

# CHAPTER 7

*Functions And Relationships*

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# 1 FUNCTIONS AND RELATIONSHIPS

## NOTE

**Output numbers** are numbers that you obtain when you apply the rule to the input numbers.

Write down the output numbers that will be obtained when the formula  $50 - 5x$  is applied to set B.

• Complete the following table for set A:

Input numbers	1	2	3	4	5	6	7	8	9
Values of $50 - 5x$									

2. Complete the following table for the set B:

Input numbers	20	30	40	50	60	70	80	90	
Values of $50 - 5x$									

• In this question your set of input numbers will be the even numbers 2; 4; 6; 8; 10; ...

1. What will all the output numbers be if the rule  $2n + 1$  is applied to the set of even numbers? Write a list.
2. What will the output numbers be if the rule  $2n - 1$  is applied?
3. What will the output numbers be if the rule  $2n + 5$  is applied?
4. What will the output numbers be if the rule  $3n + 1$  is applied?

1. What kind of output numbers will be obtained by applying the rule  $x - 1000$  to natural numbers smaller than 1 000?
2. What kind of output numbers will be obtained by applying the rule  $\frac{x}{10} + 10$  to natural numbers smaller than 10?
3. If you use the rule  $30x + 2$ , and use input numbers that are positive fractions with denominators 2, 3 and 5, what kind of output numbers will you obtain?

A quantity that changes is called a **variable quantity** or just a **variable**.

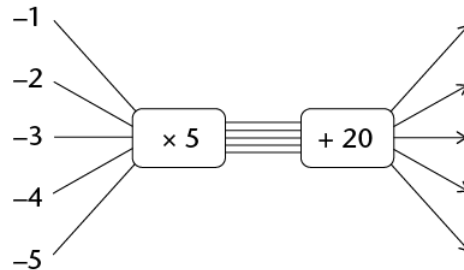
If one variable quantity is influenced by another, we say there is a **relationship** between the two variables. You can sometimes work out which number is linked to a specific value of the other variable.

The output number can also be called the output value, or the value of the expression, which is  $10x + 5$  in this case.

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A relationship between two variables in which there is only one output number for each input number, is called a **function**.

- With a table that shows some values of the two variables. A table shows clearly which value of the output variable corresponds to each particular value of the input variable.
- A flow diagram, which shows what calculations are to be done to calculate the output number that corresponds to a given input variable.
- A formula, which also describes what calculations are to be done to calculate the output number that corresponds to a given input variable.
- A graph.
- Complete the flow diagram:



A completed flow diagram shows two kinds of information:

- It shows what calculations are done to produce the output numbers.
- It shows which output number is connected to which input number.
- Each input number is multiplied by 5, then 20 is added, to produce the output numbers
- Which output numbers correspond to which input numbers.

The output numbers of a function are also called **function values**. Hence the formula can also be written as *function value* =  $5x + 20$ .

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## 2 EXERCISES

### 2.1 Exercise 1

In this activity you will do some calculations with:

- Set A: the natural numbers smaller than 10: i.e. 1, 2, 3, 4, 5, 6, 7, 8 and 9
- Set B: multiples of 10 that are bigger than 10 but smaller than 100: i.e. 20, 30, 40, 50, 60, 70, 80 and 90

1. You are going to choose a number, multiply it by 5, and subtract the answer 50.
  - (a) Choose any number from set A and do the above calculations
  - (b) Choose any number from set n and do the above calculations
2.
  - (a) Write down all the different output numbers that will be obtained when the calculations  $50 - 5x$  are on the different numbers in the set A.
  - (b) Write down the output numbers that will be obtained when the formula  $50 - 5x$  is applied to the set B.
3.
  - (a) Copy and complete the following table for set A :

Input Numbers	1	2	3	4	5	6	7	8	9
Values of $50-5x$									

- (b) Copy and complete the following table for set B :

Input Numbers	20	30	40	50	60	70	80	90
Values of $50-5x$								

4. In this question your set of output numbers will be even numbers: 2; 4; 6; 8; 10; ...
  - (a) What will all the output numbers be if the rule  $2n + 1$  is applied to the set of even numbers? Write a list.
  - (b) What will all the output numbers be if the rule  $2n - 1$  is applied?
  - (c) What will all the output numbers be if the rule  $2n + 5$  is applied?
  - (d) What will all the output numbers be if the rule  $3n + 1$  is applied?
5.
  - (a) What kind of output numbers will be obtained by applying the rule  $x - 1\ 000$  to natural numbers smaller than 1 000?

- (b) What kind of natural numbers will be obtained by applying the rule  $\frac{x}{10} + 10$  to natural numbers smaller than 10?
- (c) If you use the rule  $30x + 2$ , and use the input numbers that are positive fractions with denominators 2, 3, and 5, what kind of output numbers will you obtain?

## 2.2 Exercise 2

1. Copy and complete the following flow diagram

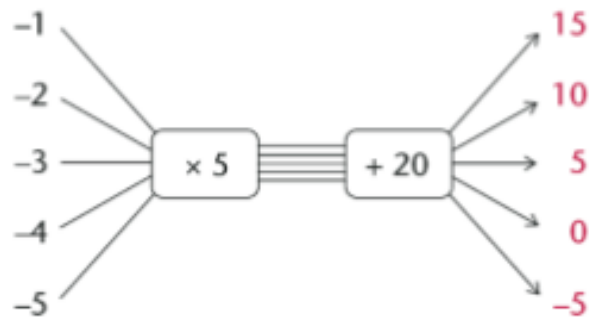


Figure 1:

2. Copy and complete the following table for set A :

Input Values	-1	-2	-3	-4	5
Function Values					

3. Draw a graph of the function  $5x + 20$  where  $-6 \geq x \leq 2$ .
4. A graph of a certain function is shown. Copy and complete the table for this function:

Input numbers					
Function values					

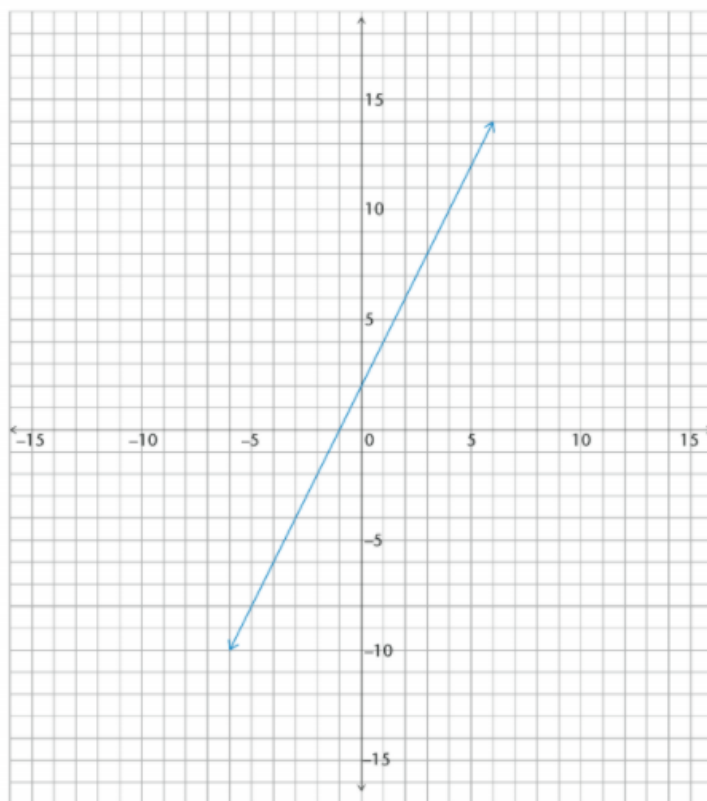


Figure 2:

## 2.3 Exercise 3

1. Represent the function,  $3x + 4$ , with the following:
  - 1.1 A flow diagram.
  - 1.2 A table of values for the set of integers from  $-5$  to  $5$ .
  - 1.3 A graph
2. Represent the function,  $2x - 5$ , with the following:
  - 3.1 A flow diagram.
  - 3.2 A table of values for the set of integers from  $-5$  to  $5$ .
  - 3.3 A graph
3. Represent the function,  $\frac{1}{2}x + 2$ , with the following:
  - 3.1 A flow diagram.
  - 3.2 A table of values for the set of integers from  $-5$  to  $5$ .

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### 3.3 A graph

4. Represent the function,  $-3x + 4$ , with the following:

4.1 A flow diagram.

4.2 A table of values for the set of integers from  $-5$  to  $5$ .

4.3 A graph

5. Represent the function,  $2.5x + 1.5$ , with the following:

5.1 A flow diagram.

5.2 A table of values for the set of integers from  $-5$  to  $5$ .

5.3 A graph

6. Represent the function,  $0.2x + 1.4$ , with the following:

6.1 A flow diagram.

6.2 A table of values for the set of integers from  $-5$  to  $5$ .

6.3 A graph

7. Represent the function,  $-2x - 4$ , with the following:

7.1 A flow diagram.

7.2 A table of values for the set of integers from  $-5$  to  $5$ .

7.3 A graph

## 3 ANSWERS

### 3.1 Exercise 1

1.1 For example, choose the number 4:  $50 - (5 \times 4) = 30$  The answer will never be negative regardless of which number you choose from set A. If we choose the smallest number, 1, the answer is  $50 - (5 \times 1) = 45$  If we choose the biggest number, 9, the answer is  $50 - (5 \times 9) = 5$  Therefore, the answer is  $> 0$ . The answer will always be positive

1.2 For example, choose the number 50:  $50 - (5 \times 50) = -200$  The answer will always be negative regardless of which number you choose from set B. If we choose the smallest number, 20, the answer is  $50 - (5 \times 20) = -50$  If we choose the biggest number, 90, the answer is  $50 - (5 \times 10) = -400$  Therefore, the answer is  $< 0$  The answer will always be negative

2.1 For example, where  $x = 1$ :  $50 - (5 \times 1) = 45$ .

45; 40; 35; 30; 25; 20; 15; 10; 5



2.2  $-50; -100; -150; -200; -250; -300; -350; -400$

3.1

Input numbers	1	2	3	4	5	6	7	8	9
Values of $50 - 5x$	45	40	35	30	25	20	15	10	5

3.2

Input numbers	20	30	40	50	60	70	80	90
Values of $50 - 5x$	$-50$	$-100$	$-150$	$-200$	$-250$	$-300$	$-350$	$-400$

4. 1 For example, if  $n = 2$ :  $2 \times 2 + 1 = 5$ . The set is:  $5; 9; 13; 17; 21; \dots$  Note that the set of input numbers is continued, so we use three dots to show this.

4. 2 For example, if  $x = 2$ :  $2 \times 2 - 1 = 3$  The set is:  $3; 7; 11; 15; 19; \dots$

4. 3 For example, if  $x = 2$ :  $2 \times 2 + 5 = 9$  The set is:  $9; 13; 17; 21; 25; \dots$

4. 4 For example, if  $x = 2$ :  $3 \times 2 + 1 = 7$  The set is:  $7; 13; 19; 25; 31; \dots$

5. The output numbers will all be negative. The largest natural number smaller than 1 000 is 999. Therefore  $999 - 1\ 000 = -1$ . Any number smaller than 999 will also result in a negative output.

6. The biggest natural number smaller than 10 is 9, and the smallest is 1.  $\frac{9}{10} + 10 = 10,9$  and  $\frac{1}{10} + 10 = 10,1$ . Therefore, the output numbers will all be mixed numbers or decimals between 10 and 11, for example,  $10\frac{1}{5}; 10\frac{2}{5}; 10,7$  and so on.

7. They will all be whole numbers (not equal to 0), because the denominators are all factors of 30.

For example, if  $x = \frac{1}{5}$ :  $30 \times \frac{1}{5} + 2 = 8$ .

### 3.2 Exercise 2

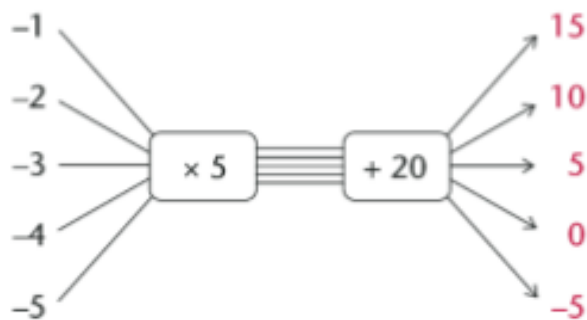


Figure 3:

1.

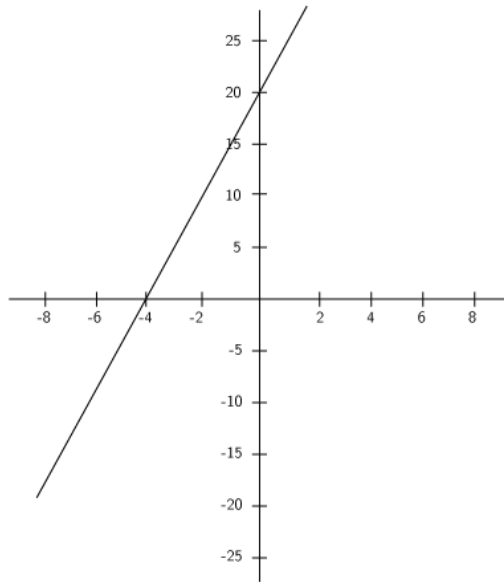


Figure 4:

2.

Input numbers	-1	-2	-3	-4	-5
Function values	15	10	5	0	-5

3.

4.

Input numbers	-5	-2	0	1	2
Function values	-8	-2	2	4	6

### 3.3 Exercise 3

1.1

1.2

$x$	-5	-4	-3	-2	-1	0	1	2	3	4	5
$3x + 4$	-11	-8	-5	-2	1	4	7	10	13	16	19

1.3

2.1

2.2

$x$	-5	-4	-3	-2	-1	0	1	2	3	4	5
$2x - 5$	-15	-13	-11	-9	-7	-5	-3	-1	1	3	5

2.3

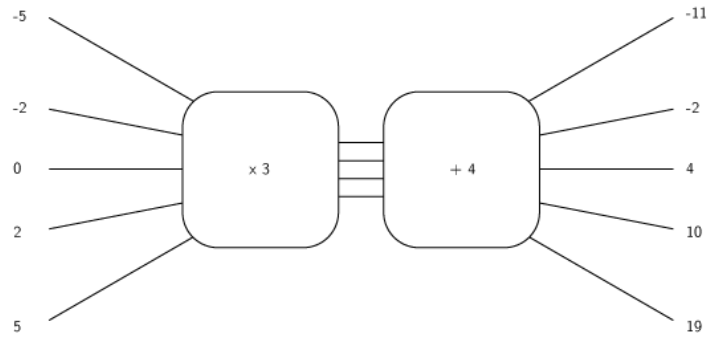


Figure 5:

3.1

3.2

$x$	-5	-4	-3	-2	-1	0	1	2	3	4	5
$\frac{1}{2}x + 2$	$-\frac{1}{2}$	0	$\frac{1}{2}$	1	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3	$3\frac{1}{2}$	4	$4\frac{1}{2}$

3.3

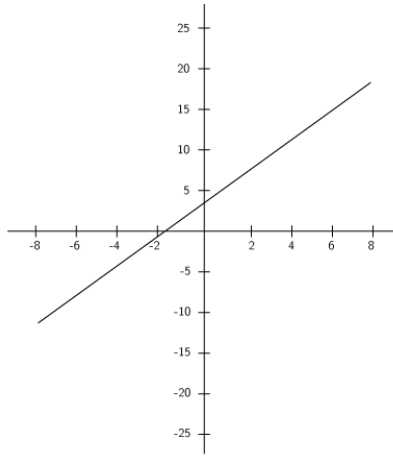


Figure 6:

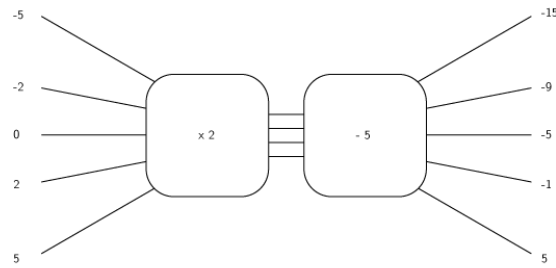


Figure 7:

4.1

4.2

$x$	-5	-4	-3	-2	-1	0	1	2	3	4	5
$-3x + 4$	19	16	13	10	7	4	1	-2	-5	-8	-11

4.3

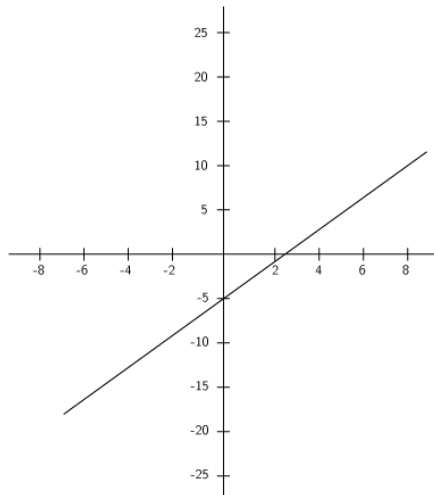


Figure 8:

5.1

5.2

$x$	-5	-4	-3	-2	-1	0	1	2	3	4	5
$2,5x + 1,5$	-11	-8,5	-6	-3,5	-1	1,5	4	6,5	9	11,5	14

5.3

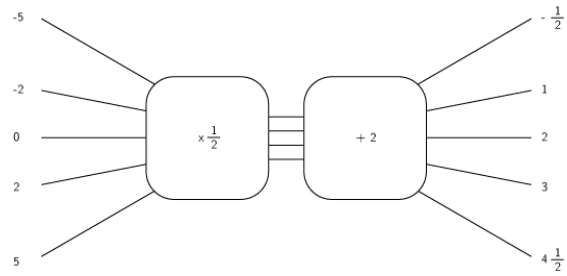


Figure 9:

6.1

6.2

$x$	-5	-4	-3	-2	-1	0	1	2	3	4	5
$0, 2x + 1, 4$	0,4	0,6	0,8	1	1,2	1,4	1,6	1,8	2,0	2,2	2,4

6.3

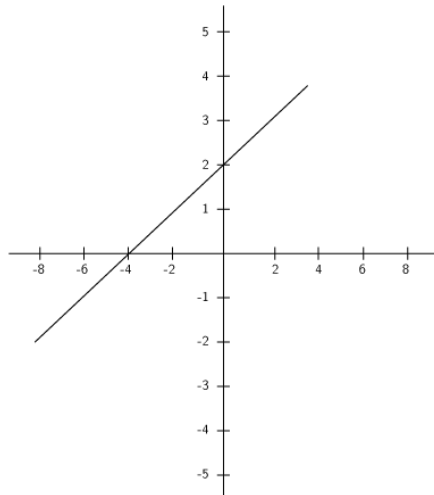


Figure 10:

7.1

7.2

$x$	-5	-4	-3	-2	-1	0	1	2	3	4	5
$-2x - 4$	6	4	2	0	-2	-4	-6	-8	-10	-12	-14

7.3

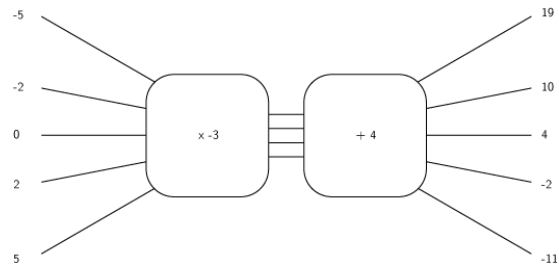


Figure 11:

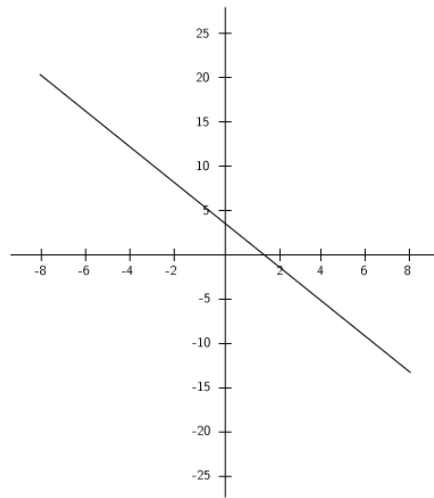


Figure 12:



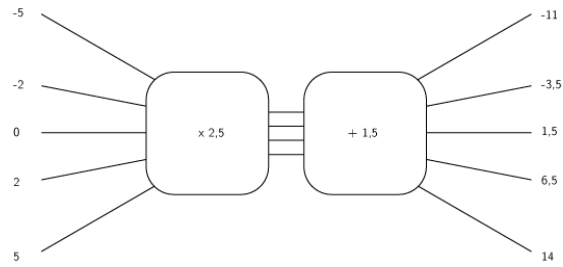


Figure 13:

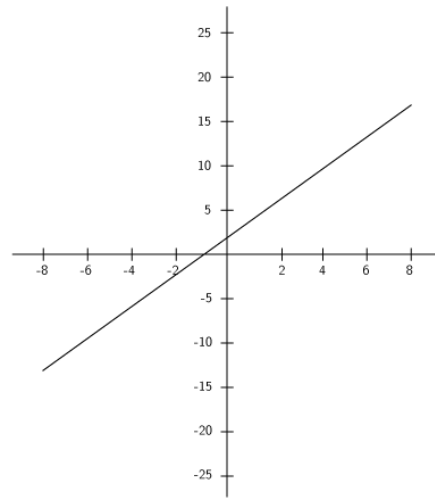


Figure 14:

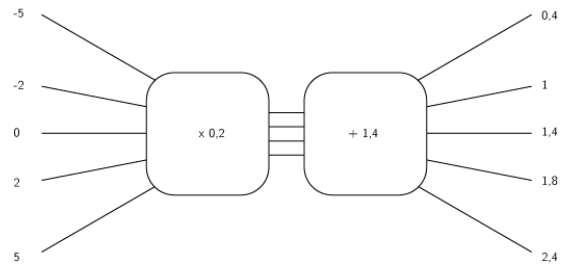


Figure 15:

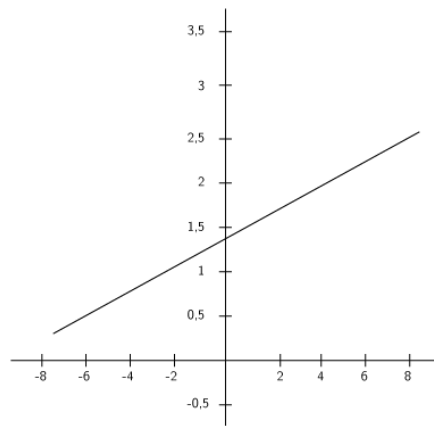


Figure 16:

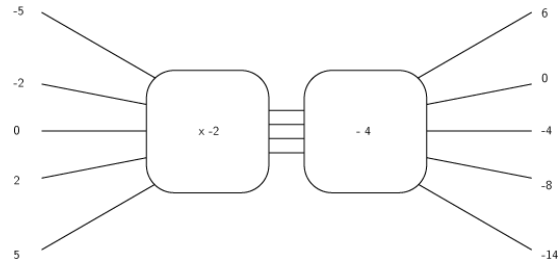


Figure 17:

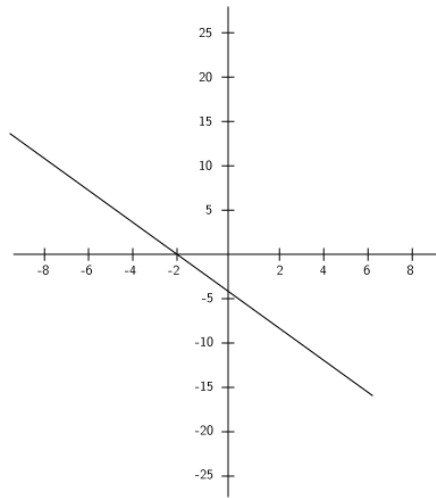


Figure 18: