Exponents

Exponents can be very helpful when multiplying the same factor many times. Exponents are simply a shorthand notation for multiplication, as in the example below.

$$2^8 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 256$$

The exponent (8) tells how many of the base (2) need to be multiplied.

Use what you know about exponents to fill in the blanks below.

1. _____ $= 5 \times 5 \times 5 \times 5$

2. $3^3 =$ _____ $\times$ _____ $\times$ _____

3. 2 _____ $= 2 \times 2 \times 2 \times 2 \times 2 \times 2$

4. 7 _____ $= 7$

5. 2 _____ $= 32$

6. $5^5 =$ _____

Exponents can be any real number. The examples above showed all exponents to be natural numbers. What happens when the exponent is zero or a negative number? Look at the pattern below. Continue the pattern in order to answer the question yourself.

$2^4 = 16$
$2^3 = 2^4 \div 2 = 8$
$2^2 = 2^3 \div 2 = 4$

7. $2^1 =$ ___ $\div 2 = 2$

8. ___ $= 2^1 \div 2 =$ ___

$2^{-1} = 2^0 \div 2 = 2^0 \times \frac{1}{2} = \frac{1}{2} = \frac{1}{2^1}$

9. $2^{-2} =$ ___ $\div 2 =$ ___ $\times \frac{1}{2} =$ ___ $=$ ___

10. $2^{-3} =$ _____

As you can see by the pattern, as the exponent gets smaller, the denominator of the fraction gets larger. Describe the pattern by completing the sentence below.

11. When any base has a negative exponent, it is equal to a fraction:

1 over _____

Patterns of Powers

When you look carefully at a specific base raised to powers, you can usually find a pattern. The pattern that emerges with powers of ten is the easiest to recognize, and also, the most helpful. Fill in the blanks below to continue the pattern.

$10^5 = 100{,}000$

$10^4 = 10{,}000$

1. $10^3 =$ _____

2. $10^2 =$ _____

3. $10^1 =$ _____

4. $10^0 =$ _____

$10^{-1} = 0.1$

$10^{-2} = 0.01$

5. $10^{-3} =$ _____

6. $10^{-4} =$ _____

7. $10^{-5} =$ _____

8. What do you notice about the relationship between the number of zeros in the answer and the positive exponent on the base? How does the exponent being negative change the relationship?

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9. What do you notice about the movement of the decimal point? How does the sign on the exponent affect this?

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10. Do you think you would find the same patterns if you changed the base? Are these patterns true only for powers of ten? Explain your answer.

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