Exponentials, x ÷

by Bill Hanlon

Exponential - is a number with an exponent.

In the number 5^3, read five to the third power, the 3 is called the exponent, the 5 is the base.

$$5^3$$

exponent

base

Exponent - tells you how many times to write the base as a factor.

Example: Evaluate 3^4

The exponent tells you how many times to write the base as a factor, So, we have

$$3^4 = 3 \times 3 \times 3 \times 3$$
$$= 81$$

Some neat patterns develop when you multiply or divide exponentials. Let's look at a couple and see if we can find them.

Example: Simplify $2^4 \times 2^3$

Expanding, I have (2x2x2x2) x (2x2x2)

Notice, I am multiplying 2 by itself seven times, therefore $2^4 \times 2^3 = 2^7$

Try $5^2 \times 5^4$. Did you get 5^6? Now look at the two problems, do you see a pattern? Try to evaluate $7^{18} \times 7^3$ in your head.

If you got 7^{21}, then you must have seen the pattern.

In math, shortcuts like this are often called

rules. Let's formalize the pattern we discovered.

> Rule 1 When you multiply exponentials with the SAME bases, you add the exponents.

Using that rule, we can simplify $4^5 \times 4^6$ very quickly. Since the bases are the same, all we need do is add the exponents.

Let's see if we can find any patterns when we divide exponentials.

Example: Simplify $7^5 \div 7^2$

Writing that out using the definition, I have

$$\frac{7 \times 7 \times 7 \times 7}{7 \times 7}$$

By dividing out the 7's, we are left with

$$7 \times 7 \times 7 = 7^3$$

If we did more examples, we'd see another pattern develop. Try this problem, $4^8 \div 4^3$. Did you get 4^5?

If you did, that would lead us to a second rule.

> Rule 2 When you divide exponentials with the SAME bases, you subtract the exponents.

Example: Simplify $5^9 \div 5^6$
Since the bases are the same, all I need do is subtract the exponents, the answer is 5^3.