

Order of Operations

Mathematical expressions are written to convey specific information. Therefore, everyone reading them interprets them the same way. For this reason, mathematicians have established a **convention** (an accepted method) that specifies the order in which operations are to be performed.

This **order of operations convention** is as follows.

- Step 1** Evaluate any expressions in brackets first.
- Step 2** THEN evaluate any functions (e.g. powers, roots, sin , cos , log).
- Step 3** THEN evaluate any multiplications or divisions.
- Step 4** THEN evaluate additions or subtractions.
- Step 5** OTHERWISE operations of equal priority are evaluated left to right.

Example 1:

$12 + 2 \times 3$	Evaluate the multiplication first.
$= 12 + 6$	Finally evaluate the addition.
$= 18.$	

Example 2:

$8 - 12 \div (7 - 4 \times 2)$	Evaluate the brackets first (multiplication first, then subtraction).
$= 8 - 12 \div -1$	Next do the division.
$= 8 - -12$	Finally the subtraction.
$= 8 + 12$	
$= 20.$	

Example 3:

$53 \times 2 - (\sqrt{81} - (7 - 3)^2 + 43)$	Evaluate the inside bracket first.
$= 53 \times 2 - (\sqrt{81} - 4^2 + 43)$	Evaluate the last bracket; powers and roots first.
$= 53 \times 2 - (9 - 16 + 43)$	Next, addition and subtraction left to right.
$= 53 \times 2 - (-7 + 43)$	Finish brackets; evaluate powers and roots.
$= 53 \times 2 - 36$	Evaluate multiplication and division.
$= 125 - 36$	Finally, do addition and subtraction.
$= 214.$	

Here are some more for you to test yourself (answers are given at the bottom of the page):

- a) $765 \div 15 + 822$
- b) $89 + 21 - 48 \times 23$
- c) $591 + 37^2$
- d) $4\,763 + 395 \div 5 \times 16$
- e) $(62 - 24^2 + (7 + 3 \times 81) - 318) + 61 \times 458$

RESOURCES

- Other Quick Tips Flyers
<http://www.usq.edu.au/learningcentre/tips.htm>
- Online resources
<http://www.usq.edu.au/learningcentre/alsonline/mathsci/mathsscitopic>
- Talk with a tutor at The Learning Centre (tlc@usq.edu.au)

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Answers to exercises

a) 873 b) -994 c) 10 174 d) 6 027 e) 27 356