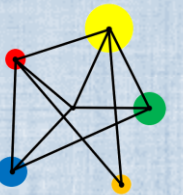


Order of Operations



Carry out calculations in the correct order

Vocabulary

Operation

A mathematical process that is applied to numbers.

These include addition, subtraction, multiplication and division as well as powers, roots and many more.

Priority

The order in which things are chosen to be done.

Addition and Subtraction

Find the value of: $1 + 2 - 3 + 4 - 5$

Addition and Subtraction

Work from left to right, performing each calculation one at a time.

$$1 + 2 - 3 + 4 - 5 = \underline{3}$$

Mixed Calculations Example

Find the value of : $1 + 2 \times 3$

Solution

$$1 + 2 \times 3 = 7$$

This is because there is an order in which we must carry out calculations.

Key Facts

In mathematics, there is an order in which we must carry out calculations.

Multiplication & Division

before

Addition & Subtraction

$$1 + 2 \times 3$$

$$= 1 + 6$$

$$= 7$$

Exercise

Evaluate:

1) $1 + 3 \times 5$

2) $2 + 5 \times 3$

3) $9 - 6 \div 2$

4) $4 \div 4 - 1$

5) $10 - 5 - 2$

Evaluate:

1) $1 + 2 \times 3 + 4$

2) $10 + 10 \times 10 \div 10$

3) $8 - 6 \div 2 + 1$

4) $2 \times 3 \times 4$

5) $10 - 8 \div 2$

Evaluate:

1) $1 + 2 \div 0.1$

2) $1 \div 2 + 0.1$

3) $\frac{1}{2} + \frac{2}{3} \times \frac{3}{4}$

Solutions

Evaluate:

$$1) \quad 1 + 3 \times 5 = 16$$

$$2) \quad 2 + 5 \times 3 = 17$$

$$3) \quad 9 - 6 \div 2 = 6$$

$$4) \quad 4 \div 4 - 1 = 0$$

$$5) \quad 10 - 5 - 2 = 3$$

Evaluate:

$$1) \quad 1 + 2 \times 3 + 4 = 11$$

$$2) \quad 10 + 10 \times 10 \div 10 = 11$$

$$3) \quad 8 - 6 \div 2 + 1 = 6$$

$$4) \quad 2 \times 3 \times 4 = 24$$

$$5) \quad 10 - 8 \div 2 = 6$$

Evaluate:

$$1) \quad 1 + 2 \div 0.1 = 21$$

$$2) \quad 1 \div 2 + 0.1 = 0.6$$

$$3) \quad \frac{1}{2} + \frac{2}{3} \times \frac{3}{4} = 1$$

Key Facts

If there is an expression with indices (powers), this takes priority over multiplication and division.

Indices

before

Multiplication & Division

before

Addition & Subtraction

Example

Evaluate: $1 + 5 \times 3^2$

Solution

$$1 + 5 \times 3^2$$

$$= 1 + 5 \times 9$$

$$= 1 + 45$$

$$= 46$$

Exercise

Evaluate:

1) $3 + 4^2$

2) $5^2 \times 4$

3) $4 - 1^2$

4) $3^2 \times 2^3$

5) $12 + 4 \times 3^2$

Evaluate:

1) $12 - 5^2$

2) $4 \div 2^3$

3) $6 - (-1)^2$

4) $9 - (-2)^3$

5) $\left(\frac{1}{2}\right)^2 \times 8$

Evaluate:

1) $\left(\frac{2}{3}\right)^2 - \left(\frac{1}{2}\right)^2$

2) $\frac{4^2 - 5^2}{5^2 - 4^2}$

Solutions

Evaluate:

$$1) 3 + 4^2 = 19$$

$$2) 5^2 \times 4 = 100$$

$$3) 4 - 1^2 = 3$$

$$4) 3^2 \times 2^3 = 72$$

$$5) 12 + 4 \times 3^2 = 48$$

Evaluate:

$$1) 12 - 5^2 = -13$$

$$2) 4 \div 2^3 = \frac{1}{2}$$

$$3) 6 - (-1)^2 = 5$$

$$4) 9 - (-2)^3 = 17$$

$$5) \left(\frac{1}{2}\right)^2 \times 8 = 2$$

Evaluate:

$$1) \left(\frac{2}{3}\right)^2 - \left(\frac{1}{2}\right)^2 = \frac{7}{36}$$

$$2) \frac{4^2 - 5^2}{5^2 - 4^2} = -1$$

Key Facts

If there is an expression in brackets, this takes priority over indices, multiplication and division.

Brackets

before

Indices

before

Multiplication & Division

before

Addition & Subtraction

This means that addition and subtraction can take place before multiplication and division.
Can you see how?

Example

Evaluate:

$$a) \quad (1 + 2) \times 3$$

$$b) \quad (5 + 6) \times (9 - 4)^2$$

Solutions

Evaluate:

$$a) \quad (1 + 2) \times 3$$

$$= 3 \times 3$$

$$= \underline{9}$$

$$b) \quad (5 + 6) \times (9 - 4)^2$$

$$= 11 \times 5^2$$

$$= 11 \times 25$$

$$= \underline{275}$$

Exercise

Evaluate:

- 1) $(2 + 3) \times 4$
- 2) $(46 - 9) \div 7$
- 3) $(3 + 5)^2$
- 4) $(5 + 2) \times (5 - 2)$
- 5) $6 + 2 \times (4 - 1)$

Evaluate:

- 1) $(0.3 + 0.9) \times 10$
- 2) $(1 + 2^2)^3$
- 3) $(-6 + 2 \times 1)^2$
- 4) $\frac{1}{2} \times \left(\frac{1}{3} + \frac{1}{4}\right)$

Use the numbers 1, 2, 3 and 4 and + , - , x , ÷ and brackets to make the numbers 1 to 16.

i.e. $(2 - 1) \times (3 + 4) = 7$

You must use all the numbers but each one only once.

Exercise

Evaluate:

$$1) (2 + 3) \times 4 = 20$$

$$2) (46 - 9) \div 7 = 5$$

$$3) (3 + 5)^2 = 64$$

$$4) (5 + 2) \times (5 - 2) = 21$$

$$5) 6 + 2 \times (4 - 1) = 12$$

Evaluate:

$$1) (0.3 + 0.9) \times 10 = 12$$

$$2) (1 + 2^2)^3 = 125$$

$$3) (-6 + 2 \times 1)^2 = 16$$

$$4) \frac{1}{2} \times \left(\frac{1}{3} + \frac{1}{4} \right) = \frac{7}{24}$$

$$(2 - 1) \times (4 - 3) = 1$$

$$2 + 3 - 4 + 1 = 2$$

$$(2 + 1) \times (4 - 3) = 3$$

$$1 + 2 - 3 + 4 = 4$$

$$(4 + 1) \times (2 - 1) = 5$$

$$1 - 2 + 3 + 4 = 6$$

$$(2 - 1) \times (3 + 4) = 7$$

$$(2 - 1) \times (3 + 4) = 7$$

$$(4 - 2) \times (3 + 1) = 8$$

$$(2 + 3 + 4) \times 1 = 9$$

$$1 + 2 + 3 + 4 = 10$$

$$4 \times 3 - 2 + 1 = 11$$

$$4 \times 3 \times (2 - 1) = 12$$

$$4 \times 3 + 2 - 1 = 13$$

$$(4 \times 3 + 2) \times 1 = 14$$

$$4 \times 3 + 2 + 1 = 15$$

$$4 \times 2 \times (3 - 1) = 16$$

Extra

Be careful of division signs written like this:

$$\frac{4 + 2 \times 3}{1 + 2 \times 2}$$

Extra

Evaluate the numerator and the denominator and then perform the division.

$$\frac{4 + 2 \times 3}{1 + 2 \times 2}$$

$$= \frac{4 + 6}{1 + 4}$$

$$= \frac{10}{5}$$

$$\underline{\underline{= 2}}$$

Mixed Exercise

Evaluate:

1) $5 + 2 \times 5$

2) $15 \div 2 + 1$

3) $2 + 2^2$

4) $4 \times (3 + 2)$

5) $(9 - 3)^2$

Evaluate:

1) $5 \div (9 - 7)$

2) $30 - 2^3 \times 3$

3)
$$\frac{5 + 3 \times 3}{11 - 2 \times 2}$$

4) $(4 - 9)^2$

Evaluate:

1) $(5 \div (1 + 1))^2$

2) $\left(1 - \frac{1}{4}\right)^3$

Solutions

Evaluate:

$$1) \quad 5 + 2 \times 5 = 15$$

$$2) \quad 15 \div 2 + 1 = 8.5$$

$$3) \quad 2 + 2^2 = 6$$

$$4) \quad 4 \times (3 + 2) = 20$$

$$5) \quad (9 - 3)^2 = 36$$

Evaluate:

$$1) \quad 5 \div (9 - 7) = 2.5$$

$$2) \quad 30 - 2^3 \times 3 = 6$$

$$3) \quad \frac{5 + 3 \times 3}{11 - 2 \times 2} = 2$$

$$4) \quad (4 - 9)^2 = 25$$

Evaluate:

$$1) \quad (5 \div (1 + 1))^2 = 6.25$$

$$2) \quad \left(1 - \frac{1}{4}\right)^3 = \frac{27}{64}$$

Investigation – a new operation

In mathematics, the operation ‘!’ is called **factorial**.

4! means $1 \times 2 \times 3 \times 4$

Find the  key on your calculator and use it to evaluate 5!

Evaluate:

a) $10!$	b) $\frac{6!}{5!}$	c) $\frac{200!}{198!}$
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Find the last digit of 200!

Exam Style Question

Tia is playing a game with number tiles.

She is trying to put down tiles to make two calculations with the same answer

Here is what Tia put down.

$$\boxed{4} \boxed{-} \boxed{3} \boxed{\times} \boxed{2} \quad \boxed{=} \quad \boxed{4} \boxed{-} \boxed{2}$$

Is she correct?

Show how you made your decision.

Solution

Tia is playing a game with number tiles.

She is trying to put down tiles to make two calculations with the same answer

Here is what Tia put down.

$$4 - 3 \times 2 = 4 - 2$$

Is she correct?

Show how you made your decision.

Tia is not correct.

$4 - 3 \times 2 = -2$ but $4 - 2 = 2$