Basic Algebra Axioms

There are only two rules of algebra which are actually the conventions on how we write algebra.

Rule 1

$a + a + a = 5 \times a = 5a$

Corollary 1

So $5a + 3a = 8a$

Corollary 2

$3 \times 2a = 2a + 2a + 2a = 6a$

Rule 2

$a \times a \times a = a^3$

so $(a \times a) \times (a \times a \times a) = a^5$

but $(a \times a) + (a \times a \times a)$

doesn't reduce to anything else useful. In algebra generally think of "a^5" as a thing in its own right - as it might well be. Only in special cases does it reduce to anything simpler.

Corollary

$a^3 = a^4 / a$

$a^2 = a^3 / a$

$a^1 = a^2 / a$

$a^0 = a^1 / a = 0$

with the possible condition a is not equal to 0 – though some will still argue 0^0 is still "one".

Continuing the pattern

$a^{-1} = a^0 (1) / a = 1 / a$

$a^{-2} = a^0 (1) / a^2 = 1 / a^2$

etc.

In higher maths it's more usual to use negative indices than fractions.

Factorial

$3\,! = 3 \times 2 \times 1 = 6$

Corollary

Using the same idea as negative fractions

$2\,! = 3\,! / 3$

$1\,! = 2\,! / 2$

$0\,! = 1\,! / 1 = 1$

Don't let anyone kid you that 0 ! is "one" by convention. It is "one" by necessity and has wider implications when you study the generalised gamma function Γ which will tell you factorials of fractions. Look forward to discovering ½ ! = ½ π.

Conclusion

All algebra follows from these rules.

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