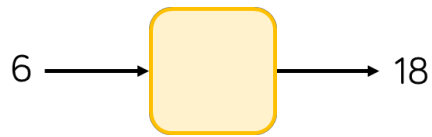


Find a Rule – One Step

Reasoning and Problem Solving

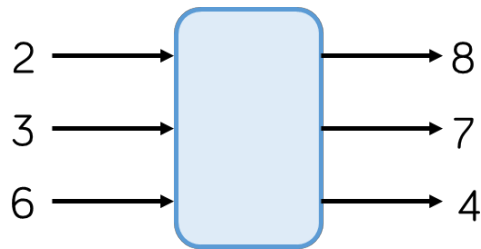
Eva has a one-step function machine. She puts in the number 6 and the number 18 comes out.



What could the function be?
How many different answers can you find?

The function could be $+ 12$, $\times 3$

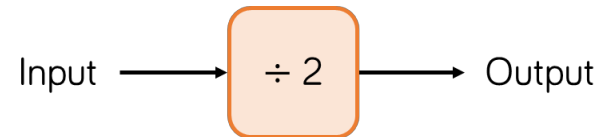
Amir puts some numbers into a function machine.



What is the output from the function when the input is 16?

The function is subtract from 10 so the output is -6

Dora puts a number into the function machine.



Dora's number is:

- A factor of 32
- A multiple of 8
- A square number

What is Dora's input?

What is her output?

Can you create your own clues for the numbers you put into a function machine for a partner to solve?

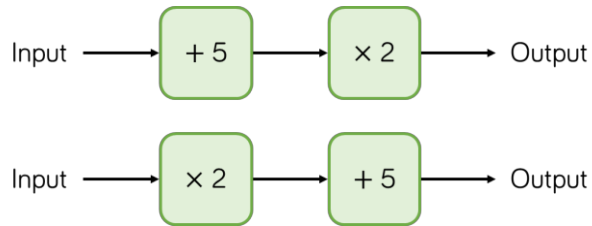
Dora's input is 16

Her output is 8

Find a Rule – Two Step

Reasoning and Problem Solving

Teddy has two function machines.



He says,



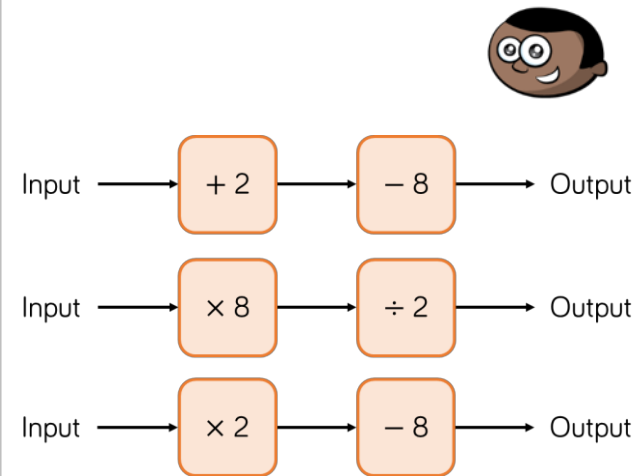
The function machines will give the same answer.

Is Teddy correct?

Is there an input that will give the same output for both machines?

No they do not give the same answer. Encourage children to refer to the order of operations to help them understand why the outputs are different.

Mo has the following function machines.



The first one can be written as $- 6$

The second can be written as $\times 4$

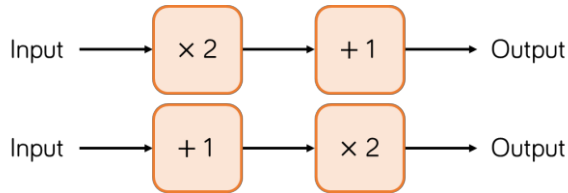
The third cannot be written as a single machine.

Explain which of these can be written as single function machines.

Forming Expressions

Reasoning and Problem Solving

Amir inputs m into these function machines.



He says the outputs of the machines will be the same.

Do you agree?

Explain your answer.

No, because $2m + 1$ isn't the same as $2m + 2$

$2m + 1$

Input



$\times 2$



$+ 1$



$2m + 2$

Input



$+ 1$



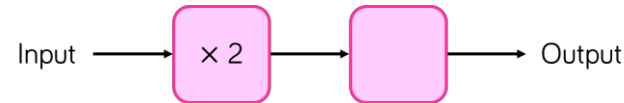
$\times 2$



Children may use examples with numbers to show this.

This function machine gives the same output for every input.

For example if the input is 5 then the output is 5 and so on.



What is the missing part of the function?

What other pairs of functions can you think that will do the same?

$\div 2$

Other pairs of functions that will do the same are functions that are the inverse of each other e.g. $+ 3, - 3$

Substitution

Reasoning and Problem Solving

Here are two formulae.

$$p = 2a + 5$$

$$c = 10 - p$$

Find the value of c when $a = 10$

$$c = -15$$

$$x = 2c + 6$$

Whitney says,



$x = 12$ because c must be equal to 3 because it's the 3rd letter in the alphabet

Is Whitney correct?

Amir says,

When $c = 5$, $x = 31$



Amir is wrong.

Explain why.

What would the correct value of x be?

No Whitney is incorrect. c could have any value.

Amir has put the 2 next to the 5 to make 25 instead of multiplying 2 by 5

The correct value of x would be 16

Formulae

Reasoning and Problem Solving

Jack and Dora are using the following formula to work out what they should charge for four hours of cleaning.

$$\text{Cost in pounds} = 20 + 10 \times \text{number of hours}$$

Jack thinks they should charge £60

Dora thinks they should charge £120

Who do you agree with?
Why?

Jack is correct as multiplication should be performed first following the order of operations.

Dora has not used the order of operations – she has added 20 and 10 and then multiplied 30 by 4

The rule for making scones is use 4 times as much flour (f) as butter (b).

Which is the correct formula to represent this?

A

$$f = \frac{b}{4}$$

B

$$f = 4b$$

C

$$f = b + 4$$

D

$$4f = b$$

Explain why the others are incorrect.

B is correct.

A shows the amount of flour is a quarter of the amount of butter.

C shows the amount of flour is 4 more than butter.

D shows butter is 4 times the amount of flour.

Forming Equations

Reasoning and Problem Solving

Rosie thinks of a number. She adds 7 and divides her answer by 2

Teddy thinks of a number. He multiplies by 3 and subtracts 4

Rosie and Teddy think of the same number.

Rosie's answer is 9

What is Teddy's answer?

Rosie and Teddy think of the same number again. This time, they both get the same answer.

Use trial and improvement to find the number they were thinking of.

They both think of 11, therefore
Teddy's answer is 29

They think of 3
and the answer
they both get is 5

Eva spends 92p on yo-yos and sweets

She buys y yo-yos costing 11p and s sweets costing 4p.

Can you write an equation to represent what Eva has bought?

How many yo-yos and sweets could Eva have bought?

Can you write a similar word problem to describe this equation?

$$74 = 15t + 2m$$

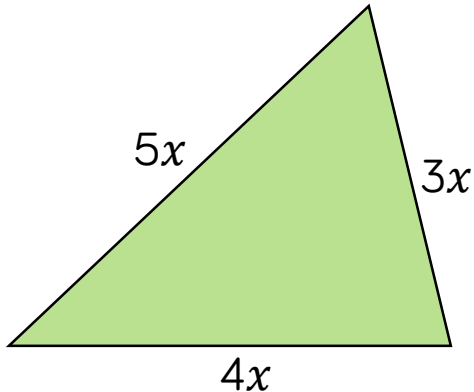
$$92 = 11y + 4s$$

She could have bought 1 sweet and 8 yo-yos or 4 yo-yos and 12 sweets.

One-step Equations

Reasoning and Problem Solving

The perimeter of the triangle is 216 cm.



Form an equation to show this information.

Solve the equation to find the value of x .

Work out the lengths of the sides of the triangle.

$$\begin{aligned} 3x + 4x + 5x &= 216 \\ 12x &= 216 \\ x &= 18 \end{aligned}$$

$$\begin{aligned} 5 \times 18 &= 90 \\ 3 \times 18 &= 54 \\ 4 \times 18 &= 72 \end{aligned}$$

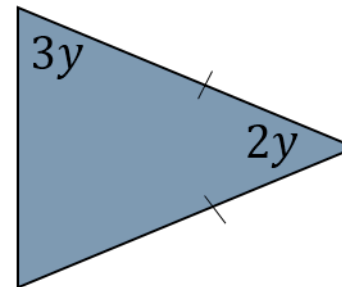
- Hannah is 8 years old
- Jack is 13 years old
- Grandma is $x + 12$ years old.
- The sum of their ages is 100

Form and solve an equation to work out how old Grandma is.

$$8 + 13 + x + 12 = 100$$

$$\begin{aligned} 33 + x &= 100 \\ x &= 77 \\ \text{Grandma is } 77 &\text{ years old.} \end{aligned}$$

What is the size of the smallest angle in this isosceles triangle?



How can you check your answer?

$$\begin{aligned} 8y &= 180 \\ y &= 22.5 \end{aligned}$$

Smallest angle = 45°
Check by working them all out and see if they add to 180°

Two-step Equations

Reasoning and Problem Solving

The length of a rectangle is $2x + 3$
The width of the same rectangle is $x - 2$
The perimeter is 17 cm.

Find the area of the rectangle.

$$\begin{aligned} 6x + 2 &= 17 \\ 6x &= 15 \\ x &= 2.5 \\ \text{Length} &= 8 \text{ cm} \\ \text{Width} &= 0.5 \text{ cm} \\ \text{Area} &= 4 \text{ cm}^2 \end{aligned}$$

Alex has some algebra expression cards.



$$y + 4$$

$$2y$$

$$3y - 1$$

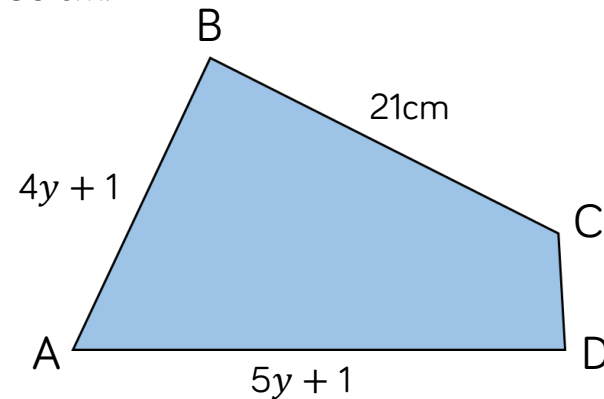
The mean of the cards is 19
Work out the value of each card.

$$\begin{aligned} 6y + 3 &= 57 \\ 6y &= 54 \\ y &= 9 \end{aligned}$$

$$\begin{aligned} \text{Card values:} \\ 13 \\ 18 \\ 26 \end{aligned}$$

Here is the quadrilateral ABCD.

The perimeter of the quadrilateral is 80 cm.



AB is the same length as BC.

Find the length of CD.

$$\begin{aligned} 4y + 1 &= 21 \\ 4y &= 20 \\ y &= 5 \end{aligned}$$

$$\begin{aligned} AB &= 21 \text{ cm} \\ BC &= 21 \text{ cm} \\ AD &= 26 \text{ cm} \\ CD &= 80 - (21 + 21 + 26) = 12 \text{ cm} \end{aligned}$$

Find Pairs of Values (1)

Reasoning and Problem Solving

a , b and c are integers between 0 and 5

$$\begin{aligned} a + b &= 6 \\ b + c &= 4 \end{aligned}$$

Find the values of a , b and c

How many different possibilities can you find?

Possible answers:

$$\begin{aligned} a &= 4 & b &= 2 \\ c &= 2 \end{aligned}$$

$$\begin{aligned} a &= 3 & b &= 3 \\ c &= 1 \end{aligned}$$

$$\begin{aligned} a &= 2 & b &= 4 \\ c &= 0 \end{aligned}$$

x and y are both positive whole numbers.

$$\frac{x}{y} = 4$$

Dora says,



x will always be a multiple of 4

Jack says,



y will always be a factor of 4

Only one is correct – who is it?
Explain your answer.

Possible answer:

Dora is correct as x will always have to divide into 4 equal parts e.g.
 $32 \div 8 = 4$,
 $16 \div 4 = 4$

Jack is incorrect.
 $40 \div 10 = 4$ and
10 is not a factor of 4

Find Pairs of Values (2)

Reasoning and Problem Solving

$$ab + b = 18$$

Mo says,



a and b must both be odd numbers

Is Mo correct?
Explain your answer.

Possible answer:

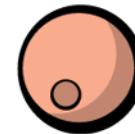
Mo is incorrect. Children may give examples to prove Mo is correct e.g. if $a = 5$ and $b = 3$, but there are also examples to show he is incorrect e.g. $a = 2$ and $b = 6$ where a and b are both even.

Large beads cost 5p and small beads cost 4p

Rosie has 79p to spend on beads.



4p



5p

How many different combinations of small and large beads can Rosie buy?

Can you write expressions that show all the solutions?

Possible answers:

$3l + 16s$
 $7l + 11s$
 $11l + 6s$
 $15l + s$