Order of operations

Imagine that someone asks you to do the following calculations (read them out loud with . . . . . . . . being a dramatic pause).

‘What is 2 add 3 . . . . . . . . times 4?’
‘What is 2 . . . . . . . . add 3 times 4?’

The first is likely to have produced the answer 20, the second 14.

Since there are no dramatic pauses in written calculations (or on calculators or computers), there is a universally accepted convention to overcome this and similar possible misunderstandings.

In calculations, operations are performed in the following order.

- Brackets
- Indices
- Division and Multiplication (the order does not matter)
- Addition and Subtraction (the order does not matter)

One way of remembering this is the mnemonic BIDMAS.

Example 1

(a) Insert brackets in each of the following calculations where necessary to emphasise the order in which it must be performed according to the above convention. Then do the calculations without using a calculator.

(i) $3 + 5 \times 2$
(ii) $10^3 \times 3$
(iii) $\frac{15 + 5}{3 + 7}$
(iv) $6 - 4 + 2$
(v) $2^2 + 3 \times 10^2$

(b) What happens when you use your calculator without the brackets?

Solution

(a) (i) $3 + (5 \times 2) = 13$
(ii) $(10^3) \times 3 = 3000$
(iii) $\frac{15 + 5}{3 + 7} = \frac{20}{10} = 2$

At first sight this looks like an exception to ‘division before addition’; but the long fraction bar is in effect ‘all divided by’, which implies brackets.

(iv) $6 - 4 + 2 = 4$ (no brackets necessary, the order does not matter in this case). Putting in brackets does change things:

$(6 - 4) + 2 = 4$; $6 - (4 + 2) = 0$.

(v) $(2^2) + (3 \times (10^2)) = 4 + (3 \times 100) = 304$.

(b) Any differences will depend on your calculator.