Maths ideas

- Use flow diagrams to demonstrate:
  - inverse operations
  - associative property
  - multiplication strategies.
- Use multiple operations in flow diagrams.

Key words

- **flow diagram** – a diagram to show how a number changes after a calculation
- **input number** – the number that goes into a calculation
- **output number** – the number that comes out of a calculation
- **rule** – a number calculation that changes an input number to an output number

Flow diagrams

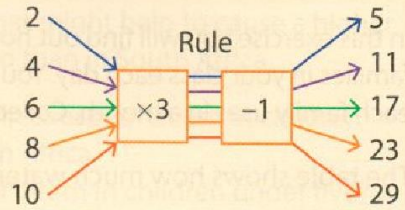
A calculation usually changes a number. You can show a calculation in a **flow diagram**. The number that you start with is called the **input number**, and the answer to the calculation is called the **output number**. The calculation is also called the **rule** for the flow diagram.

A rule can have more than one operation.

Example

Here is a flow diagram, with the input numbers on the left, the rule in two instruction boxes, and the output numbers on the right.

You apply the rule in the correct order to get the output numbers.



$(2 \times 3) - 1 = 6 - 1 = 5$; $(4 \times 3) - 1 = 12 - 1 = 11$; $(6 \times 3) - 1 = 17$; $(8 \times 3) - 1 = 23$; $(10 \times 3) - 1 = 29$

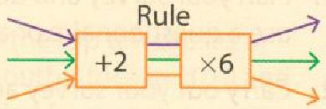
You can describe a rule in different ways.

Example

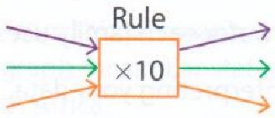
Here is a rule in words: "add 2 and multiply by 6".

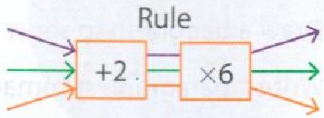
You can also write the rule as a number statement, using brackets to show which operation is done first: $(\square + 2) \times 6$.

You can show the same rule in a flow diagram.

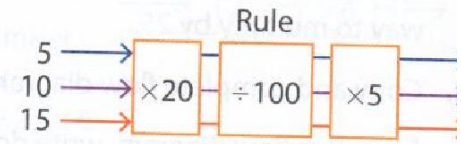


Activity 1

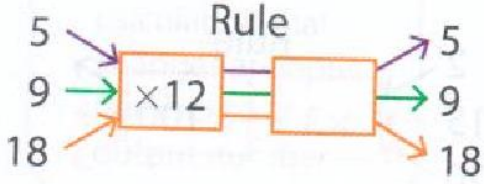
1. Write each rule in two different ways, and then find the output numbers from the input numbers 2, 4 and 10.
   a) multiply by 4
   b) + 30
   c)
   

   d)
   

2. Waheeda says she thinks that the rule "×3 then +2", is the same rule as "+ 2 then × 3". Use a number statement with 10 as the input to see if she is correct.
3. Copy the following flow diagram and then fill in the missing outputs. What do you notice about the input and output numbers? Why does this happen?



4. What is the missing part of the rule in the flow diagram below?



5. Draw a flow diagram to show that × 8 and ÷ 8 are inverse operations. Also write your flow diagram as a number sentence.
6. Use a flow diagram with three rule boxes to show that × 10 is the opposite of doing two divisions. Also write your flow diagram as a number sentence.
7. Use a flow diagram to show that × 4 × 25 is the opposite of divide by 100. Also write your flow diagram as a number sentence.

Reference: Platinum Mathematics Gr6, Learner's book, pp. 54-58

Find missing rules and numbers

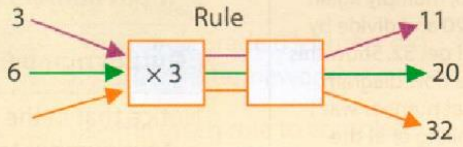
You should be able to work out numbers that are missing in the inputs, the outputs or the rule of a flow diagram.

Example

What is the missing part of the rule? Look at the two inputs and their outputs.

$(3 \times 3) \square = 11$ and $(6 \times 3) \square = 20$

$3 \times 3 = 9$ and $6 \times 3 = 18$, so it is easy to see that the missing part of the rule is +2.



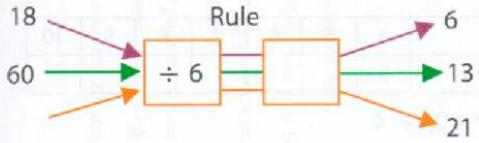
What is the missing input for the output number 32? Write it as a number sentence: $(\square \times 3) + 2 = 32$. Remember that you can use inspection or trial and improvement to work out the missing number.

If $(\square \times 3) + 2 = 32$, then $(\square \times 3)$ must be 30. What multiplied by 3 gives 30? The missing input number must be 10.

Activity 2

First find the missing operation in each rule. Then write the flow diagram as a number sentence, and solve it to find the missing input number.

1.



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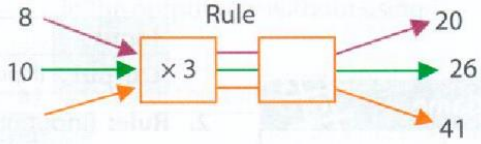
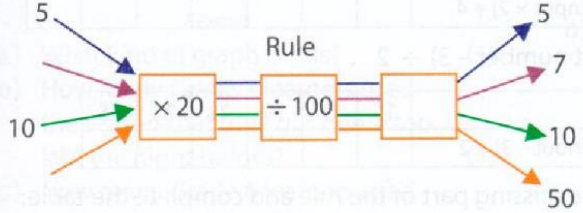


3.



4. Here is a rule in words: "multiply by 100 and subtract □".
   a) Show this rule as a flow diagram.
   b) If the input numbers 3 and 7 have output numbers 290 and 690, find the missing number in the rule.
   c) Which input number will have the output number 990?

Challenge

I am thinking of a number. When I add 3 to my number, multiply the answer by 5, multiply again by 20 and divide by 25, I get 32. Show this on a flow diagram. What number was I thinking of at the beginning? What will the output number be if I start with the number 10? Simplify the flow chart to get the same output numbers with only two operations in the rule.

Game

Work in pairs. Each draw a flow diagram that uses two of these operations in the rule: +5; ×3; –2; ÷2; ×10; –7; +4. Write in five input numbers between 1 and 100, and the five correct output numbers, but don't write in the rule that you used. Swap your flow diagrams and see who can first guess the two operations used in the rule.

You can also show input and output numbers in a table, and work in the same way with rules as you did in the flow diagrams.

Example

This table uses the rule: ×3 and then +2

Input number		2	3	4	5	6
Output number	RULE ×3 +2	8	11	14	17	20

Notice that in the bottom row of the table, you can get from each output number to the next output number by adding 3. The next three output numbers would be 23, 26 and 29.

Activity 3

For questions 1, 2 and 3:

a) Use the given rule to complete the row of output numbers.
b) Look at the row of output numbers. How do you get each output number from the previous output number?
c) Use your answer in (a) to write down the next three numbers in the output row.
d) Use the rule in the table to check your new output numbers.

1. **Rule:** (Input number – 3) × 5

Input		4	5	6	7	8	9	10
Output	(input –3) × 5	5						

2. **Rule:** (Input number × 2) + 4

Input		6	7	8	9	10	11	12
Output	(input × 2) + 4							

3. **Rule:** (Input number – 3) ÷ 2

Input		15	17	19	21	23	25
Output	(input – 3) ÷ 2						

4. Work out the missing part of the rule and complete the table:

Input		5		7	8	9	
Output	(input – 3) ?	4	6	8	10	12	20

5. Work out the missing part of the rule and complete the table:

Input		5		7	8	9	
Output	(input ?) + 1	11	13	15	17	19	29