CHAPTER 13

Algebraic Expressions 1

MathU Teaching® Emporium

CONTENTS

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1 DESCRIBING AND DOING COMPUTATIONS

An **algebraic expression** is a symbolic description of a set of calculations that can be performed on different values of a variable. For example, the expression:

$$3x + 5$$

Means "multiply the value of x by three and add five to the answer".

To find the value of an expression for particular values of the variable or variables, the normal rules of arithmetic apply – i.e. do the calculations in brackets first, then do multiplication and division in the order they appear and lastly, do the additions and subtractions in the order that they appear.

If a relationship is given as a table or in words, it can usually be given in an expression as well, for example, the table that describes a relationship is:

Input	1	2	3	4	5	6
Output	7	11	15	19	23	27

And the words are:

Three more than a number multiplied by 4.

It can be written algebraically as:

$$3 + 4 \times x \qquad \text{or} \qquad 4 \times x + 3$$

An **equation** is a statement about an unknown number (a constant, not a variable). An equation states what result (answer) is obtained if certain calculations are performed on an unknown constant. For example, the equation:

$$2x + 3 = 15$$

States that "when a certain unknown number is multiplied by two and three is added to the result, the answer is fifteen".

To "solve an equation" means to find out what the unknown number is.

Substitution is used to find out when expressions are equal in value. Algebraic expressions that have the same numerical value for the same values of x, but look different, are called equivalent expressions.

EXAMPLE 1

QUESTIONS

The diagrams below represent arrangements of small circles. In every arrangement there are two rows of circles.

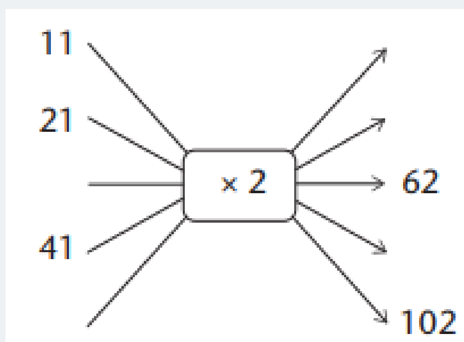
1. The table below relates to the diagrams. Copy and complete it.

Diagram number	1	2	3	4	5
Number of circles per row					
Number of rows					
How to calculate the total number of circles per diagram (**rule**)					

2. What remains the same in the diagrams above?

3. What changes in the diagrams? In other words, what are the variable quantities in the situation?

4. Copy and complete the flow diagram below.



5. How many circles will diagram 11 have if the pattern is extended? Explain.

6. What does the number 2 in the rule $2 \times n$ represent?

7. What does the letter symbol n represent in the rule $2 \times n$?

NOTE

The rule $2 \times n$ can be used to determine the total number of circles in a diagram. The number 2 in the rule $2 \times n$ remains the same all the time. We say it is a **constant**. The letter symbol n represents the number of circles per row and that is a **variable**, because it changes.

EXAMPLE 1 (CONTINUED)

SOLUTIONS

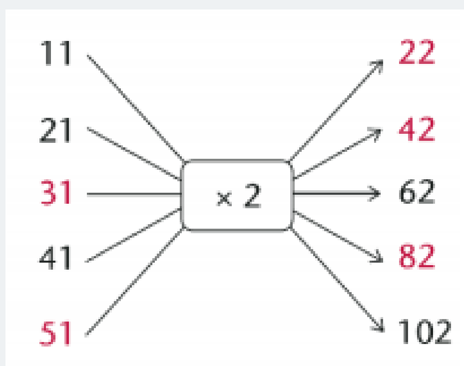
1. The completed table:

Diagram number	1	2	3	4	5
Number of circles per row	1	2	3	4	5
Number of rows	2	2	2	2	2
Rule	2×1	2×2	2×3	2×4	2×5

2. The number of rows.

3. The number of circles per diagram and the number of circles per row.

4. The completed flow diagram:



5. There will be 22 circles because diagram 11 will have 2 rows of 11 circles per row.

6. It represents the number of rows.

7. The letter symbol n represents the number of circles in a row.

WORKED EXAMPLE 2

QUESTIONS

Consider the sequence:

$$1\ ;\ 3\ ;\ 5\ ;\ 7\ ;\ 9\ ;\ ......$$

The first odd number can be written as: $2 \times 1 - 1$.
The second odd number can be written as: $2 \times 2 - 1$.
The third odd number can be written as: $2 \times 3 - 1$.

1. What is the tenth odd number?
2. What is the thirtieth odd number?
3. What is the hundredth odd number?
4. What is the nth odd number?

NOTE

The numbers 2 and -1 remain the same all the time; we call them **constants**. The numbers multiplied by 2, change according to the position of the odd number in the sequence. We call them **variables**.

SOLUTIONS

1. $2 \times 10 - 1 = 20 - 1 = 19$
2. $2 \times 30 - 1 = 60 - 1 = 59$
3. $2 \times 100 - 1 = 200 - 1 = 199$
4. $2 \times n - 1$

The rule for the odd numbers can be derived from the rule for the even numbers. If 2 is the first even number, generated by $2 \times n$, the first odd number is one less, therefore $2 \times 1 - 1$, and so on.

NOTE

Any letter symbol can be chosen to represent a variable, but that those most often used are x, y, z and n.

WORKED EXAMPLE 3

<u>QUESTIONS</u>

The rule $2 \times n - 1$ can be used to determine any odd number in the sequence:

$$1\,;\ 3\,;\ 5\,;\ 7\,;\ 9\,;\ \ldots\ldots$$

What does the letter symbol n represent in the rule $2 \times n - 1$?

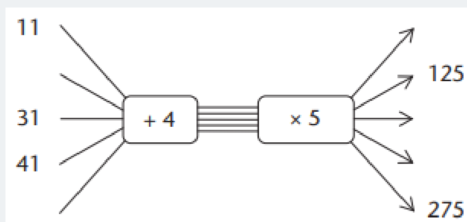
<u>SOLUTIONS</u>

The letter symbol n represents the position of the odd number in the sequence.

WORKED EXAMPLE 4

<u>QUESTIONS</u>

1. Copy and complete the flow diagram.



2. Which of the instructions below did you use to calculate the output values of the flow diagram?

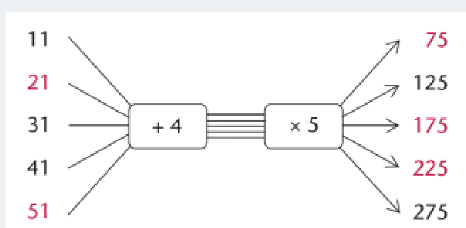
   A. Multiply the input number by 5 and then add 4.

   B. Add 45 to the input number.

   C. Add 4 to the input number and then multiply by 5.

<u>SOLUTIONS</u>

1. The complete flow diagram:



2. C. Add 4 to the input number and then multiply by 5.

We call the numbers on the left in the flow diagram the **input numbers**. The numbers on the right in the flow diagram, and whose values depend on the input numbers, are called the **output numbers**.

When the rule to generate output numbers is written as an expression, for example $5 \times x + 4$, x represents the input and $5 \times x + 4$ represents the output values.

We may write $(x + 4) \times 5$ as an abbreviation for:

Add 4 to the input number, then multiply by 5.

$(x + 4) \times 5$ can be called a computational instruction or an **algebraic expression**.

In the expression $(x + 4) \times 5$, the letter symbol x can be replaced by many different input numbers. The symbol x represents a **variable quantity** or a **variable**. If, however, the expression $(x + 4) \times 5$ is equal to 35, as in the number sentence $(x + 4) \times 5 = 35$, the symbol x represents only one value, and that is 3.

In the expression $(x + 4) \times 5$, the numbers 4 and 5 are **constants**. In the number sentence $(x + 4) \times 5 = 35$, x is an **unknown value**.

2 RELATIONSHIPS REPRESENTED IN FORMULAE

Consider the two formulae:

$$P = 2 \times l + 2 \times b \quad \text{and}$$
$$P = 2 \times (l + b)$$

These formulae are actually mathematically same and give the exact same result. We can test this by trying multiple values:

Formula :	$P = 2 \times l + 2 \times b$	$P = 2 \times (l + b)$
$l = 1\ ,\ b = 2$	$P = 2 \times 1 + 2 \times 2 = 6$	$P = 2 \times (1 + 2) = 6$
$l = 3\ ,\ b = 4$	$P = 2 \times 3 + 2 \times 4 = 14$	$P = 2 \times (3 + 4) = 14$
$l = 5\ ,\ b = 6$	$P = 2 \times 5 + 2 \times 6 = 22$	$P = 2 \times (5 + 6) = 22$
$l = 7\ ,\ b = 8$	$P = 2 \times 7 + 2 \times 8 = 30$	$P = 2 \times (7 + 8) = 30$

You can actually change the formula:

$$P = 2 \times l + 2 \times b \quad \text{to}$$
$$P = 2 \times (l + b)$$

By inserting brackets to manipulate the formulae. To show you how to do this, lets start with the orignal formula:

$$P = 2 \times l + 2 \times b$$

Remember that multiplication is simply adding the same number a certain number of times, in the case $2 \times l$ is essentially adding l to itself so we can rewrite the formula like so:

$$P = l + l + b + b$$

Since we only have addition, we can rewrite it in any order, so we can reorder it as follows:

$$P = l + b + l + b$$

We can then group terms using brackets like so:

$$P = (l + b) + (l + b)$$

We stated before that multiplication is simply repeated addition of a number to itself. From the formula above, we can see repeated addition of the terms in brackets $(l + b)$, so we can instead rewrite it as multiplication:

$$P = 2 \times (l + b)$$

And we can now see that we have written the first formula as the second formula.

3 ALGEBRAIC EXPRESSIONS PART 2

DEFINITION: Algebraic Expression

Algebraic expressions are instructions to calculate values in an expression.

DEFINITION: Independent Variable

The **independent variable**, is the input. The expression tells you what calculations should be performed on the input variable to produce an answer, called the output variable. In this way, the expression forms the rule for a relationship.

The **constants** in the expression can be negative numbers and the input values can also be integers.
An understanding of the **additive inverse** of numbers is important when we work with integers in expressions.

Rules can be simplified to make the number of calculations less or easier, for example a rule like:

- $3x + 7 + 2x - 3$ can be written as $5x + 4$
- $3(x + 2)$ can be written as $3x + 6$
- $22–(–3x)$ can be written as $22 + 3x$, and so on.

4 INTERPRET RULES TO CALCULATE VALUES OF A VARIABLE

4.1 Rules in symbolic and Verbal Form

When working through problems remember to be aware of expressions that give the same values, for example:

- $7x + 35$ is the same as saying $7(x + 5)$
- $15x + 30$ is the same as saying $30 + 15x$
- $5(x + 4)$ is the same as saying $5x + 20$

Be careful not to remove brackets from expressions incorrectly !
$3(x + 5)$ and $3x + 5$ are not the same thing and will not give the same values (and are therefore not equal).

TIP

If there are no brackets in an expression, multiplication is done first, even if it appears later in the expression like in $30 + 5x$. If there are brackets in an algebraic expression, the operations in brackets are to be done first. (BODMAS)

NOTE

By describing rules in words, you can become aware of which expressions are equivalent, which means they give the same output values for the same input values. This will teach you about removing brackets correctly, inserting brackets, when to do multiplication first and how to do operations when brackets are involved.

5 SLIGHTLY DIFFERENT KINDS OF RULES

5.1 Subtract Positive and Negative Quantities

You should notice that expressions like $–100 + 5x$ and $5x–100$ give the same values, the only difference is the order of the terms in the expression. Having said that you should keep in mind that the order of terms when adding can be changed but when negative terms are involved extra care should be taken.

For example, with $5 + 7x = 7x + 5$ you can exchange the terms, but if you have $5 - 7x$ you should think of it as $5 + (-7x)$, so if you want to change the positions, you have to write $(-7x) + 5$ and you can leave out the bracket and write $-7x + 5$.

NOTE

The additive inverse of a number may be indicated by writing a negative sign before the number.
For example, the additive inverse of 8 can be written as -8.
When a number is added to the number called its additive inverse, the answer is 0.
For example, $45 + (-45) = 0$ and $(-12) + 12 = 0$

5.2 Expressions with Additive Inverses

Remember adding the additive inverse of a number is the same as subtracting the number.
For example: $21 + (–21) = 21–21$.
May close attention to the negative signs in expressions and for example, $100–(–10x)$ is reduced to $100 + 10x$ it is **not** $100–10x$.

6 EXERCISES

6.1 Exercise 1

1. Write the abbreviations for the following computational instructions by using x for "the input number":

   1.1 Halve the input number and plus 2.

   1.2 Multiply the input number by 6 and subtract 2.

   1.3 Multiply the sum of the input number and 3 by 10.

   1.4 Subtract 4 from the input number and multiply the answer by 7.

2. Cardo's teacher writes on the board: "Add 2 and then multiply the answer by 3." The class must use 5 as an input number and apply the computational instruction.

   2.1 Cardo uses 5 as the input number and writes: $(5+2)\times 3$.
   Paul says $(5+2)\times 3$ is 7×3 which is 21. Is Paul right?

   2.2 Explain your answer in 2.1.

   2.3 Represent this flow diagram as an algebraic expression:

   $$x \; - \boxed{+2} - \boxed{\times 3} \longrightarrow$$

3. Express each computational instruction as a flow diagram and then write the abbreviation (algebraic expression) with x as input number:

   3.1 Multiply by 4 and then subtract 8.

   3.2 Subtract 8 and then multiply by 4.

   3.3 Add 15 and then divide by 5.

   3.4 Divide by 5 and then add 15.

4. Describe each computational instruction in words:

   4.1 $-\boxed{\times 4} - \boxed{+7} \longrightarrow$

   4.2 $-\boxed{+7} - \boxed{\times 4} \longrightarrow$

   4.3 $-\boxed{\times 9} - \boxed{-5} \longrightarrow$

   4.4 $-\boxed{-5} - \boxed{\times 9} \longrightarrow$

5. Two algebraic expressions are given in the table. Copy the table and use the given input values (x values) to determine the corresponding output values.

x	1	2	3	4	5	6
$6\times x+8$	14	20	26			
$2\times x\times(3+4)$						

6.2 Exercise 2

1. Chris uses the formula $P = 2 \times l + 2 \times b$ to calculate the perimeters of rectangles of differing lengths and breadths as shown in the table. He also calculates the area of each rectangle using $A = l \times b$.

   1.1 Copy and complete the table.

Rectangle	**1**	**2**	**3**	**4**
Length (l)	24	6	8	12
Breadth (b)	1	4	3	2
Perimeter: $P = 2 \times l + 2 \times b$				
Area: $A = l \times b$				

   1.2 Rita calculates the perimeter of a rectangle in a different way. She adds the value of the length of the rectangle to the value of the breadth of the rectangle and then multiplies the answer by 2. Write down the formula that Rita uses to calculate the perimeter of each rectangle.

   1.3 Refer to the formula $P = 2 \times (l + b)$
   What does the number 2 represent in the formula?

   1.4 Refer to the formula $P = 2 \times (l + b)$
   What is the number 2 called?

   1.5 Refer to the formula $P = 2 \times (l + b)$
   Which letter symbols represent variables in the formula? Explain.

   1.6 What can you say about the area of all of these rectangles?

2. Sindi calculates her father's age by using the formula $F = x + 37$, where x is Sindi's age. Her father passed away when Sindi was 43 years old. How old was he then?

3. Jacob wants to buy the cheapest cell phone in the market. He has already saved R45 and decides to save R5 per week until he has enough money to buy the phone. The formula $y = 45 + 5 \times w$ gives the amount of money (in rands) that Jacob has saved to buy the cell phone after w weeks.

   3.1 Copy and complete the table. The first row has been done as an example.

Number of weeks (w)	**How to calculate:** $45 + 5 \times w$	**Amount saved** (y)
0	$45 + 5 \times 0 = 45 + 0$	45
1		
2		
4		
5		

   3.2 The cell phone that Jacob wants to buy costs R90. Will Jacob have saved enough money to be able to buy the cell phone by the eighth week? Explain.

4. Copy the table. In each of the formulae in the table, identify the symbols that represent variables and constants and fill them in.

	Symbols for variable(s)	**Constant(s)**
$y = 5 \times x + 7$		
$y = 100 + x$		
$y = x \div 5$		
$y = 5 \times x$		
$y = 0,7 \times x + 2,3$		

6.3 Exercise 3

1. Multiply the input number by 20 and add 50 to the answer. Do this to each of the numbers in the top row of the table, and write your answers in the bottom row.

x	1	2	3	4	5	6	7	8	9
y									

2. Describe each of the following rules in words.

    2.1 $15x + 3$

    2.2 $30 + 15x$

    2.3 $15(x + 30)$

    2.4 $15(x + 2)$

    2.5 $15x - 30$

    2.6 $15(x - 30)$

    2.7 $15(x - 2)$

3. What is the difference between $3(x + 5)$ and $3x + 5$?

4. Complete the table below.

x	1	2	3	4	5	6	7	8	9
$15x + 30$									
$30 + 15x$									
$15(x + 30)$									
$15(x + 2)$									

5. Complete the table below.

x	30	40	50	60	70	80	90
$15x-30$							
$15(x-30)$							
$15(x-2)$							

6. - A: Multiply the input number by 10 and then add 20 .
   - B: Add 20 to the input number and then multiply by 10 .
   - C: Add 2 to the input number and then multiply by 10 .
   - D: Multiply the input number by 3 , add 15, add 7 times the input number, and then add 5.

6.1 Complete the table below, which rules produced the same output?

x	1	2	3	4	5	6	7	8
A								
B								
C								
D								

6.2 Describe each rule as an algebraic expression.

7. Given rules A to F answer the questions that follow.
   - A: $5x+20$
   - B: $4x+19$
   - C: $5(x+20)$
   - D: $20+5x$
   - E: $5(x+4)$
   - F: $3x+7+2x+13$

7.1 Which of these rules do you think will produce the same output numbers?

7.2 Express each of the above rules in words.

7.3 Complete this table for the rules given. Use your completed table to check your answers in Question 7.1.

x	0	5	10	15
$5x+20$				
$4x+19$				
$5(x+20)$				
$20+5x$				
$5(x+4)$				
$3x+7+2x+13$				

8. Given rules A to F answer the questions that follow.

   - A: $5x - 20$
   - B: $20 - 5x$
   - C: $5(x - 20)$
   - D: $3x - 18$
   - E: $5(x - 4)$
   - F: $9x + 10 - 4x - 30$

   8.1 Which of these rules do you think will produce the same output numbers?

   8.2 Express each of the above rules in words.

   8.3 Complete this table for the rules given. Use your completed table to check your answers in Question 8.1.

x	20	30	40	50	60	70	80	90
$5x - 20$		0						
$20 - 5x$								
$5(x - 20)$								
$3x - 18$								
$5(x - 4)$								
$9x + 10 - 4x - 30$								

6.4 Exercise 4

1. Complete the table.

x	1	10	5	20	25
$10x$					
$50 - 10x$					
$20 - 10x$					
$0 - 10x$					

2. 2.1 Complete the table

x	0	5	10	15	20	25	30
$10x - 5$							
$5x - 10$							
$100 - 5x$							
$-100 + 5x$							
$5x - 100$							
$5 - 10x$							

2.2 The values of $10x - 5$ increase as the values of x increase from 0 to 30 . For which expressions in 2.1 do the values decrease when x is increased?

2.3 Do the values of $-100 + 5x$ increase or decrease when x is increased from 0 to 30 ?

3. The values of the expression $5x - 10$ increase when x is increased from 0 to 30 . Do you think the values will increase further when x is increased beyond 30, or will they start to decrease at some stage?

4. Do you think the values of the expression $100 - 3x$ will increase when x is increased from 0 to 30 ? Explain why you think they will or will not.

5. Write the additive inverse of each of the following numbers:

5.1 20

5.2 30

5.3 -25

5.4 -20

5.5 40

6. Different values for x are given in the first row of the table below. Complete the table.

x	5	10	15	20	25	30
the additive inverse of x						
$20 +$ (the additive inverse of x)						
$20-$ (the additive inverse of x)						
$20 + x$						
$20 - x$						

7. Complete the table.

x	-5	-10	-15	-20	-25	-30
the additive inverse of x						
$20 +$ (the additive inverse of x)						
$20-$ (the additive inverse of x)						
$20 + x$						
$20 - x$						

8. Complete the table.

x	1	5	10	20	25
$5x$					
the additive inverse of $5x$					
$20+$ (the additive inverse of $5x$)					
$20-$ (the additive inverse of $5x$)					
$3x$					
$-3x$					
$10+(-3x)$					
$10-3x$					
$10-(-3x)$					

9. Complete the table.

x	1	2	3	4	-4	-3	-2
$10x-1000$							
$1000-(-10x)$							
$1000-10x$							
$(-10x)+1000$							
$10x+1000$							
$10x+(-1000)$							
$(-10x)-1000$							
$1000+(-10x)$							
$1000+10x$							
$10x-(+1000)$							

10. Complete the table.

x	1	5	10	20	25	30
$-5x+20$						
$-5x+(-20)$						

7 ANSWERS TO EXERCISES

7.1 Exercise 1

1.1 $\frac{1}{2} \times x + 2$

1.2 $x \times 6 - 2$ or $6 \times x - 2$

1.3 $(x + 3) \times 10$

1.4 $(x - 4) \times 7$

2.1 Yes, Paul is correct.

2.2 Cardo's expression means you first add 5 and 2 to get 7 and then multiply the answer by 3. By convention, the operation in brackets is done before any other operation.

2.3 $(x + 2) \times 3$

3.1 $x - \boxed{\times 4} - \boxed{-8} \longrightarrow \quad x \times 4 - 8$

3.2 $x - \boxed{-8} - \boxed{\times 4} \longrightarrow \quad (x - 8) \times 4$ or $4 \times (x - 8)$

3.3 $x - \boxed{+15} - \boxed{\div 5} \longrightarrow \quad (x + 15) \div 5$ or $\frac{(x+15)}{5}$

3.4 $x - \boxed{\div 5} - \boxed{+15} \longrightarrow \quad (x \div 5) + 15$ or $\frac{x}{5} + 15$

4.1 Multiply by 4 and then add 7.

4.2 Add 7 and then multiply the answer by 4.

4.3 Multiply by 9 and then subtract 5.

4.4 Subtract 5 and then multiply the answer by 9.

5. The complete table:

x	1	2	3	4	5	6
$6 \times x + 8$	14	20	26	32	38	44
$2 \times x \times (3 + 4)$	14	28	42	56	70	84

7.2 Exercise 2

1.1 The completed table:

Rectangle	**1**	**2**	**3**	**4**
Length (l)	24	6	8	12
Breadth (b)	1	4	3	2
Perimeter: $P = 2 \times l + 2 \times b$	50	20	22	28
Area: $A = l \times b$	24	24	24	24

1.2 $P = 2 \times (l + b)$

1.3 There are two lengths (longer sides) and two breadths (shorter sides) in every rectangle.

1.4 It is called a constant.

1.5 The letter symbols P, l and b. All (perimeter, length and breadth) have changing values.

1.6 The area of all of the rectangles is 24, so the area stays constant.

2. 80 years old

3.1 The complete table:

Number of weeks (w)	**How to calculate:** $45 + 5 \times w$	**Amount saved** (y)
0	$45 + 5 \times 0 = 45 + 0$	45
1	$45 + 5 \times 1 = 45 + 5$	50
2	$45 + 5 \times 2 = 45 + 10$	55
4	$45 + 5 \times 4 = 45 + 20$	65
5	$45 + 5 \times 5 = 45 + 25$	70

3.2 No, because by the eighth week he will have saved only
$45 + 5 \times 8 = 45 + 40 =$ R85

4. The complete table:

	Symbols for variable(s)	Constant(s)
$y = 5 \times x + 7$	y and x	5 and 7
$y = 100 + x$	y and x	100
$y = x \div 5$	y and x	5
$y = 5 \times x$	y and x	5
$y = 0,7 \times x + 2,3$	y and x	$0,7$ and $2,3$

7.3 Exercise 3

1.

x	1	2	3	4	5	6	7	8	9
y	70	90	110	130	150	170	190	210	230

2.1 Multiply the number by 15 and then add 30 to the answer.

2.2 Multiply the number by 15 and then add 30 to the answer.

2.3 Add 30 to the number and multiply the answer by 15 .

2.4 Add 2 to the number and multiply the answer by 15 .

2.5 Multiply the number by 15 and subtract 30 from the answer.

2.6 Subtract 30 from the number and multiply the answer by 15 .

2.7 Subtract 2 from the number and multiply the answer by 15 .

3. $3(x + 5)$ means you first add 5 to the number and then multiply the answer by 3, while $3x + 5$ means you first multiply the number by 3 and then add 5 to the answer.

4. .

x	1	2	3	4	5	6	7	8	9
$15x + 30$	45	60	75	90	105	120	135	150	165
$30 + 15x$	45	60	75	90	105	120	135	150	165
$15(x + 30)$	465	480	495	510	525	540	555	570	585
$15(x + 2)$	45	60	75	90	105	120	135	150	165

5. .

x	30	40	50	60	70	80	90
$15x - 30$	420	570	720	870	1020	1170	1320
$15(x - 30)$	0	150	300	450	600	750	900
$15(x - 2)$	420	570	720	870	1020	1170	1320

6.1 A, C and D will produce the same output numbers

6.2
- A: $10x + 20$
- B:$(x + 200)10$ or $10(x + 20)$
- C:$(x + 2)10$ or $10(x + 2)$
- D: $3x + 15 + 7x + 5$

7.1 A, D, E and F

7.2
- A: Multiply the number by 5 and then add 20.
- B: Multiply the number by 4 and then add 19.
- C: Add 20 to the number and then multiply the answer by 5.
- D: Multiply the number by 5 and then add 20.
- E: Add 4 to the number and then multiply the answer by 5.
- F: Multiply the number by 3, add 7, add twice the number and then add 13.

7.3 .

x	0	5	10	15
$5x + 20$	20	45	70	95
$4x + 19$	19	39	59	79
$5(x + 20)$	100	125	150	175
$20 + 5x$	20	45	70	95
$5(x + 4)$	20	45	70	95
$3x + 7 + 2x + 13$	20	45	70	95

8.1 A, E and F.

8.2
- A: Multiply the number by 5 and subtract 20 from the answer.
- B: Multiply the number by 5 and subtract the answer from 20.
- C: Subtract 20 from the number and multiply the answer by 5.
- D: Multiply the number by 3 and subtract 18 from the answer.
- E: Subtract 4 from the number and multiply the answer by 5.
- F: Multiply the number by 9, add 10, then subtract 4 times the number and then subtract 30.

8.3 .

x	20	30	40	50	60	70	80	90
$5x - 20$	80	130	180	230	280	330	380	430
$20 - 5x$	-80	-130	-180	-230	-280	-330	-380	-430
$5(x - 20)$	0	50	100	150	200	250	300	350
$3x - 18$	42	72	102	132	162	192	222	252
$5(x - 4)$	80	130	180	230	280	330	380	430
$9x + 10 - 4x - 30$	80	130	180	230	280	330	380	430

7.4 Exercise 4

1.

x	1	10	5	20	25
$10x$	10	100	50	200	250
$50-10x$	40	-50	0	-150	-200
$20-10x$	10	-80	-30	-180	-230
$0-10x$	-10	-100	-50	-200	-250

2.1 .

x	0	5	10	15	20	25	30
$10x-5$	-5	45	95	145	195	245	295
$5x-10$	-10	15	40	65	90	115	140
$100-5x$	100	75	50	25	0	-25	-50
$-100+5x$	-100	-75	-50	-25	0	25	50
$5x-100$	-100	-75	-50	-25	0	25	50
$5-10x$	5	-45	-95	-145	-195	-245	-295

2.2 $100–5x$ and $5–10x$

2.3 The values increase.

3.1 They will keep on increasing

3.2 $100–3x$ decreases as x increases, because the bigger x is, the more is subtracted from 100.

4. $–20, –30, 25, 20, –40$

5. .

x	5	10	15	20	25	30
the additive inverse of x	-5	-10	-15	-20	-25	-30
$20+$ (the additive inverse of x)	15	10	5	0	-5	-10
$20-$ (the additive inverse of x)	25	30	35	40	45	50
$20+x$	25	30	35	40	45	50
$20-x$	15	10	5	0	-5	-10

6. .

x	-5	-10	-15	-20	-25	-30
the additive inverse of x	5	10	15	20	25	30
$20+($ the additive inverse of $x)$	25	30	35	40	45	50
$20-$ (the additive inverse of x)	15	10	5	0	-5	-10
$20+x$	15	10	5	0	-5	-10
$20-x$	25	30	35	40	45	50

7. .

x	3	2	1	0	-1	-2	-3
$-x$	-3	-2	-1	0	1	2	3
$5+(-x)$	2	3	4	5	6	7	8
$5-(-x)$	8	7	6	5	4	3	2
$5-x$	2	3	4	5	6	7	8
$5+x$	8	7	6	5	4	3	2

8. .

x	1	5	10	20	25
$5x$	5	25	50	100	125
the additive inverse of $5x$	-5	-25	-50	-100	-125
$20+($ the additive inverse of $5x)$	15	-5	-30	-80	-105
$20-$ (the additive inverse of $5x$)	25	45	70	120	145
$3x$	3	15	30	60	75
$-3x$	-3	-15	-30	-60	-75
$10+(-3x)$	7	-5	-20	-50	-65
$10-3x$	7	-5	-20	-50	-65
$10-(-3x)$	13	25	40	70	85

9. .

x	1	2	3	4	-4	-3	-2
$10x-1000$	-990	-980	-970	-960	-1040	-1030	-1020
$1000-(-10x)$	1010	1020	1030	1040	960	970	980
$1000-10x$	990	980	970	960	1040	1030	1020
$(-10x)+1000$	990	980	970	960	1040	1030	1020
$10x+1000$	1010	1020	1030	1040	960	970	980
$10x+(-1000)$	-990	-980	-970	-960	-1040	-1030	-1020
$(-10x)-1000$	-1010	-1020	-1030	-1040	-960	-970	-980
$1000+(-10x)$	990	980	970	960	1040	1030	1020
$1000+10x$	1010	1020	1030	1040	960	970	980
$10x-(+1000)$	-990	-980	-970	-960	-1040	-1030	-1020

10. .

x	1	5	10	20	25	30
$-5x+20$	15	-5	-30	-80	-105	-130
$-5x+(-20)$	-25	-45	-70	-120	-145	-170