Summary

In part 1 we looked at the four basic operators:

- addition
- subtraction
- multiplication
- division

In part 1 we learnt that multiplication and division "come before" addition and subtraction. The proper way to say this is:

> Multiplication and division have precedence over addition and subtraction

In part 2 we are going to explore the same four operations – but these calculations will be a little more difficult. At each stage we will show how to obtain the result by using an example.

Although you should know the precedence rules we will continue to show how the more common errors produce completely wrong answers.

Example 1

What is the answer to $3 + 5 \times 7 + 8$?

There is only one correct way to work this out:

Step (a): first multiply the "5"by "7":

$$5 \times 7 = 35 \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\text{(a)}$$

Step (b): then add the result to the "3":

$$3 + 35 = 38 \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\text{(b)}$$

Step (c): then add the "8" to the result:

$$38 + 8 = 46 \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\text{(c)} ✔$$

Example 2

What is the answer to $8 - 3 + 6$?

This time there is no multiplication or division, just addition and subtraction. The question is: do we undertake the subtraction first or the addition? Let's try both methods:

Method 1	**Method 2**
Step (a): subtract the "3" from the "8":	Step (a): add the "−3" to the "6":
$$8 - 3 = 5 \dots\dots\dots\dots\dots\dots\text{(a)}$$	$$-3 + 6 = 6 - 3 = 3 \dots\dots\dots\text{(a)}$$
Step (b): add "6" to the result:	Step (b): add the result to the "8":
$$5 + 6 = 11 \dots\dots\dots\dots\dots\dots\text{(b)} ✔$$	$$8 + 3 = 11 \dots\dots\dots\dots\dots\dots\text{(b)} ✔$$

When dealing with addition and subtraction neither one has precedence over the other and each can be dealt with in any order.

BUT: be careful about the signs. If you did the following you would be totally wrong:

Step (c): add the "3" to the "6":

$$3 + 6 = 9 \quad\text{...(c)}$$

Step (d): subtract the result from the "8":

$$8 - 9 = -1 \quad\text{..(d)} \textcolor{red}{✗}$$

In part 3 you will see why this method is wrong.

Example 3

What is the answer to $12 \div 3 \times 6$?

This time there is no addition or subtraction, just multiplication and division. The question is: do we undertake the division first or the multiplication? Let's try both methods:

Method 1	Method 2
Step (a): divide the "12" by the "3":	Step (a): multiply the "12" by the "6":
$12 \div 3 = 4$ ....(a)	$12 \times 6 = 72$ ....(a)
Step (b): multiply the result by 6:	Step (b): divide the result by "3":
$4 \times 6 = 24$ ....(b) ✔	$72 \div 3 = 24$ ....(b) ✔

You should have noticed that we multiplied the outer numbers first, the "12" by the "6". Why didn't we multiply the "3" by the "6"?

The reason is the way the equation is written. We can rewrite $12 \div 3 \times 6$? as:

$$\frac{12 \times 6}{3} = \frac{72}{3} = 24 \quad\text{..(c)} ✔$$

Again you need to be careful; if you did the following you would be totally wrong:

Step (d): first multiply the "3" by the "6":

$$3 \times 6 = 18 \quad\text{...(d)}$$

Step (e): then divide the "12" by the result:

$$12 \div 18 = \frac{12}{18} = \frac{2}{3} = 0.667 \quad\text{.................................(e)} \textcolor{red}{✗}$$

The safest way to deal with repeated multiplication and division is to take each term in sequence (left-to-right) and:

- divide the intermediate result by a number when there is a division operator in front
- multiply the intermediate result by a number when there is a multiplication operator in front

This is what we did in method 1, above.

Example 4

What is the answer to $63 + 20 \div 4 - 12{\times}2$?

This calculation is in two parts:

$$63 + 20 \div 4 \text{ and } 12{\times}2$$

The two parts are separated by the "−" sign: we can calculate each part separately:

First part:

$$63 + 20 \div 4$$

Step (a): first divide the "20" by the "4" (division has precedence over addition):

$$20 \div 4 = 5 \dotfill \text{(a)}$$

Step (b): then add the result to "63":

$$63 + 5 = 68 \dotfill \text{(b)}$$

Second part:

$$12{\times}2$$

Step (c): multiply the "12" by "2":

$$12{\times}2 = 24 \dotfill \text{(c)}$$

Step (b): finally subtract result (c) from result (b):

$$68 - 24 = 44 \dotfill \text{(d)} ✔$$

These are the simplest operations. Practice them. In part 3 we show how brackets can change this natural order of precedence.