Rules of Algebra (7)

Contents

1 What is algebra?

Algebra is considered to be the language of Mathematicians. So that we all understand each other, we must stick to these three basic rules:

Rule	Examples
We do not use a multiplication sign.	Write $5 \times p$ as $5p$. Write $a \times b$ as ab.
In products (multiplications), numbers come before letters.	We write $5p$ not $p5$.
We do not use a division sign: instead, we use fractions	$w \div 7$ is written as $\frac{w}{7}$.

To really get used to expressions in algebra, always read everything you see, starting with the words *I think of a number and I* ...

Example.

$4k$	*I think of a number and I multiply it by* 4.
$\frac{y}{5}$	*I think of a number and I divide it by* 5
$3(x+2)$	*I think of a number, add 2 then multiply it by 3*
y^2	*I think of a number and multiply it by itself (Note* y^2 *is much nicer than writing* yy*)*
$\frac{5x-7}{9}$	*I think of a number, multiply it by* 5*, subtract* 7 *and then divide this all by* 9.

2 BODMAS

When reading some expressions, we must think of the order in which things are important in Mathematics. The word **BODMAS** helps us to remember this:

B	**O**	**D**	**M**	**A**	**S**
Brackets	powers Of	Division	Multiplication	Addition	Subtraction

If our expression contains brackets, we do these first. Next, powers of (the correct name for powers is "indices", so some people say BIDMAS instead of BODMAS). Division and multiplication are equally as important as one another and finally comes addition and subtraction.

$3x+5$	*I think of a number, multiply it by* 3 *and add* 5.
$3(x+5)$	*I think of a number, add* 5 *then multiply it by* 3 *(the brackets have been used to make "+" more important than "$\times$").*
$3x^2$	*I think of a number, multiply it by itself, then by* 3.
$(3x)^2$	*I think of a number, multiply it by* 3*, then by itself.*

N.B. Learn the last two — they come up a lot!

Example. Match each expression with its meaning:

Expression	Meaning
A $2x-7$	**1** I think of a number, subtract 7 and multiply it by 2.
B $7p^2$	**2** I think of a number, multiply it by itself and then by 7.
C $(7q)^2$	**3** I think of a number, divide it by 2 and subtract 7.
D $2(y-7)$	**4** I think of a number, multiply it by 2 and subtract 7.
E $\frac{m}{2}-7$	**5** I think of a number, multiply it by 7 then by 2.

(Solution: A4, B2, C5, D1, E3)

3 Substitution

If we know the value of the number that we are thinking of then we can substitute this into an expression and find the value of the whole expression.

Example. Find the value of the following, given that $a = 5$ and $b = 2$.

$$\begin{aligned} 3a - 4 &= 3 \times 5 - 4 \\ &= 15 - 4 \\ &= 11 \end{aligned}$$

$$\begin{aligned} b^2 + 9 &= 2^2 + 9 \\ &= 4 + 9 \\ &= 13 \end{aligned}$$

$$\begin{aligned} \frac{a+7}{2} &= \frac{5+7}{2} \\ &= \frac{12}{2} \\ &= 6 \end{aligned}$$

$$\begin{aligned} (ab)^2 &= (5 \times 2)^2 \\ &= 10^2 \\ &= 100 \end{aligned}$$

$$\begin{aligned} 5b^3 &= 5 \times 23 \\ &= 5 \times 8 \\ &= 40 \end{aligned}$$

Notice how we always follow BODMAS e.g. in $(ab)^2$, we had to do the brackets first before squaring. Look also at the logical layout: one equals sign per line, working down the page and showing all working.
If we substitute negative numbers, we should always substitute them in brackets and take real care to evaluate our expressions accurately.

Example. Given that $x = -2$, $y = -5$ and $z = -20$, find:

$$\begin{aligned} x^2 &= (-2)^2 \\ &= 4 \end{aligned}$$

$$\begin{aligned} yz &= (-5) \times (-20) \\ &= 100 \end{aligned}$$

$$\begin{aligned} \frac{2z}{xy} &= \frac{2 \times (-20)}{(-2) \times (-5)} \\ &= \frac{-40}{10} \\ &= -4 \end{aligned}$$