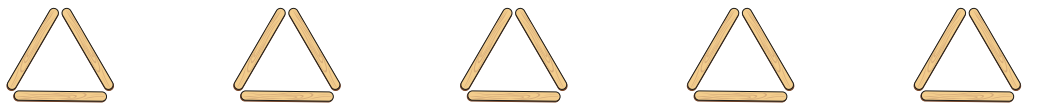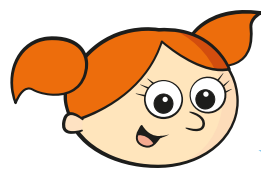# Find a rule – one step

1 Whitney makes a pattern of triangles using sticks.

Complete the table below.

Number of triangles	1	2	3	4	5	10	
Number of sticks							90

2 Complete the tables.

To find the number of wheels, you multiply the number of bicycles by 2

a)

Number of bicycles	1	2	5			16
Number of wheels	2			18	24	

b)

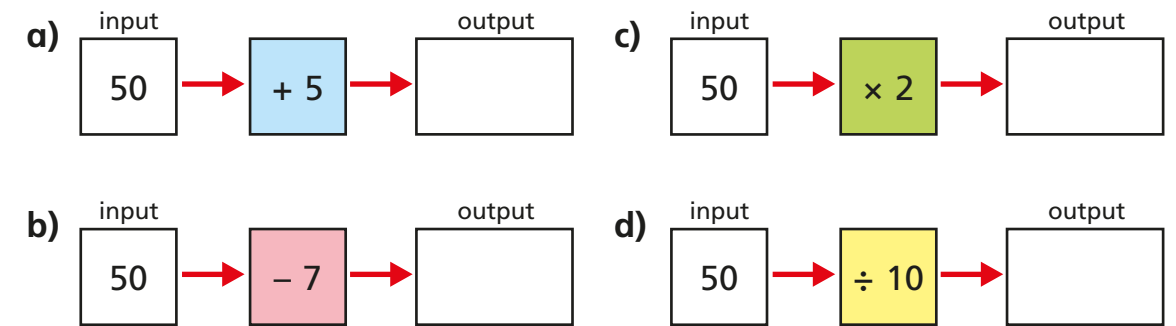| Number of ants	1	2	5			16
Number of legs		12		18	24	

Explain how to find the number of legs.

_____

_____

3 Calculate the outputs for the function machines below.

a) input: 50 → + 5 → output: ☐

b) input: 50 → − 7 → output: ☐
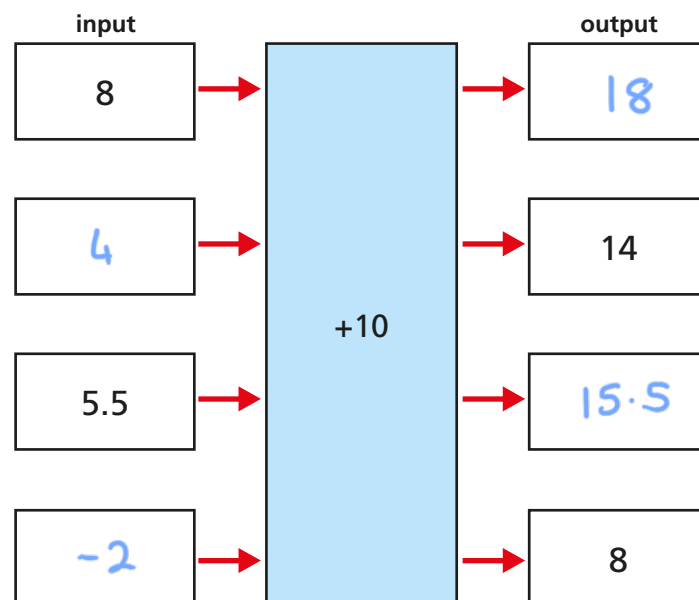
c) input: 50 → × 2 → output: ☐

d) input: 50 → ÷ 10 → output: ☐

4 Calculate the inputs for the function machines.

a) input: ☐ → + 9 → output: 45

b) input: ☐ → − 2 → output: 21

c) input: ☐ → × 10 → output: 350

d) input: ☐ → ÷ 3 → output: 9
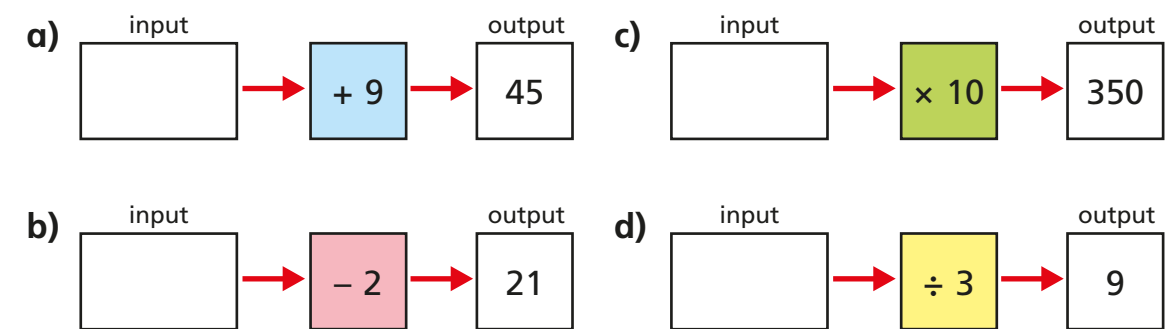
5 Write the missing functions in the function machines.

a)
input: 2 → ☐ → output: 10
input: 5 → ☐ → output: 25
input: 10 → ☐ → output: 50

b)
input: 8 → ☐ → output: 15
input: 0 → ☐ → output: 7
input: −3 → ☐ → output: 4
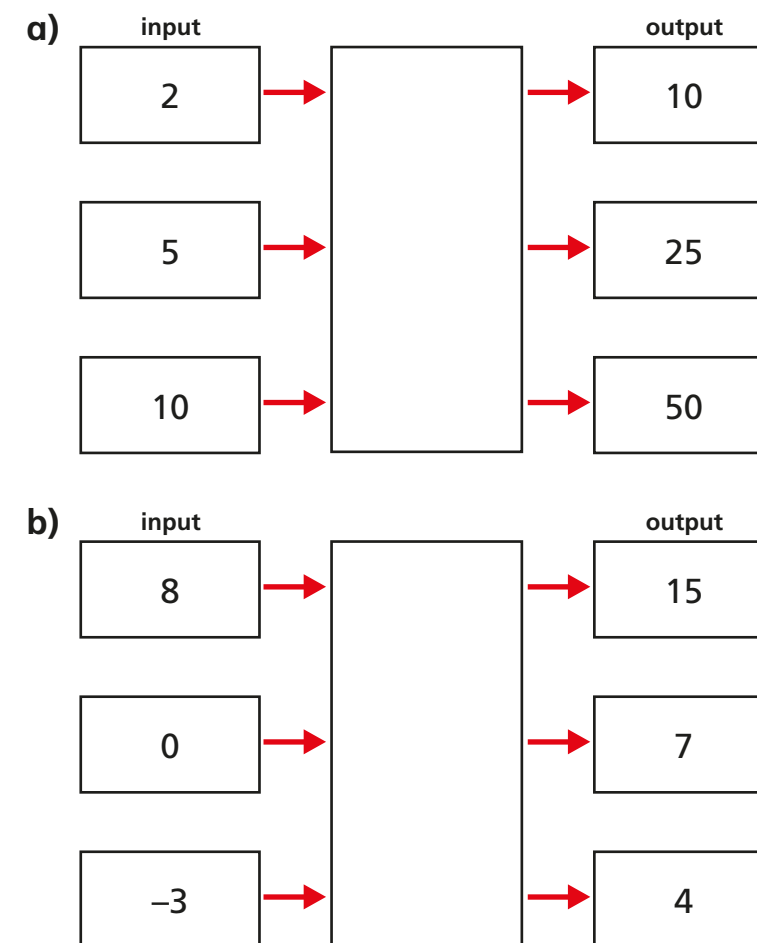
6 Calculate the missing inputs and outputs for the function machine.

input
| 8 |
| 4 |
| 5.5 |
| -2 |

+10

output
| 18 |
| 14 |
| 15·5 |
| 8 |

7 Look at the function machine.
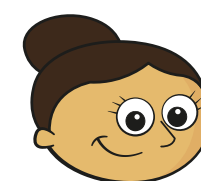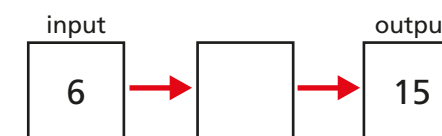
input
| 15 |
| 20 |
| 50 |
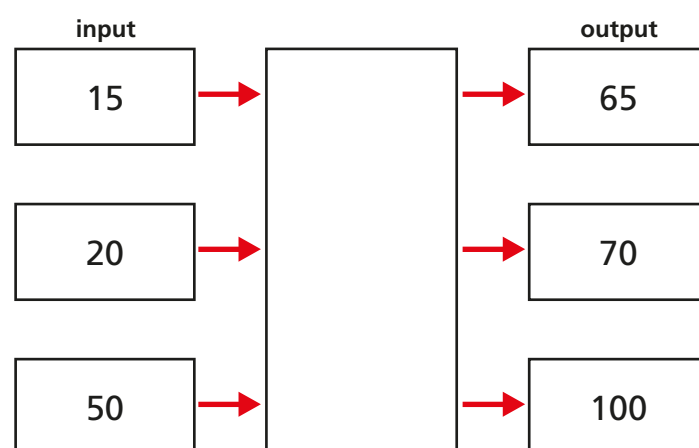
output
| 65 |
| 70 |
| 100 |

a) What is the output, if the input is zero?

50

b) What is the input, if the output is zero?

- 50

8 Here is a function machine.

input
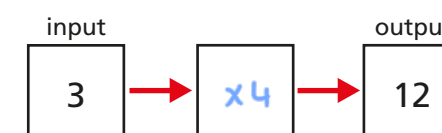| 6 | → | | → | 15 |

Dora: The rule is add 9
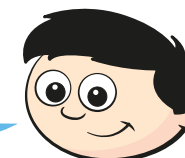
Dexter: The rule is multiply by 2.5

Who do you agree with? ___Both___

Explain your answer.

9 In a function machine, if the input is 3 and the output is 12, what could the function be?

Write two different functions and complete the table of outputs for each function.

input
| 3 | → | x4 | → | 12 |

Input	3	4	5	10	20	100
Output	12	16	20	40	80	400

input
| 3 | → | +9 | → | 12 |

Input	3	4	5	10	20	100
Output	12	13	14	19	29	109

Find a rule – two step

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
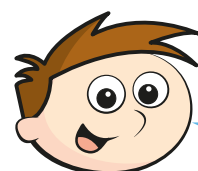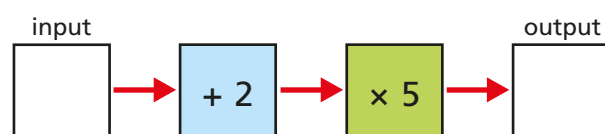
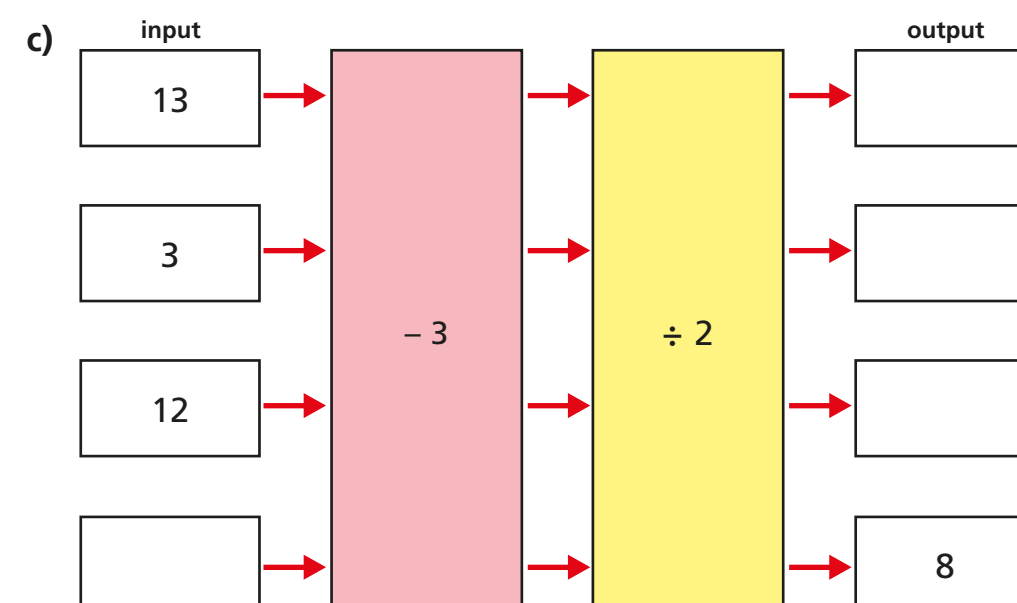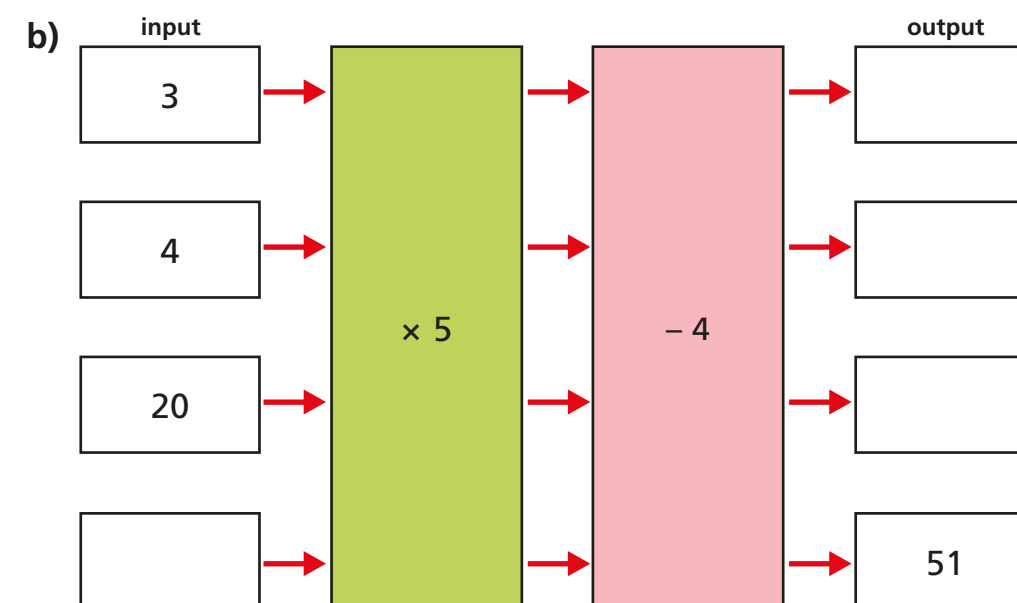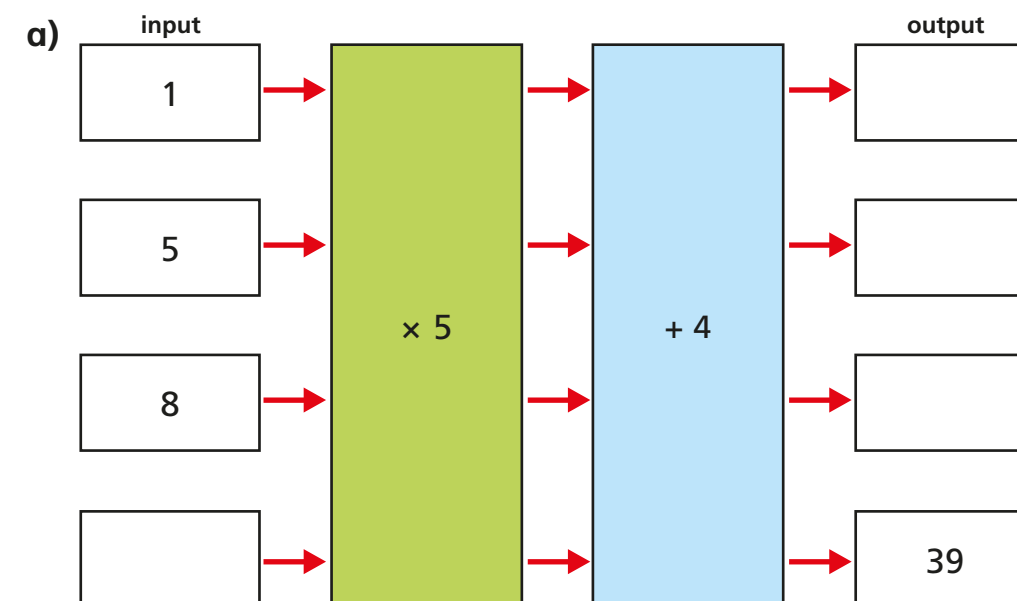Teddy: The outputs will be the same.

Jack: The outputs will be different.

Explain to a partner who you think is correct.
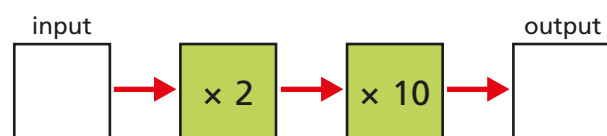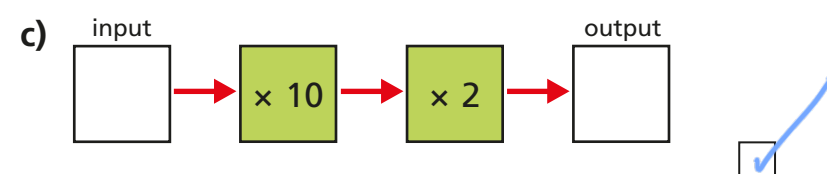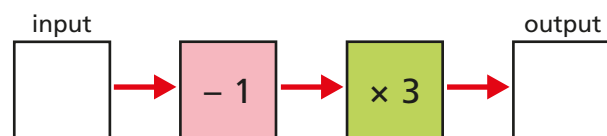
Use the function machine to complete the table.

Input	1	2	3	5	10	50
Output						

Who is correct? _____

3 Work out the missing outputs and inputs.

a)

input → [1] → × 5 → + 4 → output [ ]

[5] → × 5 → + 4 → [ ]

[8] → × 5 → + 4 → [ ]

[ ] → × 5 → + 4 → [39]

b)

input → [3] → × 5 → − 4 → output [ ]

[4] → × 5 → − 4 → [ ]

[20] → × 5 → − 4 → [ ]

[ ] → × 5 → − 4 → [51]

c)

input → [13] → − 3 → ÷ 2 → output [ ]

[3] → − 3 → ÷ 2 → [ ]

[12] → − 3 → ÷ 2 → [ ]

[ ] → − 3 → ÷ 2 → [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   ✓
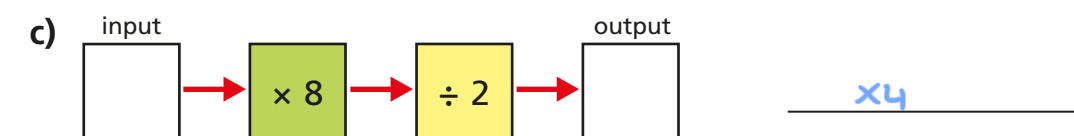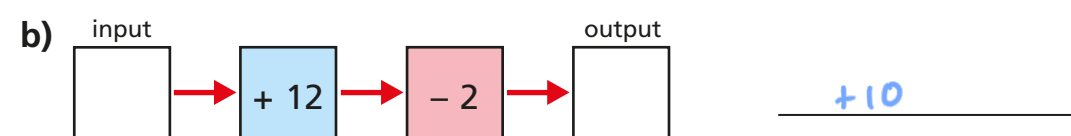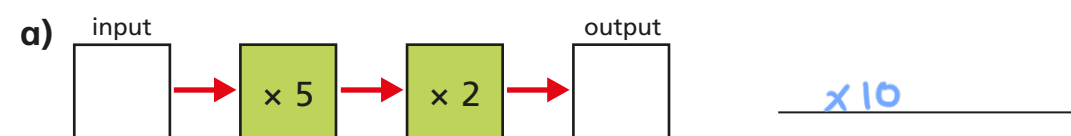
input → × 2 → × 10 → output
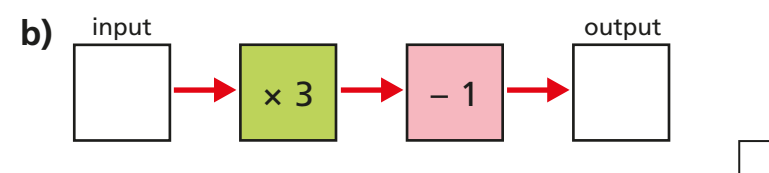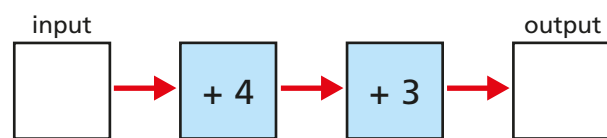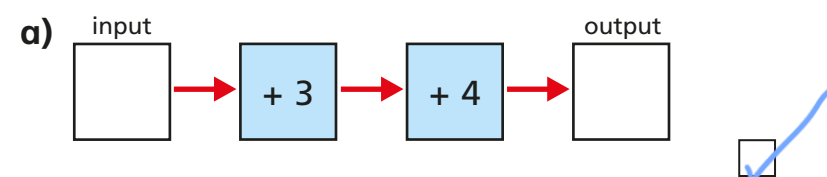
Explain your reasoning to a partner.

5 Here are some 2-step function machines.

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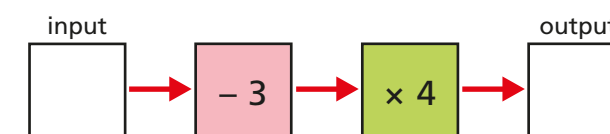
Check your answers by inputting values.

a)

input → × 5 → × 2 → output   ___×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
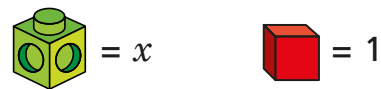
Forming expressions

1 Tommy uses multilink cubes to represent an unknown number and base ten ones to represent 1
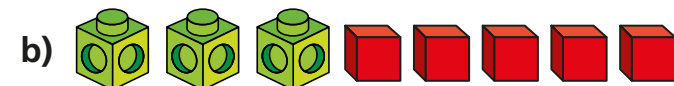
$$= x \qquad = 1$$

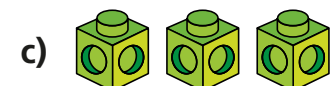Write algebraic expressions to describe the sets of cubes.
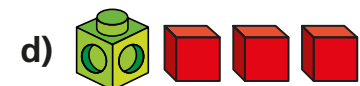
The first one has been done for you.

a) $\qquad$ 2x + 3
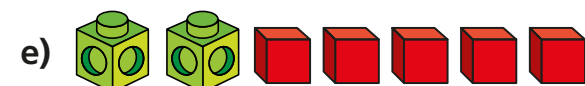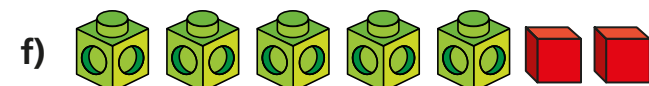
b) $\qquad$ 3x + 5

c) $\qquad$ 3x

d) $\qquad$ x + 3

e) $\qquad$ 2x + 5

f) $\qquad$ 5x + 2

g) $\qquad$ 2x + 6
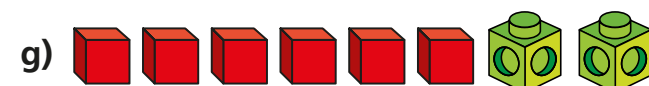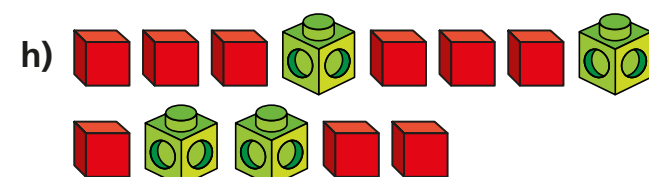
h) $\qquad$ 4x + 9

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) $2y + 5 + y$
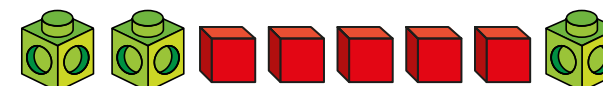
$\qquad$ 3y + 5

b) $3a + 2 + a + a$
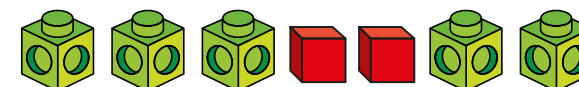
$\qquad$ 5a + 2

c) $6p + 2 - 2p$

$\qquad$ 4p + 2

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

$\qquad$ 4m + 1

4 Complete the function machines.

a)

input		output
2	→ +4 →	6
7	→ +4 →	11
y	→ +4 →	y+4

b)

input		output
2	→ ×2 →	4
5	→ ×2 →	10
y	→ ×2 →	2y

c)

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

d)

input		output
30	→	3
50	→ ÷10 →	5
y	→	$\frac{y}{10}$
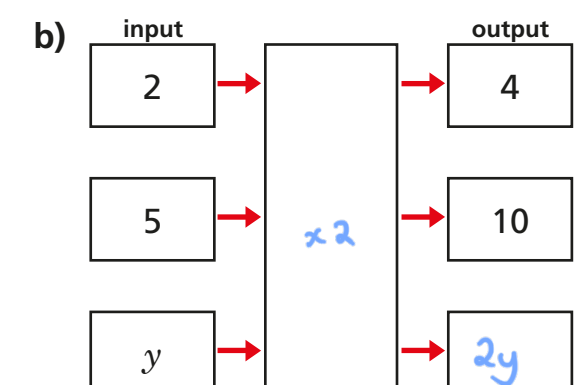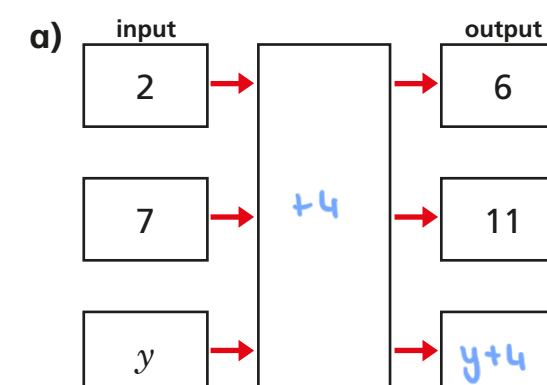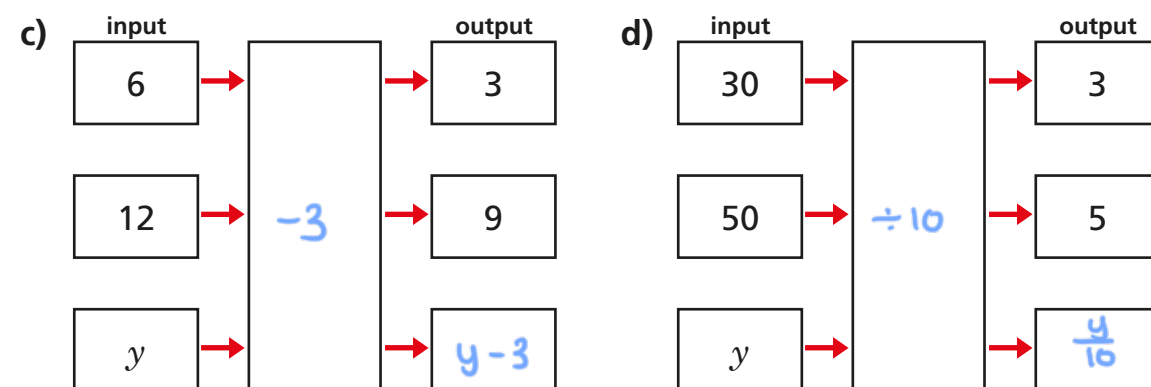
5 Match each statement to the equivalent algebraic expression.

Write the missing statements.

Statements		Expressions
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)

$3a$

d)

$2a + 2b$

b)

$4b$

e)

$3x + 2y$

c)

$6x$
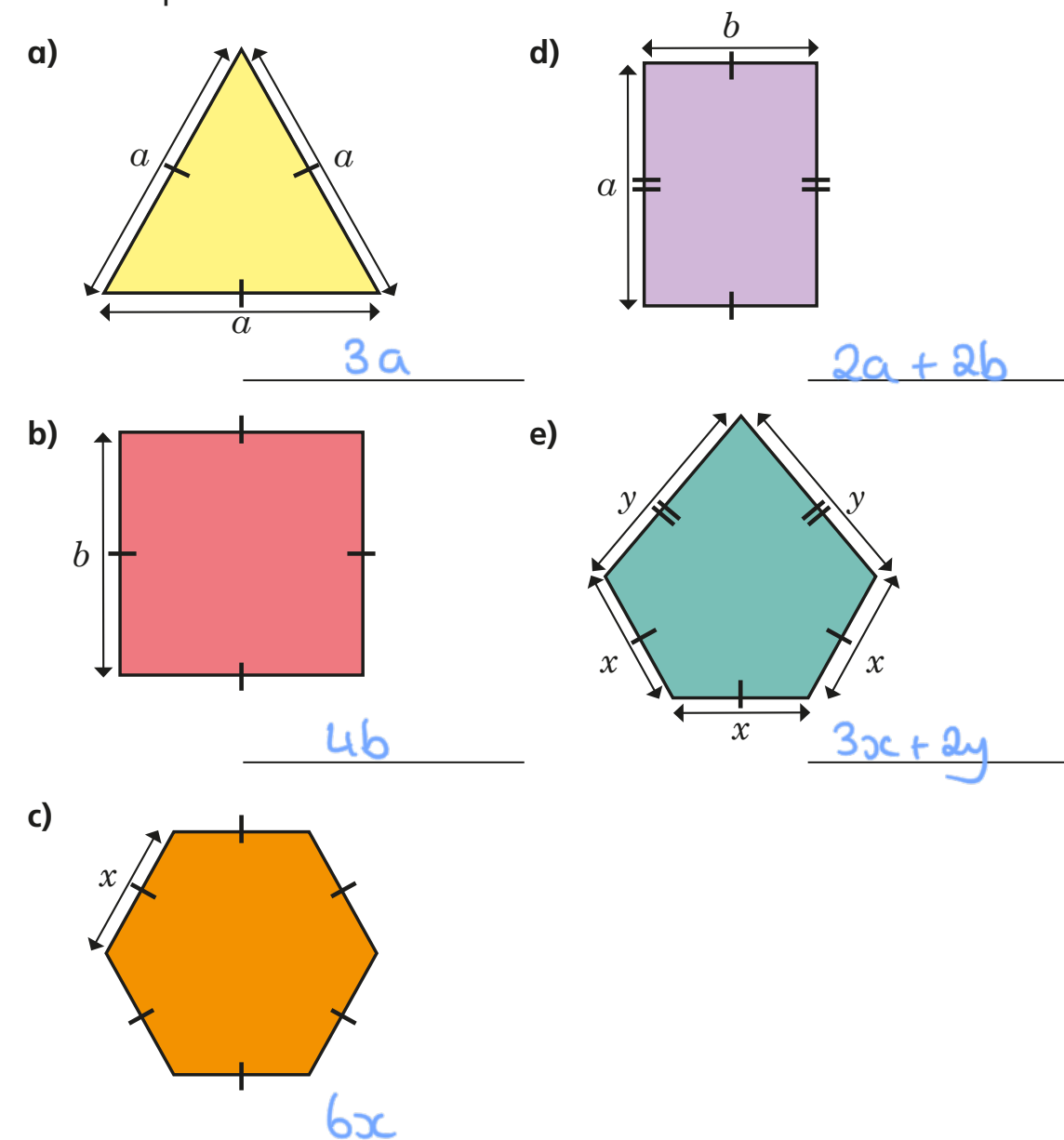
7 Complete the bar models.
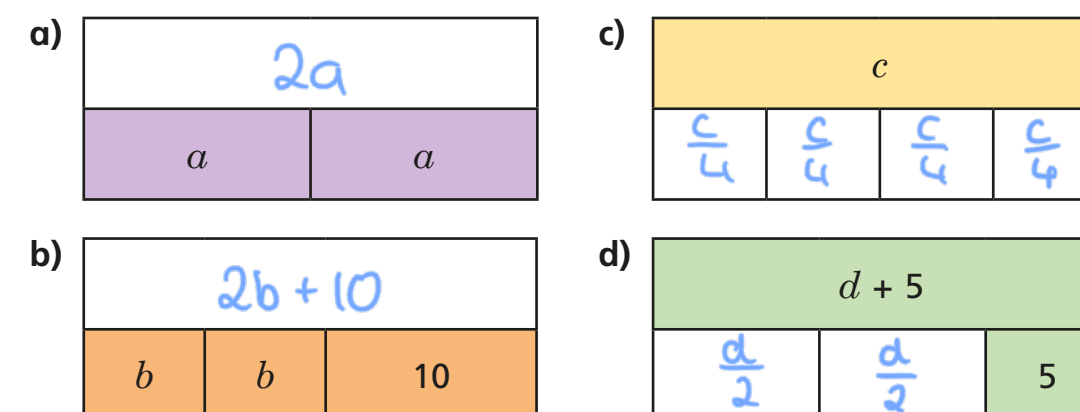
a)

$2a$	
a	a

c)

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

b)

$2b + 10$		
b	b	10

d)

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

Substitution

1

$$\text{pentagon} = 4 \qquad \text{circle} = 5$$

Use the given facts to work out the calculations.

a) pentagon + pentagon + circle

$$13$$

b) pentagon + pentagon − circle

$$3$$

c) circle + circle + circle + pentagon + pentagon

$$23$$

2

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

Use the given facts to work out the calculations.

a) triangle − square

$$7$$

b) triangle × square

$$60$$

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

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
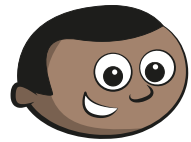
c) $2a =$ 20

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

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

$$1$$

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) $7n$ = $5m$

8

$$a = 10$$

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

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

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

9

$$a = 15$$

Write three different algebraic expressions that give a value of 40

e.g.

$\underline{2a + 10}$ $\underline{3a - 5}$ $\underline{\dfrac{8a}{3}}$

10   Complete the table.

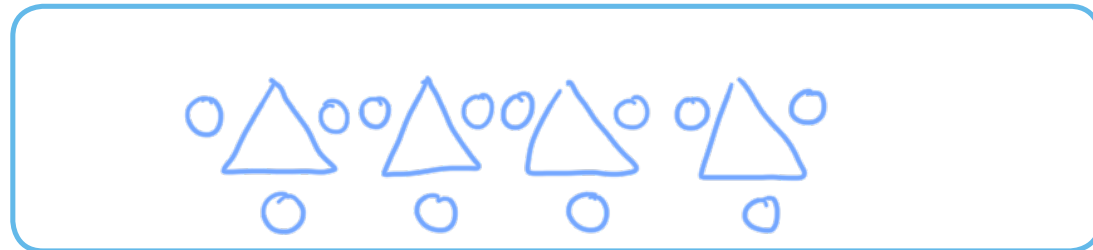| x	$5x$	$5x - 1$
2	10	9
10	50	49
12	60	59
5	25	24
7	35	34
20	100	99

Formulae

1 Scott builds a pattern using triangles and circles.
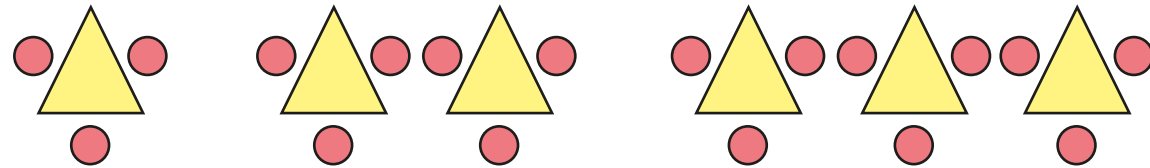
a) Draw the next diagram in the pattern.

b) Scott records the number of triangles and circles in a table.

Complete the table.

Number of triangles	1	2	3	4	5
Number of circles	3	6	9	12	15

c) c = number of circles and t = number of triangles

Circle the formula that describes the pattern.

$c = t + 3$	$c = 3t$ ✓	$t = 3c$	$t = 3 + c$

d) How many circles will there be with 10 triangles? | 30 |

Show your working.

3 × 10 = 30

2 a) Complete the table.

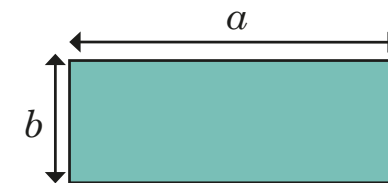| Number of weeks	1	2	3	5	10
Number of days	7	14	21	35	70

b) Complete the formula to show the relationship between days (d) and weeks (w).

$$d = \boxed{7}\, w$$

c) How many days are there in 32 weeks?

| 224 |

3 a) Write a formula for the area and perimeter of the rectangle.

area = __ab__

perimeter = __2a + 2b__

b) Work out the area and perimeter of the rectangle if a = 17 cm and b = 8 cm
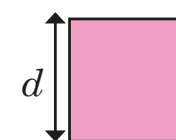
Show your workings.

area = | 136 cm² | perimeter = | 50 cm |

4 a) Write a formula for the area and perimeter of the square.

area = __d²__

perimeter = __4d__

b) Work out the area and perimeter of the square if d = 8.5 cm

Show your workings.

area = | 72.25 cm² | perimeter = | 34 cm |

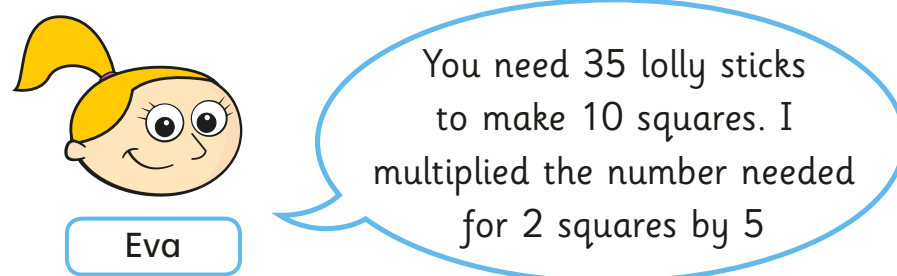**5** Dora makes a square pattern using lolly sticks.
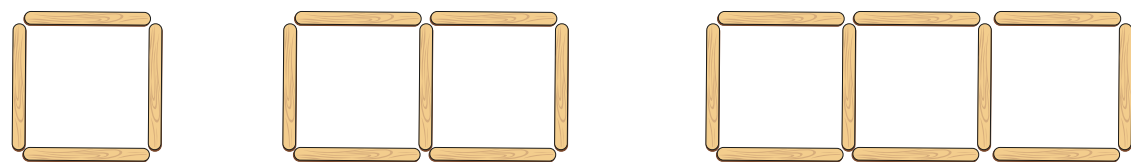
She records the number of squares and sticks in a table.

a) Continue the pattern and complete the table.

Number of squares, s	1	2	3	4	5
Number of lolly sticks, l	4	7			

b)

Eva

You need 35 lolly sticks to make 10 squares. I multiplied the number needed for 2 squares by 5

Show that Eva is wrong.

How many sticks are needed to make 10 squares?

c) Circle the formula that describes the pattern.

$l = 3s + 1$	$l = 4s + 1$	$l = 3(s + 1)$

6 Here are a dog walker's prices.

Walkies

Dog Walker

£12 per hour plus £5 travel

a) How much does the dog walker charge for a 2-hour job?

b) Write a formula to show the cost (c) for (h) hours.

7 The Wooden Letter Company sells wooden letters for £2 each, plus £1.50 for delivery of each order.

a) Whitney places an order for the letters to spell out her name.

How much does it cost?

£

b) Write a formula to show the cost (c) for the number of letters (n).