Chapter 6

Order of operations and brackets

Learn the ideas below, follow each worked example, then attempt the practice before checking the answers.

6.1 The operation hierarchy

Evaluate brackets first, then powers and roots, then multiplication and division, then addition and subtraction. Multiplication and division have equal priority and are done from left to right. Addition and subtraction also have equal priority and are done from left to right.

Worked example $18 - 6 \div 3 \times 2 = 18 - 2 \times 2 = 18 - 4 = 14$. Doing the subtraction first would change the intended calculation.

6.2 Brackets within brackets

Start with the innermost brackets and work outwards. Keep all remaining parts of the expression unchanged at each step. Square brackets and braces can group calculations in the same way as round brackets. Copy signs carefully.

Worked example $3 \times [12 - (5 + 3)] = 3 \times [12 - 8] = 3 \times 4 = 12$. Each line removes only one completed part.

6.3 Powers roots and negative values

A power or root is evaluated before multiplication, division, addition or subtraction unless brackets change the order. A power applies only to its base. A root symbol covers the expression shown underneath it.

Worked example $2 + 3^2 \times 4 = 2 + 9 \times 4 = 38$. Also, $\sqrt{(16 + 9)} = \sqrt{25} = 5$, whereas $\sqrt{16} + \sqrt{9} = 4 + 3 = 7$.

6.4 Fraction bars as grouping symbols

A fraction bar groups the whole numerator and the whole denominator. Simplify each separately before dividing. If another operation is outside the fraction, apply the normal hierarchy. The denominator must not become zero.

Worked example $\dfrac{8+4}{7-3} = \dfrac{12}{4} = 3$. The expression means $(8 + 4) \div (7 - 3)$, rather than $8 + 4 \div 7 - 3$.

6.5 Building and checking expressions

Translate the order described in words into an expression. Use brackets to show a sum or difference that must be completed before another operation. Estimate the likely size, then evaluate line by line. Equivalent expressions can have different appearances.

Worked example Three times the sum of 7 and 5 is $3 \times (7 + 5) = 36$. Three times 7, then add 5, is $3 \times 7 + 5 = 26$. The wording determines the brackets.

Chapter 6 practice

Work in your notebook. Show your method and include units where needed.

1. Calculate $9 + 4 \times 3$.
2. Calculate $(9 + 4) \times 3$.
3. Calculate $30 - 12 \div 3 + 2$.
4. Calculate $\dfrac{15 - 3}{2 + 4}$.
5. Write and evaluate five less than the square of 6.

Answers with methods

1. $9 + 12 = 21$.

2. $13 \times 3 = 39$.

3. $30 - 4 + 2 = 26 + 2 = 28$.

4. $\dfrac{12}{6} = 2$.

5. $6^2 - 5 = 36 - 5 = 31$.

Common mistake to avoid

In $24 \div 6 \times 2$, division comes first because it is leftmost. The result is 8, not 2.