Warmup 5

Simplify the following expressions. Write on your own paper, and use these solutions to check your answers.

1. Simplify $x^6 \times x^5$

The rules tell me to add the exponents. The " x^6 " means "six copies of x multiplied together", and the " x^5 " means "five copies of x multiplied together". So if I multiply those two expressions together, I will get eleven copies of x multiplied together. That is:

$$x^6 \times x^5 = (x^6)(x^5)$$

$$= (xxxxxx)(xxxxx) \quad \text{(6 times, and then 5 times)}$$

$$= xxxxxxxxxxx \quad \text{(11 times)}$$

$$= x^{11}$$

2. Simplify the following expression:

$$\frac{6^8}{6^5}$$

The exponent rules tell me to subtract the exponents. But let's suppose that I've forgotten the rules. The " 6^8 " means I have eight copies of 6 on top; the " 6^5 " means I have five copies of 6 underneath.

$$\frac{6 \cdot 6 \cdot 6 \cdot 6 \cdot 6 \cdot 6 \cdot 6 \cdot 6}{6 \cdot 6 \cdot 6 \cdot 6 \cdot 6}$$

How many extra 6's do I have, and where are they? I have three extra 6's, and they're on top. Then:

$$\frac{6 \cdot 6 \cdot 6 \cdot \cancel{6} \cdot \cancel{6} \cdot \cancel{6} \cdot \cancel{6} \cdot \cancel{6}}{\cancel{6} \cdot \cancel{6} \cdot \cancel{6} \cdot \cancel{6} \cdot \cancel{6}} = \frac{6 \cdot 6 \cdot 6}{1} = 6^3$$

3. Simplify the following expression:

$$\frac{t^{10}}{t^8}$$

How many extra copies of t do I have, and where are they? I have two extra copies, on top:

$$\frac{t^{10}}{t^8} = \frac{t \cdot t \cdot t \cdot t \cdot t \cdot t \cdot t \cdot t \cdot t \cdot t}{t \cdot t \cdot t \cdot t \cdot t \cdot t \cdot t \cdot t}$$

$$= \frac{\cancel{t \cdot t \cdot t \cdot t \cdot t \cdot t \cdot t \cdot t} \cdot t \cdot t}{\cancel{t \cdot t \cdot t \cdot t \cdot t \cdot t \cdot t \cdot t}}$$

$$= \frac{t \cdot t}{1} = t^2$$

4. Simplify the following expression:

$$\frac{5^3}{5^9}$$

How many extra copies of 5 do I have, and where are they? I have six extra copies, underneath:

$$\frac{5^3}{5^9} = \frac{5 \cdot 5 \cdot 5}{5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5}$$

$$= \frac{\cancel{5 \cdot 5 \cdot 5}}{\cancel{5 \cdot 5 \cdot 5} \cdot 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5}$$

$$= \frac{1}{5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5} = \frac{1}{5^6}$$

Note: If you apply the subtraction rule, you'll end up with $5^{3-9} = 5^{-6}$, which is mathematically correct, but is almost certainly not the answer they're looking for. Whether or not you've been taught about negative exponents, when they say "simplify", they mean "simplify the expression so it doesn't have any negative or zero powers". Some students will try to get around this minus-sign problem by arbitrarily switching the sign to magically get " 5^6 " on top (rather than below a "1"), but this is incorrect.