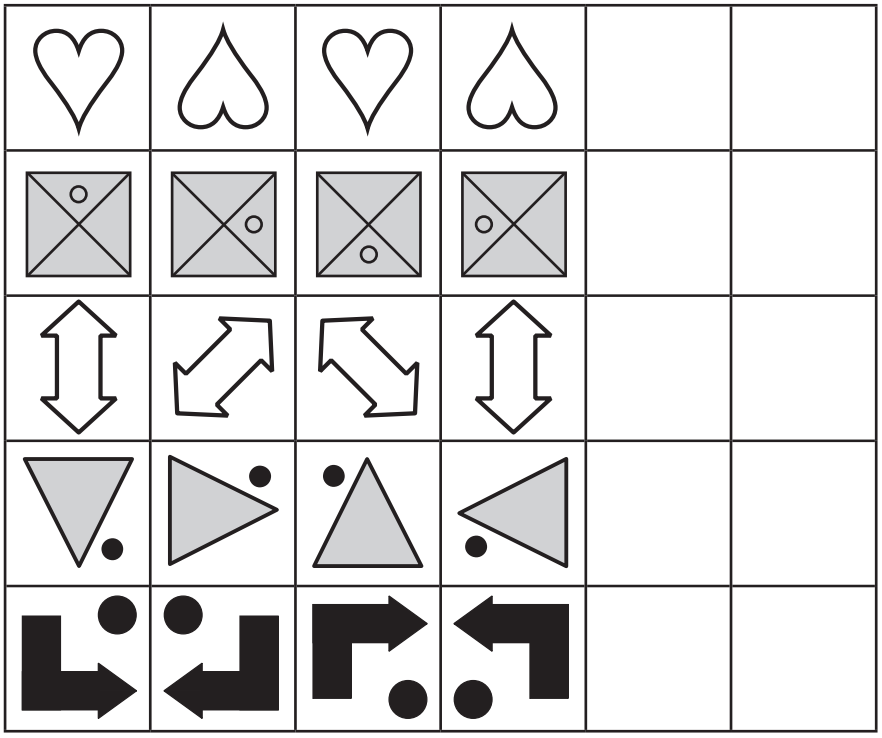


3 **Complete what comes next in this growing pattern:**



4 **Look at these repeating shape patterns. Draw the next two shapes:**

a
b
c
d
e



5 **If the patterns (above) continued, what would the 10th shape be on each row:**

a ☐ **b** ☐ **c** ☐ **d** ☐ **e** ☐

6 **Write your name by putting each letter in the grid as a repeating pattern. For example, if your name is Ben, you would write:**

1	2	3	4	5	6	7	8	9	10
B	E	N	B	E	N	B	E	N	B

1	2	3	4	5	6	7	8	9	10

a Which letter of your name will be under the letter 32? ☐

b How did you work this out?

Patterns and functions – skip counting

There are many skip counting patterns to discover on a hundred grid.

1 **Colour the skip counting pattern on each hundred grid:**

a Show the 4s pattern.

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

b Show the 3s and 6s pattern. Shade the 3s and circle the 6s.

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

c Show the 11s pattern.

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

d Shade the 9s pattern, then put a circle around all the numbers 5 less than numbers ending in 9.

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

2 **Complete these number patterns by looking for skip counting patterns.**

a	6			24	30			
b	9	18		36		54		
c	32			20			8	

3 **Colour the skip counting pattern for 3s up to 30. If you kept going on a complete hundred grid, would 52 be coloured in?**

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

How can you tell without using a whole hundred grid?

_____

4 **Only 3 numbers are shaded in each of the skip counting patterns below. Work out the pattern and complete the shading:**

a

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

This shows a skip counting pattern of: ☐

b

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

This shows a skip counting pattern of: ☐

5 **Shade these sequences on the hundred grid:**

Sequence 1: start at 1 and show a skip counting pattern of 11.

Sequence 2: start at 1 and show a skip counting pattern of 9.

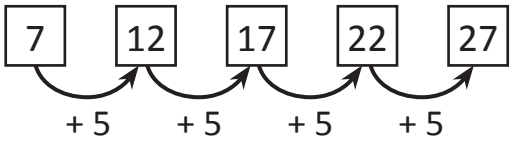
1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Patterns and functions – completing and describing patterns

So far we have looked at skip counting patterns that begin at zero.
Here is a skip counting pattern of 5s that begins at 7.

This pattern starts at 7.

The rule is: add 5.



1 **Continue the pattern from the starting number:**

a	Add 10	11							
b	Add 5	55							
c	Subtract 4	40							

2 **Practise counting backwards by 10 and 100.**

Backwards by 10:

a	112				
b	219				
c	583				

Backwards by 100:

a	673				
b	798				
c	1 010				

3 **Look carefully at these number pattern grids. There are four rules: across, down, and along each diagonal.**

a

15			
	26	27	
			38
		47	

b

32			41
	41	44	
	47		53
50		56	

Patterns and functions – completing and describing patterns

4 **Figure out the missing numbers in each pattern and write the rule.**

a 72 63 ☐ 45 36 ☐

Rule: _____

b 81 73 65 ☐ ☐ ☐

Rule: _____

c ☐ 49 54 ☐ 64 ☐

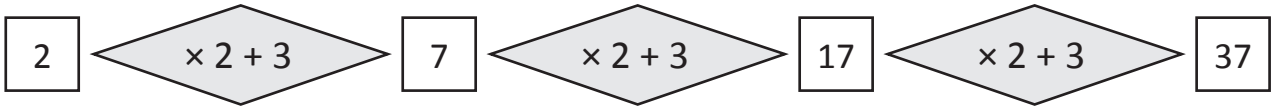
Rule: _____

d 28 35 ☐ 49 56 ☐

Rule: _____

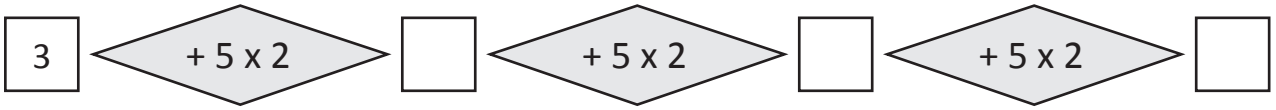
Some number patterns can be formed with two operations each time.

For example:



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

5 **Complete these number patterns, by following the rules written in the diamond shapes. Describe the rule underneath.**



The rule is _____

6 **Roll a die to make the starting number. Continue the sequence by following the rule:**

a Rule: + 4 × 2 ☐☐☐☐☐☐☐☐

b Rule: + 1 × 3 ☐☐☐☐☐☐☐☐

c Rule: + 3 × 2 ☐☐☐☐☐☐☐☐

Patterns and functions – predicting repeating patterns

When we use number patterns in tables, it can help us to predict what comes next. Look at the table below and how we can use it to predict the total number of sweets needed for any number of children at a party.

This table shows us that 1 sweet bag contains 8 sweets and 2 bags contain 16 sweets. We can see that the rule for the pattern is to multiply the top row by 8 to get the bottom row each time.

Number of sweet bags	1	2	3	4	5	10
Number of sweets	8	16	24	32	40	80

To find out how many sweets are in 10 bags, we don't need to extend the table, we can just apply the rule.

10 × 8 = 80. So, 10 bags contain 80 sweets. This helps us plan how many sweets are needed for a party.

1 **Complete the table for each problem:**

a Tom receives $5 a week pocket money as long as he does all his chores. How much pocket money does Tom get after 10 weeks?

Weeks	1	2	3	4	5	10
Pocket money	5	10				

b A flower has 7 petals. How many petals are there in a bunch of 10 flowers?

Flowers	1	2	3	4	5	10
Number of petals	7	14				

c A flag has 6 stars. How many stars are there on 10 flags?

Flags	1	2	3	4	5	10
Number of stars	6	12				

d At a pizza party, each person eats 3 pieces of pizza. How many pieces of pizza do 10 people eat?

Guests	1	2	3	4	5	10
Pizza pieces			9	12		

2 **Each of these kids wrote the first 3 numbers of a skip counting pattern of 6, starting at different numbers. Each kid's sequence goes down the column. Imagine the sequence continues.**

Mel	Brianna	Brad	Gen	Jo	Kate
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18

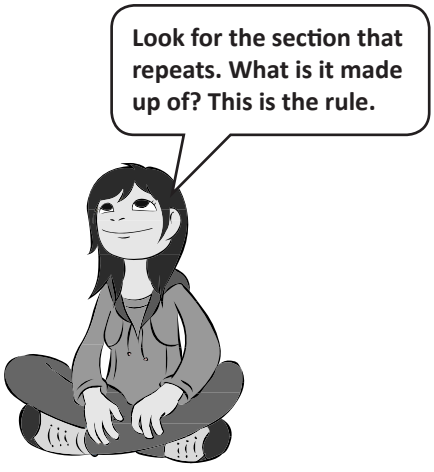
a Who had the number 42 in their column? _____

b Who had the number 50 in their column? _____

3 **Look at each pattern of shapes and complete the table below:**

Repeat section	1	2	3	4	5	10
Number of circles	2	4	6	8	10	20
Number of triangles	1	2	3	4	5	10

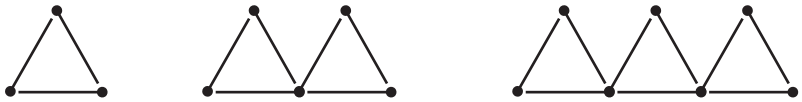
a Show what this entire sequence would look like with 10 repeat sections:



Patterns and functions – predicting growing patterns

Number patterns in tables can help us with problems like this. Mia is making this sequence of shapes with matchsticks and wants to know how many she will need for 10 shapes.

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



Shape number	1	2	3	4	5	10
Number of matchsticks	3	6	9	12	15	30

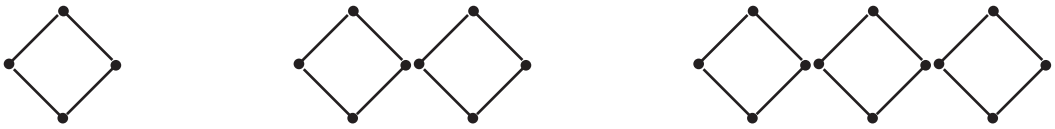
× 3

To find out how many matchsticks are needed for 10 triangles, we don't need to extend the table, we can just apply the function rule:

Number of matchsticks = Shape number × 3

1 **Complete the table for each sequence of matchstick shapes and find the number of matchsticks needed for the 10th shape.**

a Shape 1 Shape 2 Shape 3

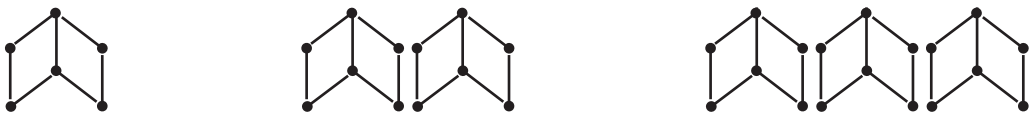


Shape number	1	2	3	4	5	**10**
Number of matchsticks	4					

b Shape 1 Shape 2 Shape 3

Shape number	1	2	3	4	5	**10**
Number of matchsticks	6					

c Shape 1 Shape 2 Shape 3



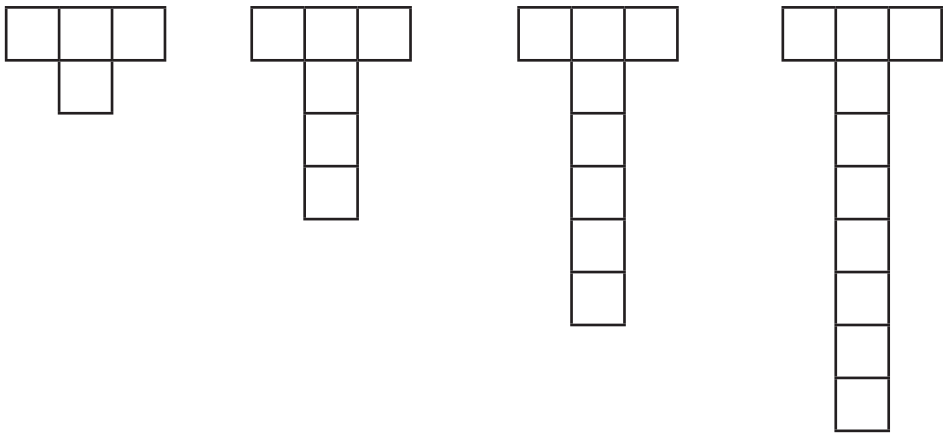
Shape number	1	2	3	4	5	**10**
Number of matchsticks	7					

2 **Look at these growing patterns. Complete the table and follow the rule to draw Picture 5:**

a Picture 1 Picture 2 Picture 3 Picture 4 Picture 5

Picture number	1	2	3	4	5
Number of dots	1	3	5	7	
Rule	Picture number × 2 − 1 = Number of dots				

b Picture 1 Picture 2 Picture 3 Picture 4 Picture 5



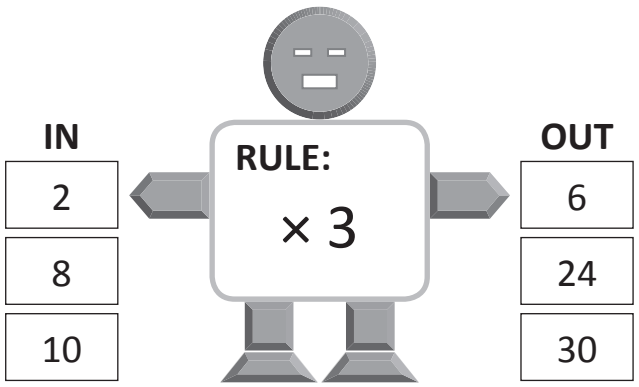
Picture number	1	2	3	4	5
Number of squares	4	6	8	10	
Rule	Picture number × 2 + 2 = Number of squares				

How many squares will Picture 8 have?

Patterns and functions – function machines

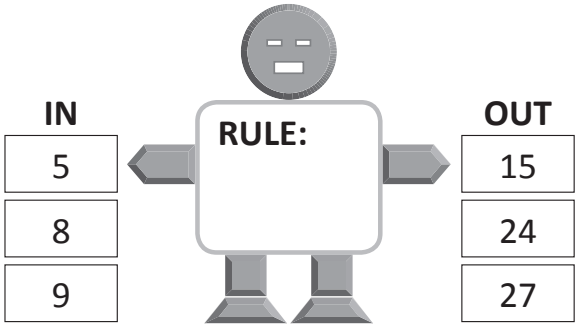
This is a function machine.

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 is the rule?**

a



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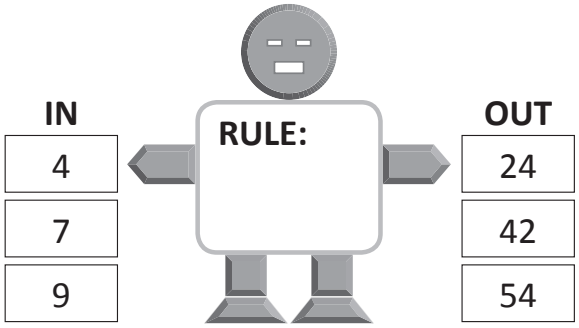
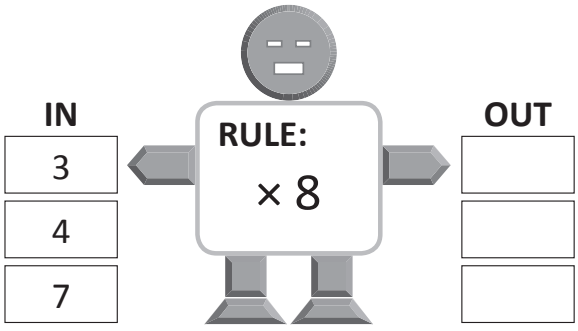


2 **What numbers will come *out* of these function machines?**

a



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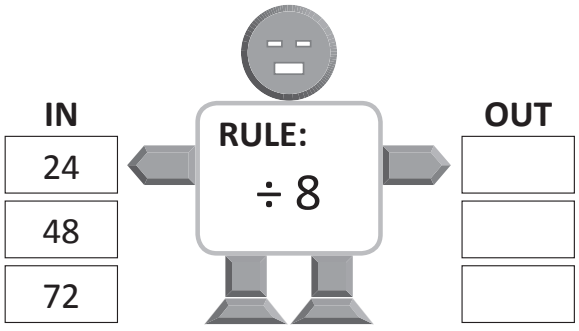
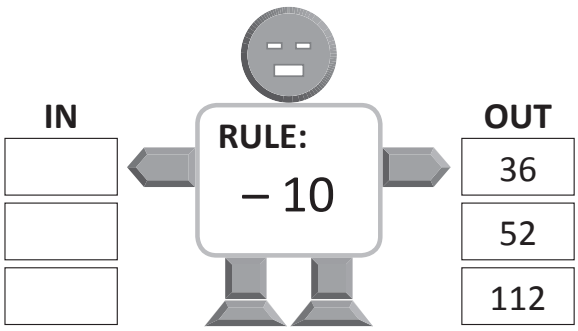


3 **What numbers go *in* to these number function machines?**

a



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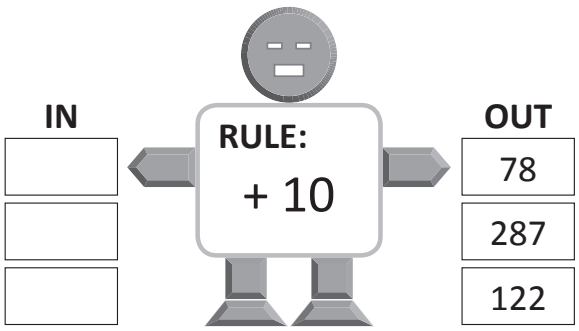


That's my number! apply

This is a game for 2 players. You will need some transparent counters each in 2 different colours and 2 dice.

Player 1 rolls 2 dice. The first die shows the starting number and the second die shows the skip counting pattern. Player 1 writes down the first 4 numbers of their sequence.

For example, if Player 1 rolls a 2 and a 6, the starting number is 2 and the rule is + 6. So Player 1 writes 2, 8, 14, 20 and chooses one of these numbers to cover with their counter.

Player 2 has their turn, following the same steps as above. They choose 1 number to cover with their counter. If the number is already covered, they can't put down a counter. Continue with Player 1 and Player 2 rolling again until there is a winner. The aim is to be the first to have their counters in a group of 4 (2 × 2).

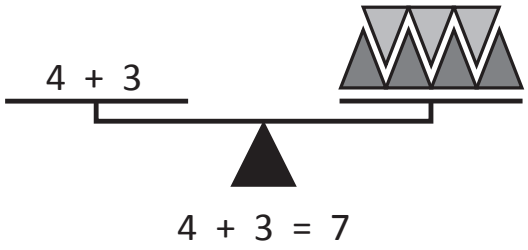
1	2	3	4	5	6	7	8	9	10
7	8	9	10	15	16	17	18	19	20
21	22	23	24	1	2	3	4	5	6
7	8	9	10	11	12	13	14	15	16
17	18	19	20	21	22	23	24	1	2
3	4	5	6	7	8	9	10	11	12
13	14	15	16	17	18	19	20	21	22
23	24	1	2	3	4	5	6	7	8
9	10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	1	2	3	4

Equations and equivalence – understanding equivalence

Look at these balanced scales.

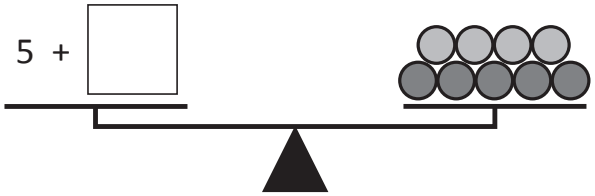
On one side there is the sum 4 + 3 and on the other side there is a total of 7 triangles. This makes sense because it shows the equation 4 + 3 = 7.

Equation is another word for a sum. With equations, both sides must be equal.



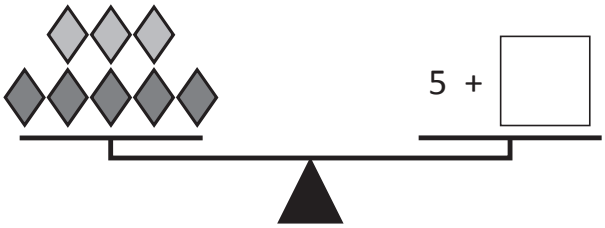
1 **Balance each set of scales by writing a number in the box that is equivalent to the total number of shapes. Then write the matching equation.**

a



□ + □ = □

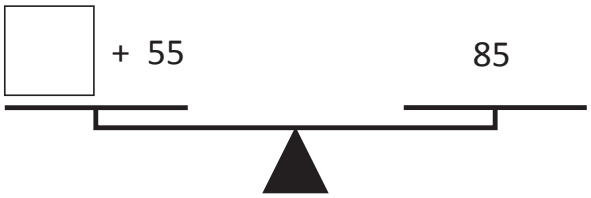
b



□ + □ = □

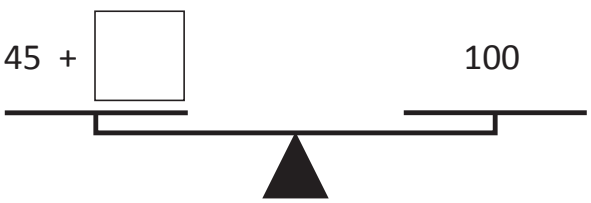
2 **Balance each set of scales by writing a number in the box. Then write the matching equation.**

a



□ + □ = □

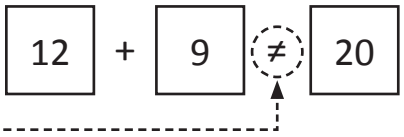
b



□ + □ = □

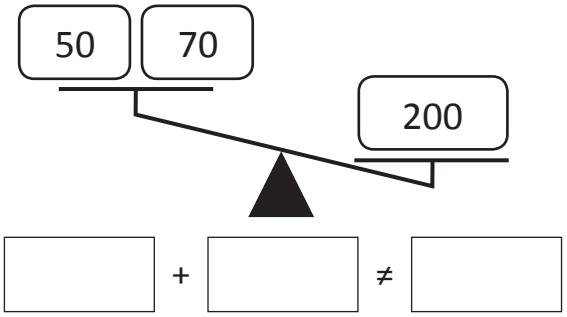
Equations and equivalence – not equal to symbol

When two sides of an equation are not balanced, it means that they are not equal. To show that an equation is not equal, we use the not equals symbol like this:

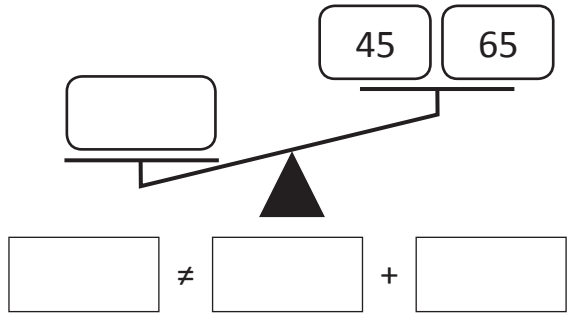


1 **Write numbers in each box to show equations that are not balanced:**

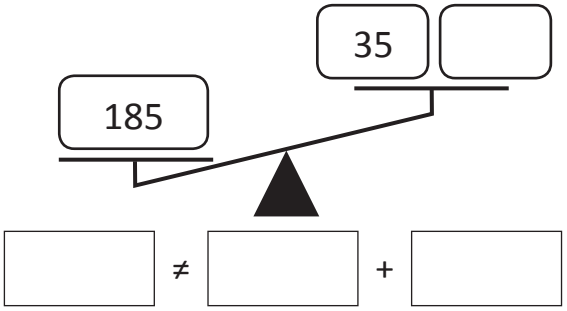
a



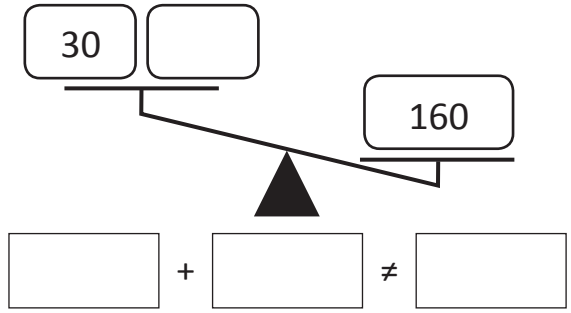
b



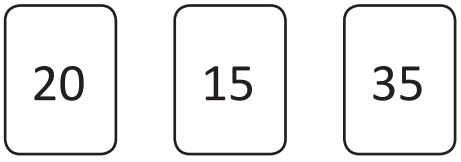
c



d



2 **Complete the equations below by using only the numbers in the cards. Look carefully to see whether it is an = or ≠ symbol.**



a ☐ + ☐ = 50

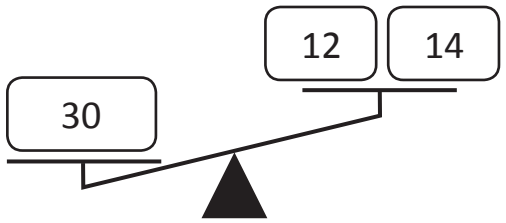
b ☐ + ☐ ≠ 50

c ☐ + ☐ = 35

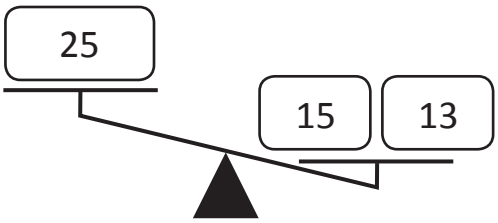
d ☐ + ☐ ≠ 35

Equations and equivalence – greater than and less than

When two sides of an equation are not balanced, one side is greater than the other. We can show this with greater than (>) and less than (<) symbols like this:



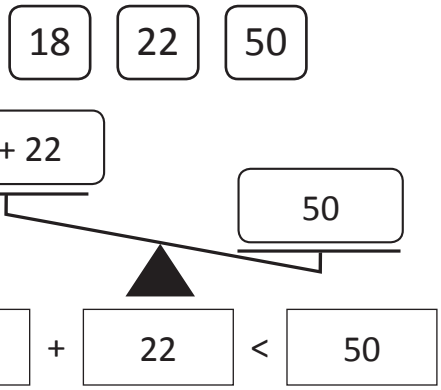
12 + 14 < 30



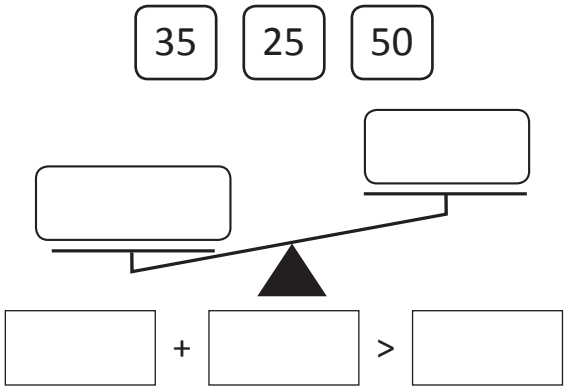
15 + 13 > 25

1 **Complete the equations below by using only the numbers in the cards. Look carefully to see whether it is an > or < symbol. The first one has been done for you.**

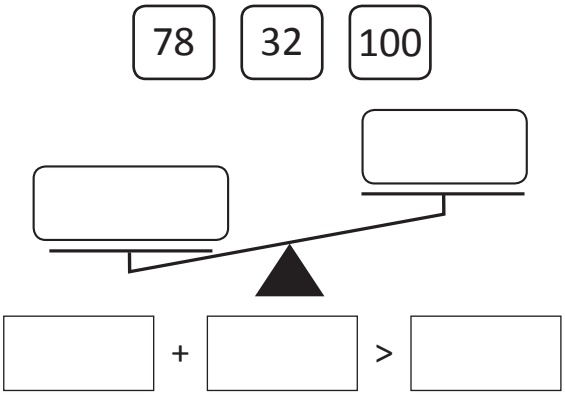
a



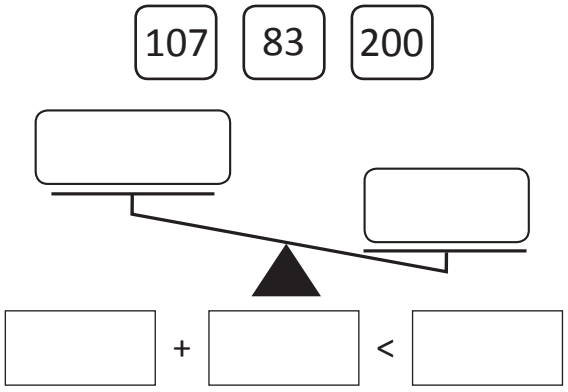
b



c



d



2 **Alex is older than Gilly but younger than Taylor. Their ages could be described as:**

16 > 12 > 9

How old is each person? Alex is _____ Gilly is _____ Taylor is _____

Equations and equivalence – greater than and less than

3 **Complete the number sentences below by writing numbers in the blank boxes:**

a 38 + ☐ > 100

b 29 + ☐ < 100

c ☐ > 243 + 257

d 500 < 460 + ☐

e ☐ + ☐ > 1 000

f ☐ + ☐ < 1 000

g ☐ + ☐ > ☐

h ☐ + ☐ < ☐

4 **Sam and Will's mother is trying to work out how much to budget for her children's daily lunch orders. She is wondering if $50 is enough for both Sam and Will. Add up the cost of each child's lunch order for the week and then complete a matching number sentence.**

When you add these amounts, look for bonds to $1. For example:

$1.40 + $1.60 = (40c + 60c) + $1 + $1 = $3

THINK

Sam's lunch orders	Monday	Tuesday	Wednesday	Thursday	Friday
	$4.60	$5.40	$7.30	$3.70	$6

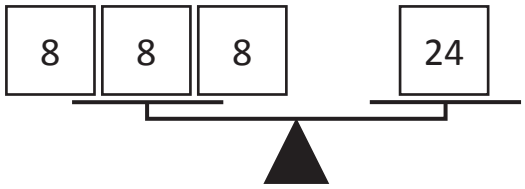
Will's lunch orders	Monday	Tuesday	Wednesday	Thursday	Friday
	$5.20	$3.80	$5.90	$6.10	$5

☐ + ☐ ◯ $50

Sam's total Will's total

Equations and equivalence – balanced equations using + and ×

There are 2 different equations we could write for one set of balanced scales.

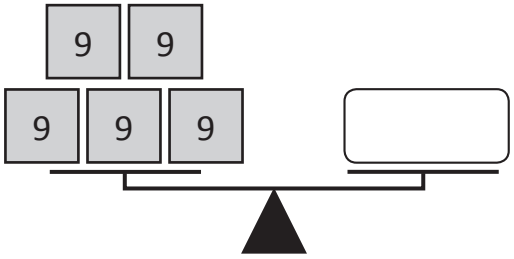


8 + 8 + 8 = 24

3 × 8 = 24

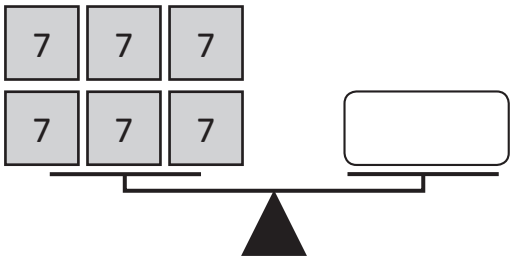
1 **Work out the values of the symbols in each problem:**

a



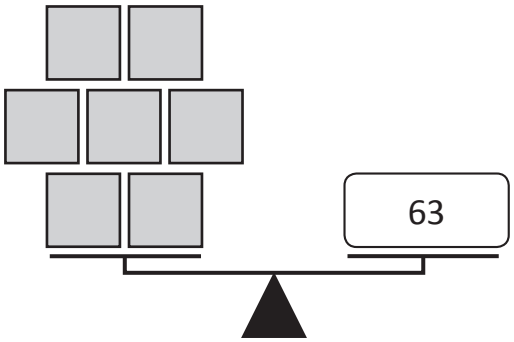
5 × 9 = ☐

b



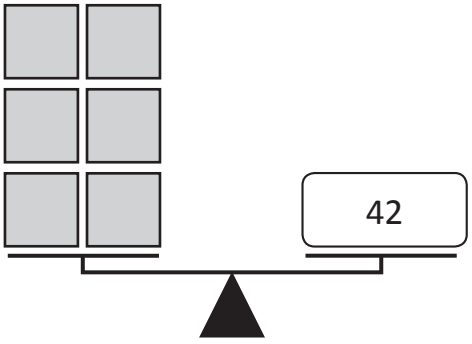
6 × ☐ = ☐

c



7 × ☐ = 63

d

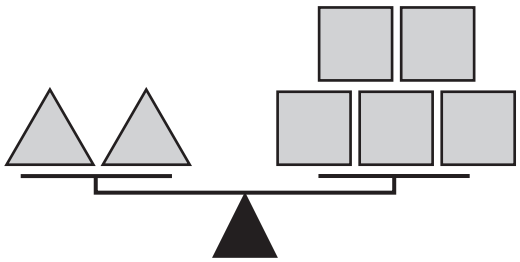


6 × ☐ = 42

Equations and equivalence – balanced equations using + and ×

2 **Find the values of these symbols:**

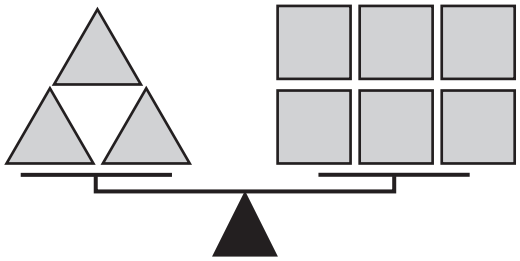
a If  is 5, what is the value of  ?



2 × 5 = 5 × ☐

☐ = ☐

b If  is 8, what is the value of  ?

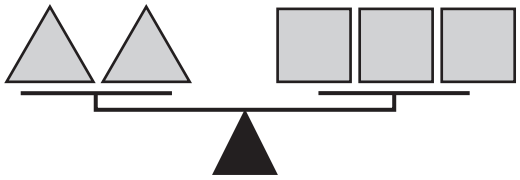


3 × 8 = 6 × ☐

☐ = ☐

3 **Find the values of both symbols from the clues:**

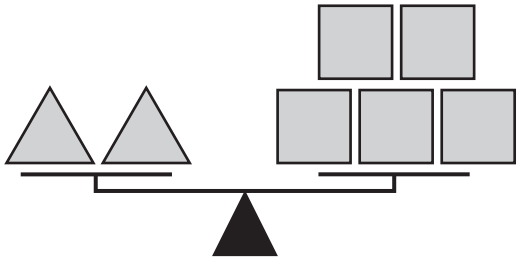
a If both sides are equal to 36, what is the value of each symbol?



2 × ☐ = 3 × ☐

 = ☐ ☐ = ☐

b If both sides are equal to 10, what is the value of each symbol?



2 × 5 = 5 × ☐

 = ☐ ☐ = ☐

Equations and equivalence – using symbols for unknowns

1 **Write an equation for these word problems. Write an equation using a ▲ for the unknown number.**

a Bec collects stickers. She has 48 bumper stickers, 12 glitter stickers and 15 smiley face stickers. How many stickers does Bec have in her collection?

48 + 12 + 15 = ▲ ▲ = ☐

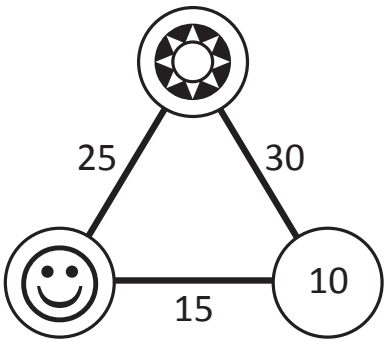
b Charlie saved $5 a week of his pocket money over 8 weeks but then spent $15. How much did Charlie have at the end of 8 weeks?

▲ = ☐

c 5 000 people are spectators at a football match. 2 700 are there to support Team A while the rest are there to support Team B. How many spectators support Team B?

▲ = ☐

2 **In this triangle, the numbers on the sides are the totals.**



So 10 + ☼ = 30

Work out the value of the other symbols:

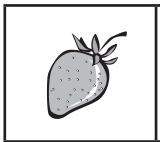
☼ = 20 ☺ = ☐

Fruit values

solve

What to do

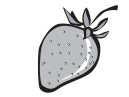
Work out the value of each type of fruit:

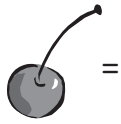
			37
			45
			33
35	39	41	

 =

 =

 =

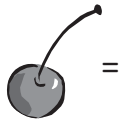
			14
			33
			22
15	23	31	

 =

 =

 =

			18
			38
			33
48	13	28	

 =

 =

 =

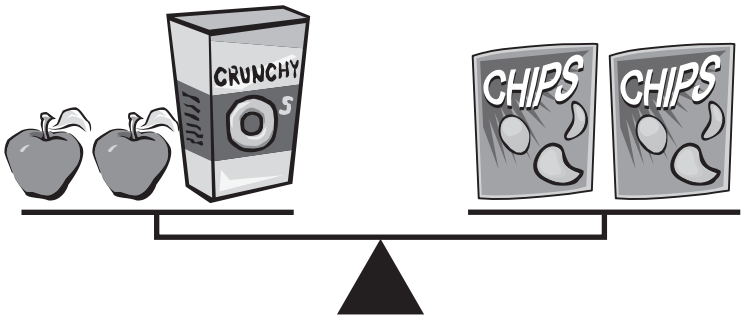
Mystery snacks

solve

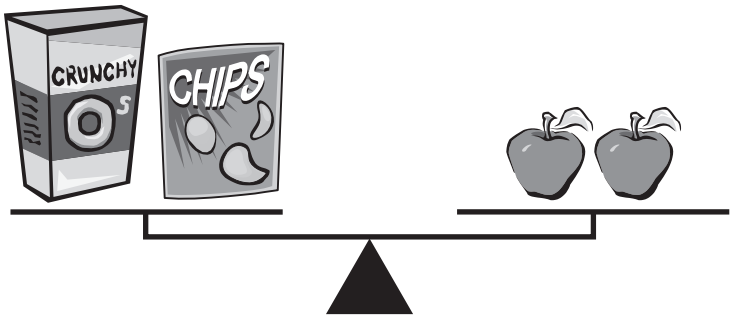
What to do

Work out what is the snack box from the clues.

Clue 1



Clue 2



Hint: **Keep the scale balanced by adding Crunchy Os to each side in Clue 2. Then work out what else 2 packets of chips is equal to. From there, you can work out your answer.**

DISCOVER