Lesson 1
Find a rule
https://vimeo.com/425603587
Lesson 2
Forming expressions
https://vimeo.com/425603866
Lesson 3
Substitution
https://vimeo.com/425603939
Lesson 4
Solve simple one-step equations
https://vimeo.com/425605040
Lesson 5
Challenge

Lesson 1

Find a rule
https://vimeo.com/425603587

Answer questions on next few slides.

1 Use the function machine to complete the table.

Input → ×5 → +2 → output
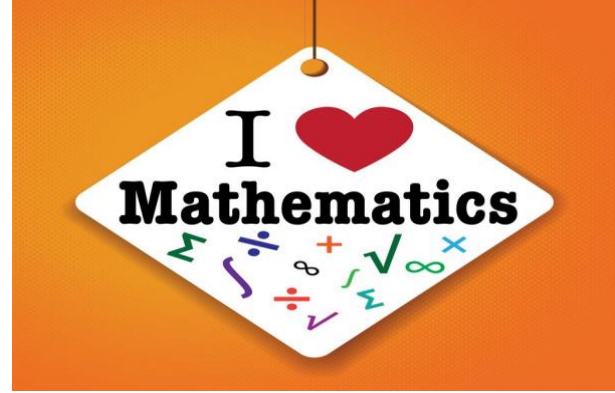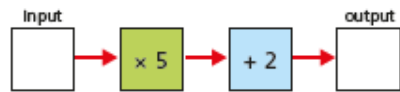
Input	1	2	3	5	10	50
Output						

2 Here is the same function machine with the steps in the reverse order.

Input → +2 → ×5 → output

The outputs will be the same. — Teddy

The outputs will be different. — Jack

Explain to a partner who you think is correct.

Use the function machine to complete the table.

Input	1	2	3	5	10	50
Output						

Who is correct? _____

3 Work out the missing outputs and inputs.

a)

Input → ×5 → +4 → output

Input		Output
1		
5		
8		
		39

b)

Input → ×5 → −4 → output

Input		Output
3		
4		
20		
		51

c)

Input → −3 → ÷2 → output

Input		Output
13		
3		
12		
		8

1 Use the function machine to complete the table.

Input → × 5 → + 2 → output
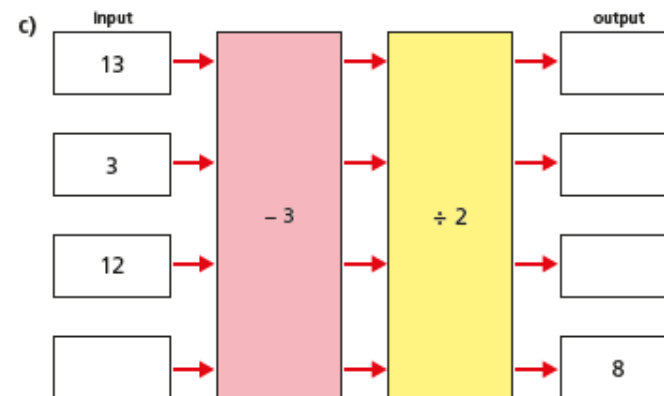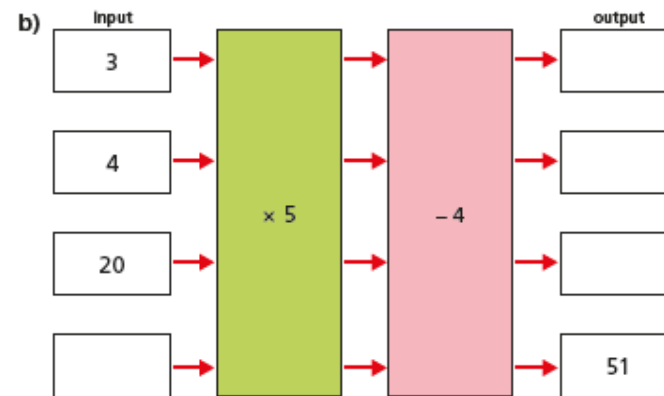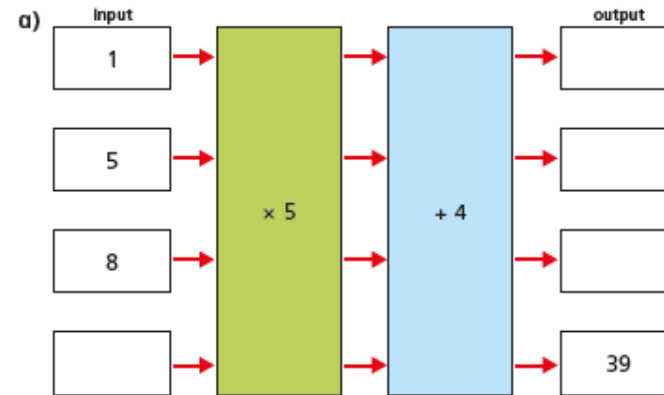
Input	1	2	3	5	10	50
Output	7	12	17	27	52	252

2 Here is the same function machine with the steps in the reverse order.

Input → + 2 → × 5 → output

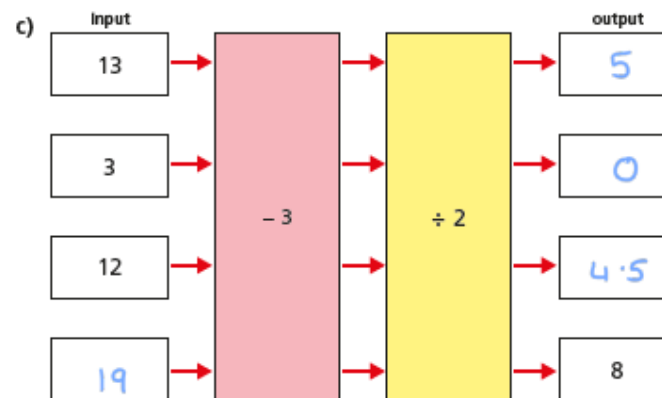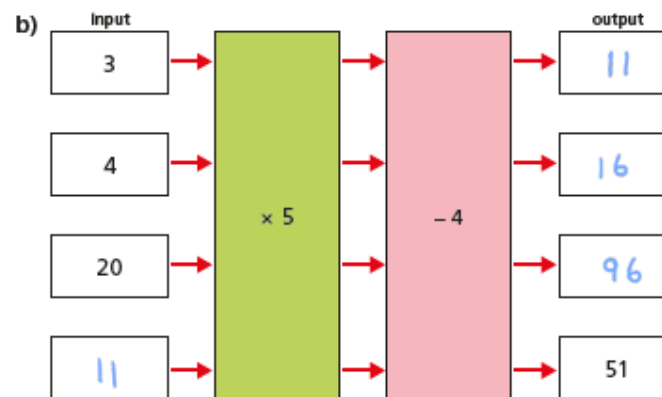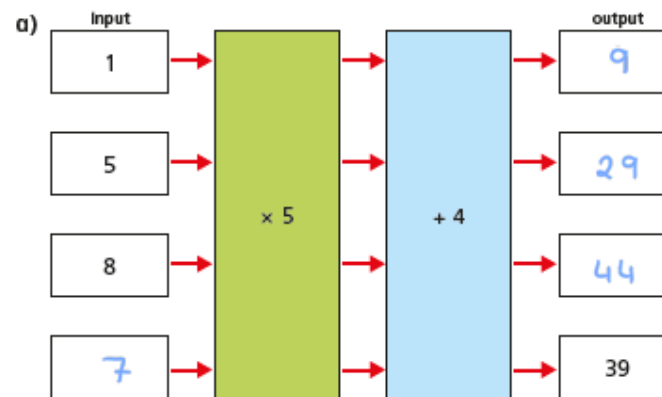Teddy: The outputs will be the same.

Jack: The outputs will be different.

Explain to a partner who you think is correct.

Use the function machine to complete the table.

Input	1	2	3	5	10	50
Output	15	20	25	35	60	260

Who is correct? __Jack__

3 Work out the missing outputs and inputs.

a)

Input	× 5	+ 4	output
1			9
5			29
8			44
7			39

b)

Input	× 5	− 4	output
3			11
4			16
20			96
11			51

c)

Input	− 3	÷ 2	output
13			5
3			0
12			4·5
19			8

4 Tick the pairs of function machines that will give the same outputs for a given input.

a)
Input → +3 → +4 → output

Input → +4 → +3 → output

☐

b)
Input → ×3 → −1 → output

Input → −1 → ×3 → output

☐

c)
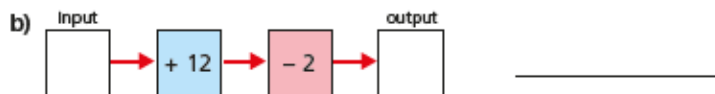Input → ×10 → ×2 → output

Input → ×2 → ×10 → output

☐

Explain your reasoning to a partner.

5 Here are some 2-step function machines.

For each machine, write a single step that would give the same output.

Check your answers by inputting values.

a)
Input → ×5 → ×2 → output _____

b)
Input → +12 → −2 → output _____

c)
Input → ×8 → ÷2 → output _____

Can all 2-step function machines be written as a 1-step function machine?

Talk about it with a partner.

6 Here is a function machine.

Input → −3 → ×4 → output
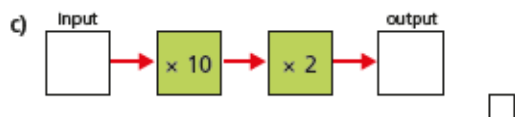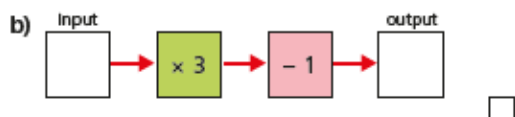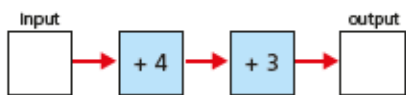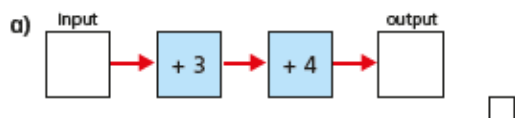
a) Complete the table.

Input	10	3		
Output			40	280

b) Rosie puts a number into the machine and she gets out the same number.

Work out Rosie's number.

☐

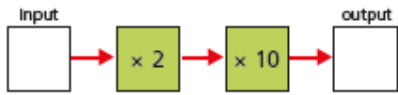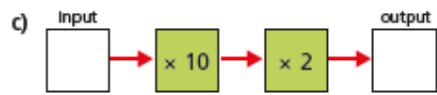**7** Mr Hall and Mrs Rose order some photos online.

Order photos online
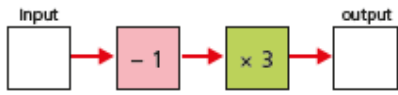Photos 20p each
Delivery £1.25
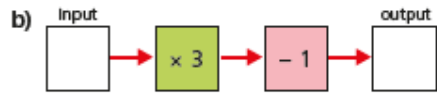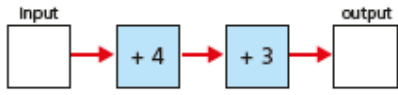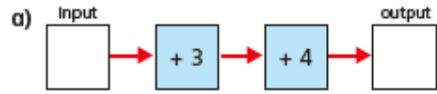
a) Mr Hall orders 16 photos.

How much does he pay?

☐

b) Mrs Rose pays £6.05

How many photos did she order?

☐

4 Tick the pairs of function machines that will give the same outputs for a given input.

a)
Input → +3 → +4 → output ✓

Input → +4 → +3 → output

b)
Input → ×3 → −1 → output ☐

Input → −1 → ×3 → output

c)
Input → ×10 → ×2 → output ✓
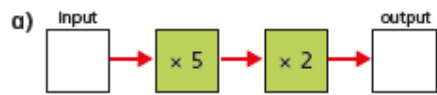
Input → ×2 → ×10 → output

Explain your reasoning to a partner.

5 Here are some 2-step function machines.

For each machine, write a single step that would give the same output.
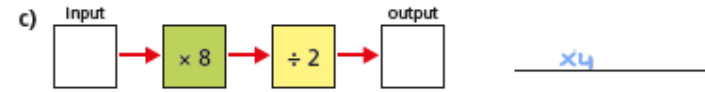
Check your answers by inputting values.

a)
Input → ×5 → ×2 → output   ×10

b)
Input → +12 → −2 → output   +10

c)
Input → ×8 → ÷2 → output   ×4

Can all 2-step function machines be written as a 1-step function machine?

Talk about it with a partner.

6 Here is a function machine.

Input → −3 → ×4 → output
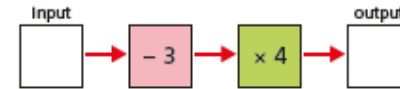
a) Complete the table.

Input	10	3	13	73
Output	28	0	40	280

b) Rosie puts a number into the machine and she gets out the same number.

Work out Rosie's number.   4

7 Mr Hall and Mrs Rose order some photos online.

Order photos online
Photos 20p each
Delivery £1.25

a) Mr Hall orders 16 photos.

How much does he pay?   £4.45

b) Mrs Rose pays £6.05

How many photos did she order?   24

Forming expressions
https://vimeo.com/425603866

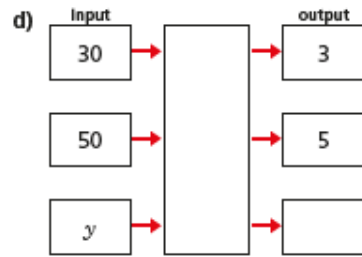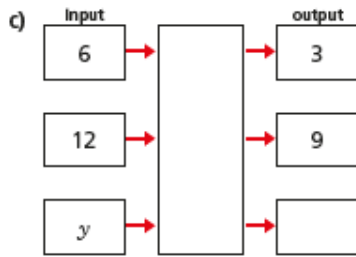Answer questions on next few slides.

1 Tommy uses multilink cubes to represent an unknown number and base ten ones to represent 1

 $= x$ $= 1$

Write algebraic expressions to describe the sets of cubes.

The first one has been done for you.

a) $2x + 3$

b)   _____

c)   _____

d)   _____

e)   _____

f)   _____

g)   _____

h)   _____

2 Use Tommy's method to represent these expressions.

a) $x + 2$ c) $3x + 1$

b) $2x$ d) $x + 6$

Compare answers with a partner.

3 Use cubes to help you simplify the following expressions.
The first one has been done for you.

a) $2y + 5 + y$

    $3y + 5$

b) $3a + 2 + a + a$

    _____

c) $6p + 2 - 2p$

    _____

d) $m + 4 + 3m - 3$

_____

4 Complete the function machines.

a)
Input		output
2	→	6
7	→	11
y	→	

b)
Input		output
2	→	4
5	→	10
y	→	

White Rose Maths

1 Tommy uses multilink cubes to represent an unknown number and base ten ones to represent 1

 $= x$ $= 1$

Write algebraic expressions to describe the sets of cubes.

The first one has been done for you.

a) $2x + 3$

b) $3x + 5$

c) $3x$

d) $x + 3$

e) $2x + 5$

f) $5x + 2$

g) $2x + 6$

h) $4x + 9$

2 Use Tommy's method to represent these expressions.

a) $x + 2$ c) $3x + 1$

b) $2x$ d) $x + 6$

Compare answers with a partner.

3 Use cubes to help you simplify the following expressions.
The first one has been done for you.

a) $2y + 5 + y$

     $3y + 5$

b) $3a + 2 + a + a$

     $5a + 2$

c) $6p + 2 - 2p$

     $4p + 2$

d) $m + 4 + 3m - 3$

$4m + 1$

4 Complete the function machines.

a)

Input		output
2		6
7	+4	11
y		$y+4$

b)

Input		output
2		4
5	×2	10
y		$2y$

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c)

Input		output
6	→ →	3
12	→ →	9
y	→ →	

d)

Input		output
30	→ →	3
50	→ →	5
y	→ →	

5 Match each statement to the equivalent algebraic expression.

Write the missing statements.

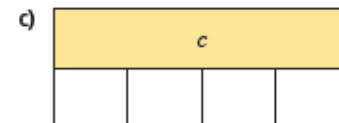|	
5 more than y	$2y$
y less than 5	$y - 5$
y multiplied by 5	$5 - y$
y divided by 5	$y + 5$
double y	$5y$
	y^2
	$\dfrac{y}{5}$

CHALLENGE QUESTIONS

6 Write an algebraic expression to represent the perimeter of each shape.

a)

_____

d)

_____

b)

_____

e)

_____

c)

_____

7 Complete the bar models.

a)

a	a

c)

c		

b)

b	b	10

d)

$d + 5$		
		5

c)

Input		output
6	→ →	3
12	→ -3 →	9
y	→ →	$y-3$

d)

Input		output
30	→ →	3
50	→ ÷10 →	5
y	→ →	$\frac{y}{10}$

5 Match each statement to the equivalent algebraic expression.
Write the missing statements.

Statement		Expression
5 more than y		$2y$
y less than 5		$y-5$
y multiplied by 5		$5-y$
y divided by 5		$y+5$
double y		$5y$
5 less than y		y^2
y multiplied by y		$\frac{y}{5}$

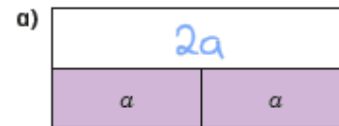**6** Write an algebraic expression to represent the perimeter of each shape.

a)

a, a, a

__3a__

d)

b, a

__2a + 2b__

c)

b

__4b__

e)

y, y, x, x, x

__3x + 2y__

c)

x

__6x__

7 Complete the bar models.

a)

2a	
a	a

b)

2b + 10		
b	b	10

c)

c			
$\frac{c}{4}$	$\frac{c}{4}$	$\frac{c}{4}$	$\frac{c}{4}$

d)

d + 5		
$\frac{d}{2}$	$\frac{d}{2}$	5

Lesson 3
Substitution
https://vimeo.com/425603939
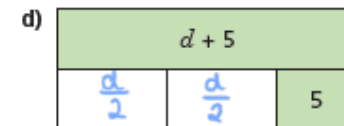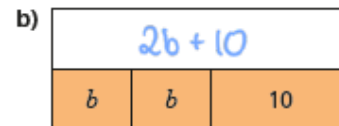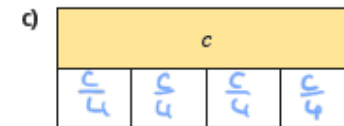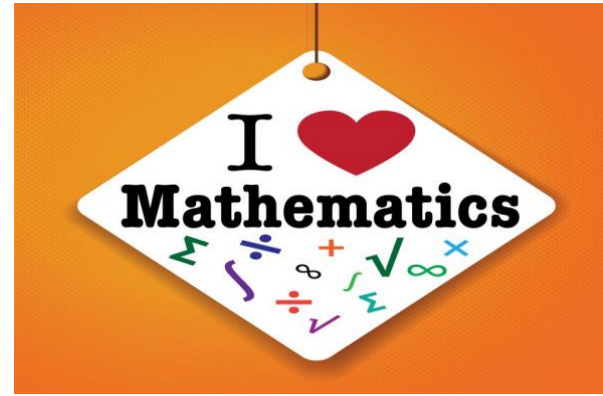
Answer questions on next few slides.

Substitution

1

$\boxed{⬠ = 4 \qquad ⬤ = 5}$

Use the given facts to work out the calculations.

a) ⬠ + ⬠ + ⬤

$\boxed{}$

b) ⬠ + ⬠ − ⬤

$\boxed{}$

c) ⬤ + ⬤ + ⬤ + ⬠ + ⬠

$\boxed{}$

2

$\boxed{▲ = 12 \qquad ■ = 5}$

Use the given facts to work out the calculations.

a) ▲ − ■

$\boxed{}$

b) ▲ × ■

$\boxed{}$

c) Create your own calculation that will be equal to 22

$\boxed{}$

3 If $x = 5$, write the values of the expressions in the corresponding grid. The first one has been done for you.

$3x$	x^2	$2x - 5$
$4x + 2$	$\dfrac{x}{2}$	$2(x + 1)$
$7x$	$x + 9$	$x - 7$

15		

4 If $a = 10$ and $b = 6$, work out the values of the expressions.

a) $a + b = \boxed{}$

d) $2a + b = \boxed{}$

b) $a - b = \boxed{}$

e) $3a - 17 = \boxed{}$

c) $2a = \boxed{}$

f) $2(a - b) = \boxed{}$

5 If $m = \dfrac{4}{5}$ and $k = 0.1$, work out the value of $m + 2k$

$\boxed{}$

Substitution

1

$$\pentagon = 4 \qquad \bigcirc = 5$$

Use the given facts to work out the calculations.

a) $\pentagon + \pentagon + \bigcirc$

13

b) $\pentagon + \pentagon - \bigcirc$

3

c) $\bigcirc + \bigcirc + \bigcirc + \pentagon + \pentagon$

23

2

$$\triangle = 12 \qquad \blacksquare = 5$$

Use the given facts to work out the calculations.

a) $\triangle - \blacksquare$

7

b) $\triangle \times \blacksquare$

60

c) Create your own calculation that will be equal to 22

e.g. $\triangle + \square + \square$

3 If $x = 5$, write the values of the expressions in the corresponding grid.
The first one has been done for you.

$3x$	x^2	$2x - 5$
$4x + 2$	$\frac{x}{2}$	$2(x + 1)$
$7x$	$x + 9$	$x - 7$

15	25	5
22	2.5	12
35	14	−2

4 If $a = 10$ and $b = 6$, work out the values of the expressions.

a) $a + b =$ 16

d) $2a + b =$ 26

b) $a - b =$ 4

e) $3a - 17 =$ 13

c) $2a =$ 20

f) $2(a - b) =$ 8

5 If $m = \frac{4}{5}$ and $k = 0.1$, work out the value of $m + 2k$

1

6

> It does not matter what p and q are, $p + q$ and $q + p$ will always give the same answer.

Mo

Do you agree with Mo? _____

Explain your answer.

_____

_____

_____

7

$$m = 7 \quad n = 5$$

Write >, < or = to compare the expressions.

a) $2m$ ◯ 10

b) $n - 1$ ◯ 5

c) $2n + m$ ◯ $2m + n$

d) $7n$ ◯ $5m$

8

$$a = 10$$

Write the expressions in order, starting with the smallest value.

| $5a$ | $a + 5$ | $\frac{a}{5}$ | a^2 |

☐ ☐ ☐ ☐

9

$$a = 15$$

Write three different algebraic expressions that give a value of 40

_____   _____   _____

10 Complete the table.

x	$5x$	$5x - 1$
2		
10		
12		
	25	
		34
		99

6

Mo: It does not matter what p and q are, $p + q$ and $q + p$ will always give the same answer.

Do you agree with Mo? __Yes__

Explain your answer.

__Addition is commutative.__

_____

_____

7

$m = 7 \quad n = 5$

Write >, < or = to compare the expressions.

a) $2m$ ⊘> 10

b) $n - 1$ ⊘< 5

c) $2n + m$ ⊘< $2m + n$

d) $7n$ ⊘= $5m$

CHALLENGE ANSWERS

8

$a = 10$

Write the expressions in order, starting with the smallest value.

| $5a$ | $a + 5$ | $\frac{a}{5}$ | a^2 |

| $\frac{a}{5}$ | $a + 5$ | $5a$ | a^2 |

9

$a = 15$

Write three different algebraic expressions that give a value of 40

e.g.

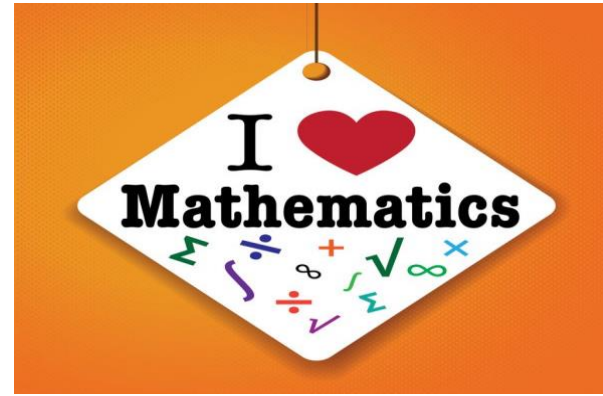__$2a + 10$__   __$3a - 5$__   __$\frac{8a}{3}$__

10 Complete the table.

x	$5x$	$5x - 1$
2	10	9
10	50	49
12	60	59
5	25	24
7	35	34
20	100	99

Lesson 4
Solve simple one-step equations
https://vimeo.com/425605040

Answer questions on next few slides

1 Write an equation for each part-whole model.

Work out the value of the multilink cube in each equation.

a)

_____

⬛ = ☐

b)

_____

⬛ = ☐

2 There are some counters under the cup.
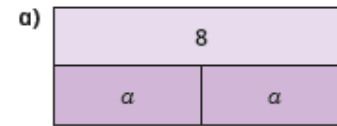
There are 10 counters in total.

a) If c is the number of counters under the cup, explain why
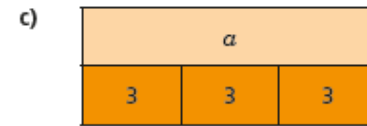$c + 6 = 10$

b) Work out the value of c.

$c =$ ☐

c) How many counters are under the cup?

☐

3 Write algebraic equations to represent the bar models.
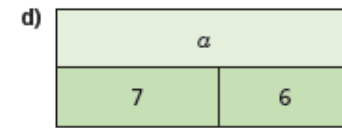
Find the value of a in each one.

a)

8	
a	a

c)

a		
3	3	3

$a =$ ☐

$a =$ ☐

b)

15	
a	10

d)

a	
7	6

$a =$ ☐

$a =$ ☐

4 Nijah is solving the equation $x - 8 = 20$

$$x - 8 = 20$$
$$x = 20 - 8$$
$$x = 12$$

What mistake has Nijah made?

_____

_____

1 Write an equation for each part-whole model.

Work out the value of the multilink cube in each equation.

a)

6

$3x = 6$

$\blacksquare = \boxed{2}$

b)

18

$x + 4 = 18$

$\blacksquare = \boxed{14}$

2 There are some counters under the cup.

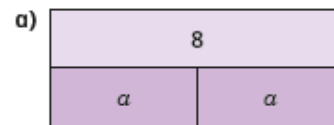There are 10 counters in total.

a) If c is the number of counters under the cup, explain why
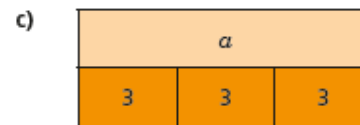$c + 6 = 10$

b) Work out the value of c. $c = \boxed{4}$

c) How many counters are under the cup? $\boxed{4}$

3 Write algebraic equations to represent the bar models.

Find the value of a in each one.

a)

8	
a	a

$a = \boxed{4}$

c)

a		
3	3	3

$a = \boxed{9}$

b)

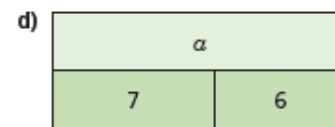| 15	
a	10

$a = \boxed{5}$

d)

a	
7	6

$a = \boxed{13}$

4 Nijah is solving the equation $x - 8 = 20$

$$x - 8 = 20$$
$$x = 20 - 8$$
$$x = 12$$

What mistake has Nijah made?

She should have added 8 to 20

$x = 28$

5 Solve the equations.

a) $x + 7 = 20$

d) $g - 3 = 15$

$x = \boxed{}$

$g = \boxed{}$

b) $10y = 80$

e) $32 = t - 5$

$y = \boxed{}$

$t = \boxed{}$

c) $4m = 22$

f) $\frac{u}{6} = 3$

$m = \boxed{}$

$u = \boxed{}$

CHALLENGE QUESTIONS

6 Filip thinks of a number.

He subtracts 5 from his number.

He ends up with 10

Write an algebraic equation to represent Filip's problem.

_____

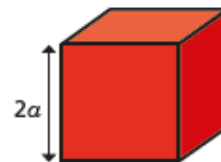Solve the equation to work out his number.

$\boxed{}$

7 Dexter builds a tower.

Each block is $2a$ high.

He uses 7 blocks.

$2a$

The total height of his tower is 42 cm.

Write an equation to represent the height of Dexter's tower and find the value of a.

$a = \boxed{}$ cm

8 Work out the value of each shape.

Write the equations that you solved to find the value of each shape.

1+1=2

★	♥	★	♥	
★	▲	★	★	
♥	♥	♥	♥	= 40
▲	★	♥	▲	= 20

=
32

♥ = $\boxed{}$ ★ = $\boxed{}$ ▲ = $\boxed{}$

Work out the missing total of each row and column.

Compare answers with a partner.

5 Solve the equations.

a) $x + 7 = 20$

d) $g - 3 = 15$

$x = \boxed{13}$

$g = \boxed{18}$

b) $10y = 80$

e) $32 = t - 5$

$y = \boxed{8}$

$t = \boxed{37}$

c) $4m = 22$

f) $\frac{u}{6} = 3$

$m = \boxed{5 \cdot 5}$

$u = \boxed{18}$

6 Filip thinks of a number.

He subtracts 5 from his number.

He ends up with 10

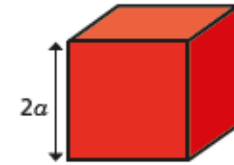Write an algebraic equation to represent Filip's problem.

$\underline{x - 5 = 10}$

Solve the equation to work out his number.

$\boxed{15}$

7 Dexter builds a tower.

Each block is $2a$ high.

He uses 7 blocks.

$2a$

The total height of his tower is 42 cm.

Write an equation to represent the height of Dexter's tower and find the value of a.

$14a = 42$

$a = \boxed{3}$ cm

8 Work out the value of each shape.

Write the equations that you solved to find the value of each shape.

⭐ ❤️ ⭐ ❤️

⭐ 🔺 ⭐ ⭐

❤️ ❤️ ❤️ ❤️ = 40

🔺 ⭐ ❤️ 🔺 = 20

=
32

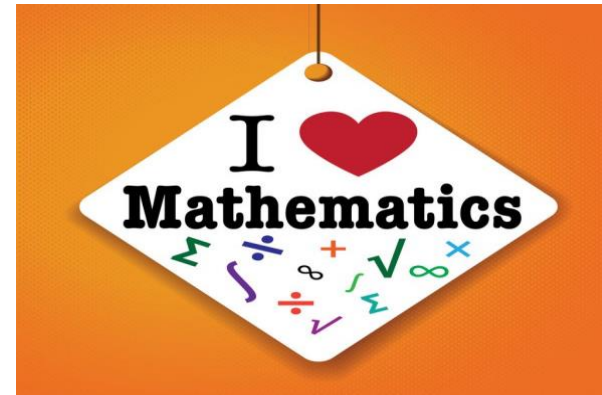❤️ = $\boxed{10}$ ⭐ = $\boxed{6}$ 🔺 = $\boxed{2}$

Work out the missing total of each row and column.

Compare answers with a partner.

CHALLENGE
ANSWERS

1+1=2

Lesson 5
Challenge
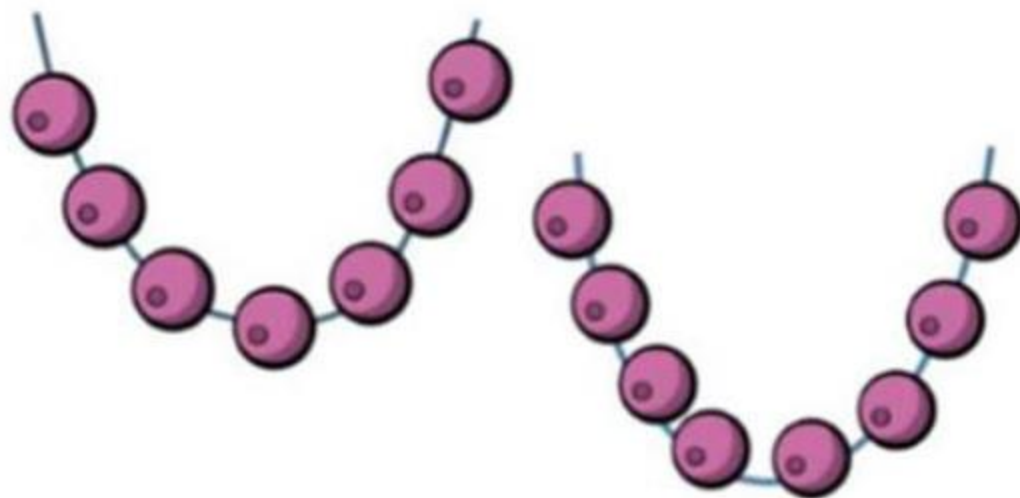Attempt the following problems.
Remember to use RUCSAC

Challenge 1

Sal has 20 beads.

She uses some beads to make these two necklaces.

How many beads does she have left?

Challenge 2

George is thinking of a 2 digit number.

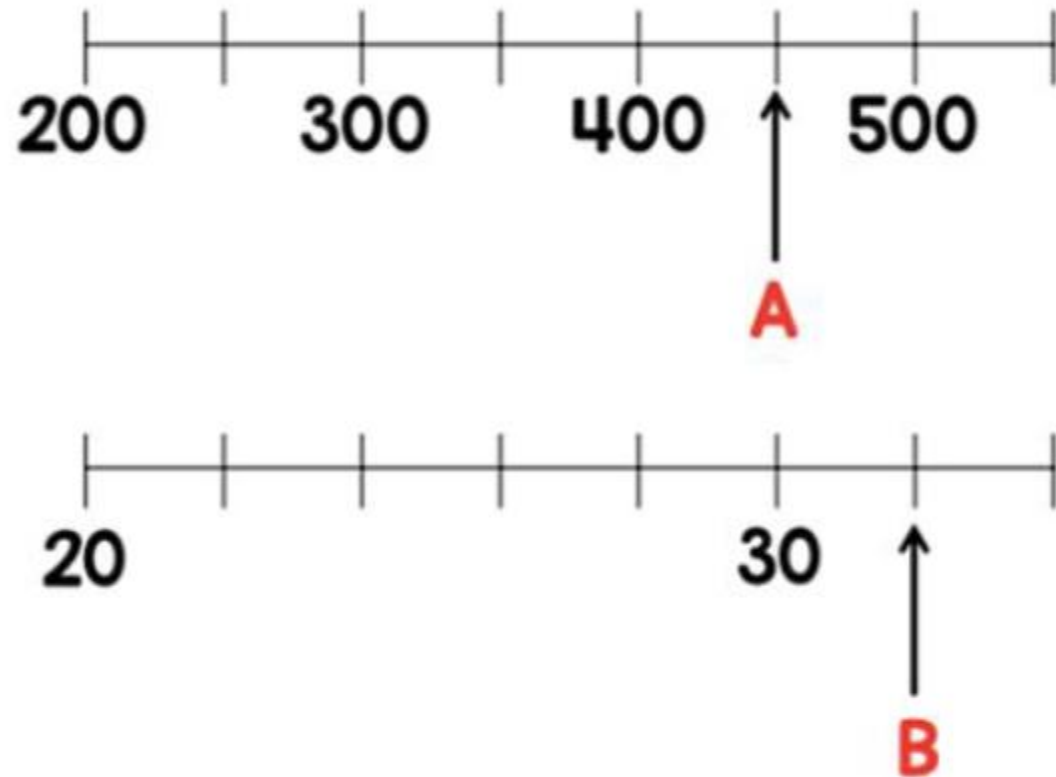What number is George thinking of?

My number is in the 5 times table.

My number is less than 80

The sum of the digits is 9

Challenge 3

Two numbers, A and B, are marked on the number lines.

Find the sum of A and B.

Challenge 4

Max buys a shirt and a jacket.

The jacket costs **£25** more than the shirt.

The total cost of the shirt and jacket is **£87**.

How much does each item cost?

Challenge 5

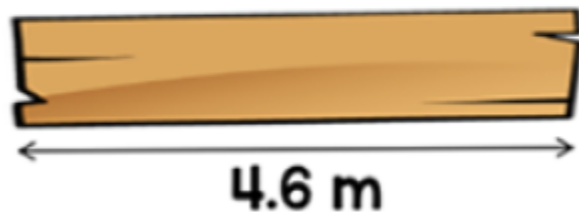The mass of 1 cube and 4 cones is **110 g**.

The mass of 1 cube and 2 cones is **72 g**.

What is the mass of 1 cube?

Challenge 6

A plank of wood is 4.6 metres long.

4.6 m

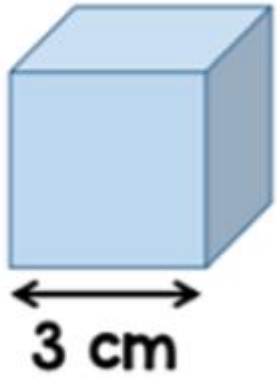These three lengths of wood are cut from the plank.

1.45 m	88 cm	1630 mm

What is the length of the wood left?

Challenge 7

A factory makes these wooden cubes.

3 cm

They are packed into large boxes.

15 cm

12 cm

27 cm
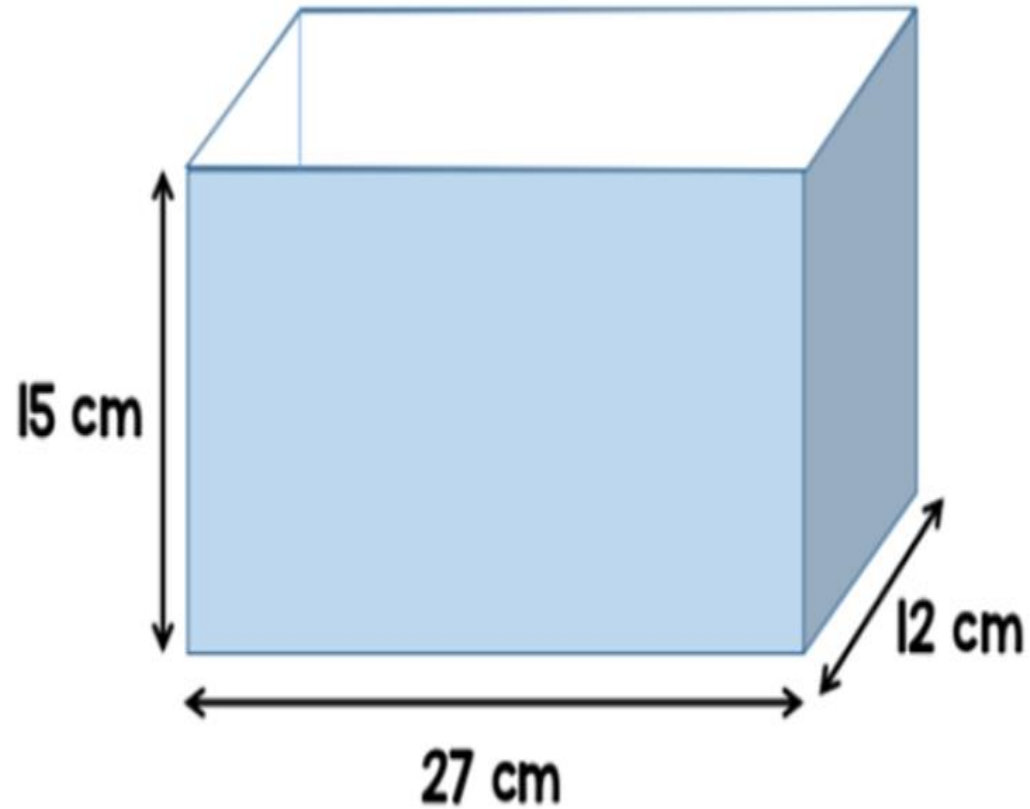
How many wooden cubes can be packed into one large box?

Challenge 8

Amrit, Beth and Caroline sell cookies.

Amrit sells $\frac{1}{6}$ of the cookies.

Beth sells **30%** of the remaining cookies. Beth sells **12** cookies.

Caroline sells the rest.

How many cookies do they sell altogether?

Challenge 9

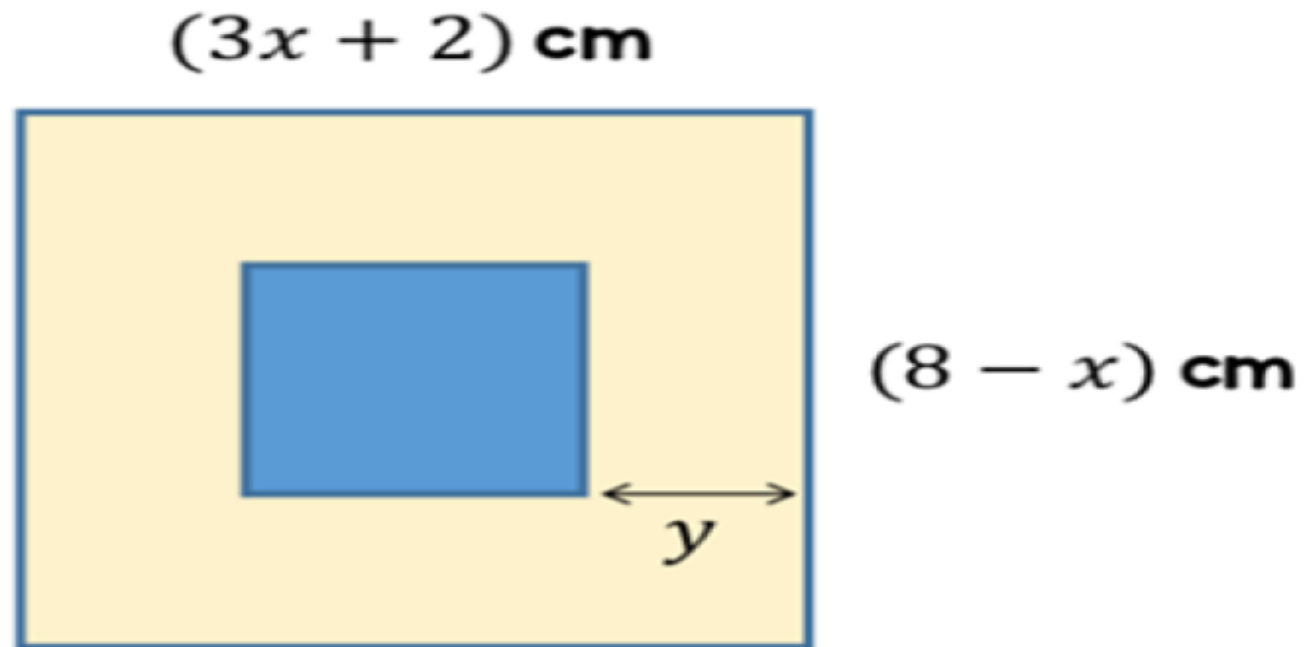$\frac{1}{2}$ of the length of rope A is equal to $\frac{3}{5}$ of the length of rope B.

Rope A is **42 cm** longer than rope B.

How long is rope A?

Challenge 10

A blue square is placed inside a large yellow square.

The centre of the squares are aligned one over the other.

$(3x + 2)$ cm

$(8 - x)$ cm

The area of the blue square is **36%** of the area of the yellow square.

Find the distance marked y.

Answers

Challenge 1 - 5 beads

Challenge 2 - 45

Challenge 3 - 482

Challenge 4 - Jacket £56 and Shirt £31

Challenge 5 - 34 g

Challenge 6 - 0.64 m, 64 cm or 640 mm

Challenge 7 - 180 cubes

Challenge 8 - 48 cookies

Challenge 9 - 252 cm

Challenge 10 - 1.3 cm