Introduction

This topic will cover how to:

- use the rules of precedence (BIMDAS) to solve problems involving multiple operations and positive numbers;
- add, subtract, multiply and divide expressions with negative numbers; and
- use the rules of precedence (BIMDAS) to solve problems involving multiple operations and negative numbers.

Welcome to Numeracy Basics.

This topic will cover how to:

- use the rules of precedence to solve problems involving multiple operations and positive numbers;
- add, subtract, multiply and divide expressions with negative numbers; and
- use the rules of precedence to solve problems involving multiple operations and negative numbers.

Problems Involving Multiple Operations

Suppose you are asked to solve the following problem:

\[ 4 + 3(6 - 5) - (-3 + 50 ÷ 5) \times -2 \]

This problem requires you to have an understanding of the following ideas, facts and rules about numbers:

- what order to do each part of the problem; and
- what to do about negative numbers.

The following topic will explain these concepts, and by the time you complete it you should be able to solve such problems with ease!
Consider this problem:

Four plus three multiplied by (in brackets) six subtract five, subtract (in brackets) negative three plus fifty divided by five, multiplied by negative two.

You need to think about:

• what order to do each part of the problem, and
• what to do about negative numbers.

The following will explain these concepts.

Order of Mathematical Operations

When a problem involves many different operations like the one specified, we need to know what order to do them in.

Consider the following example:

\[ 9 + 3 \times 6 - 4 \div 2 \]

Depending on what order you add, multiply, subtract and divide, some of the possible solutions to this problem could be:

\[ 9 + 3 \times 6 - 4 \div 2 = 34? \]
\[ 9 + 3 \times 6 - 4 \div 2 = 11.5? \]
\[ 9 + 3 \times 6 - 4 \div 2 = 12? \]
\[ 9 + 3 \times 6 - 4 \div 2 = 25? \]
\[ 9 + 3 \times 6 - 4 \div 2 = 70? \]

Clearly, we need a rule telling us which of these is the right answer.

Consider this example:

**Nine plus three multiplied by six subtract four divided by two**

The solution of 34 is obtained when we do the addition first, then the multiplication, subtraction and finally the division.

The solution of 11.5 is obtained when we do the multiplication first, then the addition, subtraction and finally the division.

The solution of 12 is obtained when we do the subtraction first, then the addition, multiplication and finally the division.

The solution of 25 is obtained when we do the multiplication first, then the division, addition and finally the subtraction.

The solution of 70 is obtained when we do the division first, then the addition, multiplication and finally the subtraction.

We clearly need a rule telling us which of these solutions is the right answer.
Order of Mathematical Operations: BIMDAS

The rule we use for this is known by the acronym BIMDAS.

This stands for:

**B** – Brackets. So evaluate whatever is in brackets first.

**I** – Indices. Next we work out any indices (not discussed here).

**MD** – Multiplication and Division. Next we work out any multiplication or division. Note that these operations are considered equal, so we work from left to right and do whichever comes first.

**AS** – Addition and Subtraction. Finally, we work out any addition and subtraction. Note again that these operations are considered equal, so we work from left to right and do whichever comes first.

Hence we work out our problem as follows:

\[ 9 + 3 \times 6 - 4 \div 2 = 9 + 18 - 2 \]

(Evaluate \(3 \times 6\))

\[ = 9 + 18 - 2 \]

(Evaluate \(4 \div 2\))

\[ = 27 - 2 \]

(Evaluate \(9 + 18\))

\[ = 25 \]

(Evaluate \(27 - 2\))

The rule we use for following the order of mathematical operations is known by the acronym BIMDAS. **B** stands for brackets, **I** stands for Indices, **MD** stands for Multiplication and Division. **AS** stands for Addition and Subtraction.

Brackets are calculated first. If there are multiple operations inside the brackets, we also evaluate them according to BIMDAS.

Indices (otherwise known as exponents) are calculated next. Indices are covered in another topic.

We then calculate multiplications and division, and lastly, we calculate addition and subtraction.

We can use BIMDAS to evaluate the expression from our previous example.

We evaluate the multiplication first as this comes before the division in the expression. Since three multiplied by six is equal to eighteen, our expression becomes: **nine plus eighteen subtract four divided by two**, after this first step of working.

We evaluate the division next, and since four divided by two is equal to two our expression becomes: **nine plus eighteen subtract two**, after this second step of working.

Now that we have evaluated all the multiplication and division, we can move onto addition and subtraction. We evaluate the addition first as this comes before the subtraction in the expression, and since nine plus eighteen is equal to twenty seven our expression becomes: **twenty seven subtract two**, after this step of working.

Finally, we evaluate the subtraction, to give a result of **twenty five**.
Examples: BIMDAS

1. \[ 3 + 4 \times 2 - 7 = 3 + 8 - 7 \]
   \[ = 11 - 7 \]
   \[ = 4 \]

2. \[ (25 + 3 \times 5) \div 8 = (25 + 15) \div 8 \]
   \[ = 40 \div 8 \]
   \[ = 5 \]

3. \[ 40 - 12 \times (7 - 5) \div 8 = 40 - 12 \times 2 \div 8 \]
   \[ = 40 - 24 \div 8 \]
   \[ = 40 - 3 \]
   \[ = 37 \]

Let’s work through some more examples using BIMDAS.

Example one requires us to solve: **three plus four multiplied by two subtract seven**.

To do this we evaluate four multiplied by two first, which leaves us with: **three plus eight subtract seven**.

We evaluate three plus eight next, which leaves us with: **eleven subtract seven**.

And finally we evaluate eleven subtract seven to give our solution of: **four**.

Example two requires us to solve: **(in brackets) twenty five plus three multiplied by five, divided by eight**.

To do this we focus on the multiplication inside the brackets first and evaluate three multiplied by five, which leaves us with: **(in brackets) twenty five plus fifteen, divided by eight**.

Next we evaluate the addition of twenty five and fifteen inside the brackets, which leaves us with: **forty divided by eight**.

And finally we evaluate forty divided by eight to give our solution of: **five**.

Example three requires us to solve: **forty subtract twelve multiplied by (in brackets) seven subtract five, divided by eight**.

To do this we focus on the operation inside the brackets first and evaluate seven subtract five, which leaves us with: **forty subtract twelve multiplied by two divided by eight**.

Next we evaluate twelve multiplied by two which leaves us with: **forty subtract twenty four divided by eight**.

Next we evaluate twenty four divided by eight which leaves us with: **forty subtract three**.

And finally we evaluate forty subtract three to give our solution of: **thirty seven**.
Activity 1: Practice Questions

Click on the Activity 1 link in the right-hand part of this screen.

Now have a go at using BIMDAS on your own by working through some practice questions.

Working with Negative Numbers

Adding a negative number is the same as subtracting a positive number. For example:

$$4 + (-5) = 4 - 5 = -1$$

Subtracting a negative number is the same as adding a positive number. For example:

$$4 - (-5) = 4 + 5 = 9$$

If you multiply or divide two numbers with the same sign, the answer is positive. For example:

$$5(3) = 5 \times 3 = 15$$
$$-5(-3) = -5 \times -3 = 15$$
$$6/3 = 6 \div 3 = 2$$
$$-6/-3 = -6 \div -3 = 2$$

If you multiply or divide two numbers with different signs, the answer is negative. For example:

$$5(-3) = 5 \times -3 = -15$$
$$-5(3) = -5 \times 3 = -15$$
$$6/-3 = 6 \div -3 = -2$$
$$-6/3 = -6 \div 3 = -2$$
Recall that a negative number is just a number that has a value less than zero.

There are a few rules to remember when we solve problems involving negative numbers, in particular when we add, subtract, multiply and divide with negative numbers.

Adding a negative number is the same as subtracting a positive number. For example:
Four plus negative five is the same as four subtract five, which is equal to negative one.

Subtracting a negative number is the same as adding a positive number. For example:
Four subtract negative five is the same as four plus five, which is equal to nine.

If you multiply or divide two numbers with the same sign, the answer is positive. For example:
Five times three is equal to fifteen (note here and in subsequent problems the use of brackets to indicate multiplication)
Similarly, negative five times negative three is equal to fifteen
Six divided by three is equal to two
Similarly, negative six divided by negative three is equal to two

If you multiply or divide two numbers with different signs, the answer is negative. For example:
Five multiplied by negative three is equal to negative fifteen
Similarly, negative five multiplied by three is equal to negative fifteen
Six divided by negative three is negative two
Similarly, negative six divided by three is equal to negative two

Examples: Working with Negative Numbers

1. Simplify the following expressions involving addition and subtraction of negative numbers:
   
   a. \(4 + (-8) = 4 - 8 = -4\)
   
   b. \(13 - (-9) = 13 + 9 = 22\)
   
   c. \(-3 + (-4) = -3 - 4 = -7\)

2. Simplify the following expressions involving multiplication and division of negative numbers:
   
   a. \(-4(-8) = -4 \times -8 = 32\)
   
   b. \(8(-9) = 8 \times -9 = -72\)
   
   c. \(-12/4 = -12 \div 4 = -3\)
   
   d. \(-8/-2 = -8 \div -2 = 4\)
Let’s work through some more examples involving negative numbers.

Example ‘one a’ requires us to solve four plus negative eight. Recall that adding a negative number is the same as subtracting a positive number, so we can rewrite our expression as four minus eight, which is equal to negative four.

Example ‘one b’ requires us to solve thirteen subtract negative nine. Recall that subtracting a negative number is the same as adding a positive number, so we can rewrite our expression as thirteen plus nine, which is equal to twenty two.

Example ‘one c’ requires us to solve negative three plus negative four. Recall that adding a negative number is the same as subtracting a positive number, so we can rewrite our expression as negative three minus four, which is equal to negative seven.

Example ‘two a’ requires us to solve negative four multiplied by negative eight, and since these two numbers have the same sign this is equal to positive thirty two.

Example ‘two b’ requires us to solve eight multiplied by negative nine, and since these two numbers have different signs this is equal to negative seventy two.

Example ‘two c’ requires us to solve negative twelve divided by four, and since these two numbers have different signs this is equal to negative three.

Example ‘two d’ requires us to solve negative eight divided by negative two, and since these two numbers have the same sign this is equal to positive four.

Activity 2: Practice Questions

Click on the Activity 2 link in the right-hand part of this screen.

Now have a go at working with negative numbers on your own by working through some practice questions.
Examples: BIMDAS and Negative Numbers

1. \[10 - (4 - 5) = 10 - (-1) = 10 + 1 = 11\]
2. \[10 - (4 + 5) = 10 - 9 = 1\]
3. \[10(4 - 5) = 10(-1) = -10\]
4. \[-10(4 - 5) = -10(-1) = 10\]

When evaluating expressions with negative numbers that involve more than one mathematical operation you should follow the usual BIMDAS convention, as well as keeping in mind the rules for negative numbers. Let’s try some of these types of problems now.

Example one requires us to solve ten subtract (in brackets) four subtract five.
To do this we focus on the subtraction inside the brackets first and evaluate four subtract five, which leaves us with ten subtract (in brackets) negative one.

Now since subtracting a negative number is the same as adding a positive number, we can rewrite our expression as ten plus one, which is equal to eleven.

Example two requires us to solve ten subtract (in brackets) four plus five.
To do this we focus on the addition inside the brackets first and evaluate four plus five, which leaves us with ten subtract nine, which is equal to one.

Example three requires us to solve ten multiplied by (in brackets) four subtract five.
To do this we focus on the subtraction inside the brackets first and evaluate four subtract five, which leaves us with ten multiplied by negative one. Since these two numbers have different signs this is equal to negative ten.

Example four requires us to solve negative ten multiplied by (in brackets) four subtract five.
To do this we focus on the subtraction inside the brackets first and evaluate four subtract five, which leaves us with negative ten multiplied by negative one. Since these two numbers have the same sign this is equal to positive ten.

Activity 3: Practice Questions

Click on the Activity 3 link in the right-hand part of this screen.
Now have a go at using BIMDAS with negative numbers by working through some practice questions.

### Solving Problems with Multiple Operations

Now that we have learnt about BIMDAS and negative numbers, we can return to our original problem:

\[ 4 + 3(6 - 5) - (-3 + 50 \div 5) \times -2 \]

You should now be able to solve this problem as follows:

\[
4 + 3(6 - 5) - (-3 + 50 \div 5) \times -2
= 4 + 3(1) - (-3 + 10) \times -2 \\
= 4 + 3(1) - 7 \times -2 \\
= 4 + 3 - 7 \times -2 \\
= 4 + 3 - (-14) \\
= 7 + 14 \\
= 21
\]
Next, evaluate the first lot of multiplication. Since three multiplied by one is three, the expression becomes four plus three subtract seven multiplied by negative two.

Next evaluate the second lot of multiplication. Since seven multiplied by negative two is negative fourteen, the expression becomes four plus three subtract negative fourteen.

Next evaluate the addition. Since four plus three is seven, the expression becomes seven subtract negative fourteen, which is equal to seven plus fourteen.

Finally, adding together seven and fourteen gives twenty one.

End of Topic

Congratulations, you have completed this topic.
You should now have a better understanding of Order of Operations.