Powers Continued

An important property of powers is that when you multiply two power expressions with the same base, you **add** the exponents:

$$8 \times 4 = 2^3 \times 2^2 = (2 \times 2 \times 2) \times (2 \times 2)$$

Powers Continued

An important property of powers is that when you multiply two power expressions with the same base, you **add** the exponents:

$$8 \times 4 = 2^3 \times 2^2 = (2 \times 2 \times 2) \times (2 \times 2)$$

Since the order of multiplication does not matter, we can remove the parentheses:

$$= (2 \times 2 \times 2 \times 2 \times 2)$$

Powers Continued

An important property of powers is that when you multiply two power expressions with the same base, you **add** the exponents:

$$8 \times 4 = 2^3 \times 2^2 = (2 \times 2 \times 2) \times (2 \times 2)$$

Since the order of multiplication does not matter, we can remove the parentheses:

$$= (2 \times 2 \times 2 \times 2 \times 2)$$

now back to a power expression

$$= 2^5 = 32$$

Powers Continued

So

$$2^3 \times 2^2 = 2^{(3+2)} = 2^5$$

Powers Continued

So

$$2^3 \times 2^2 = 2^{(3+2)} = 2^5$$

Another example:

$$3 \times 27 = 3^1 \times 3^3 = 3^{(1+3)} = 3^4 = 81$$

Powers Continued

So

$$2^3 \times 2^2 = 2^{(3+2)} = 2^5$$

Another example:

$$3 \times 27 = 3^1 \times 3^3 = 3^{(1+3)} = 3^4 = 81$$

This property is often useful when working with powers of 10:

$$1000 \times 100,000 = 10^3 \times 10^5 = 10^{(3+5)} = 10^8 = 100,000,000$$

Powers Continued

So

$$2^3 \times 2^2 = 2^{(3+2)} = 2^5$$

Another example:

$$3 \times 27 = 3^1 \times 3^3 = 3^{(1+3)} = 3^4 = 81$$

This property is often useful when working with powers of 10:

$$1000 \times 100,000 = 10^3 \times 10^5 = 10^{(3+5)} = 10^8 = 100,000,000$$

For powers of 10, the exponent always matches the number of zeros.

Powers Continued

Example:

$$10,000 \times 100 = 10^4 \times 10^2 = 10^{(4+2)} = 10^6 = 1,000,000$$

Powers Continued

Example:

$$10,000 \times 100 = 10^4 \times 10^2 = 10^{(4+2)} = 10^6 = 1,000,000$$

Example:

$$5^2 \times 5^4 = 5^{(2+4)} = 5^6 = 15,625$$

Powers Continued

Example:

$$10,000 \times 100 = 10^4 \times 10^2 = 10^{(4+2)} = 10^6 = 1,000,000$$

Example:

$$5^2 \times 5^4 = 5^{(2+4)} = 5^6 = 15,625$$

Example:

$$2^8 \times 2^6 = 2^{(8+6)} = 2^{14} = 16,384$$

Powers Continued

Example: Powers of 10

Ten	10^1	10
One Hundred	10^2	100
One Thousand	10^3	$1,000$
Ten Thousand	10^4	$10,000$
One Hundred Thousand	10^5	$100,000$
One Million	10^6	$1,000,000$
Ten Million	10^7	$10,000,000$
One Hundred Million	10^8	$100,000,000$
One Billion	10^9	$1,000,000,000$
Ten Billion	10^{10}	$10,000,000,000$
One Hundred Billion	10^{11}	$100,000,000,000$
One Trillion	10^{12}	$1,000,000,000,000$

Powers Continued

Exponents can also be fractions. Consider an exponential expression like:

$$2^{\frac{1}{2}}$$

How should this be defined?

Powers Continued

Exponents can also be fractions. Consider an exponential expression like:

$$2^{\frac{1}{2}}$$

How should this be defined?
As we have seen, when we multiply exponential expressions, we add the exponents, so

$$2^{\frac{1}{2}} \times 2^{\frac{1}{2}} = 2^{(\frac{1}{2}+\frac{1}{2})} = 2^1 = 2$$

Powers Continued

Exponents can also be fractions. Consider an exponential expression like:

$$2^{\frac{1}{2}}$$

How should this be defined?
As we have seen, when we multiply exponential expressions, we add the exponents, so

$$2^{\frac{1}{2}} \times 2^{\frac{1}{2}} = 2^{(\frac{1}{2}+\frac{1}{2})} = 2^1 = 2$$

This means that $2^{\frac{1}{2}}$ is the number that produces 2 when multiplied by itself, that is,

$$2^{\frac{1}{2}} = \sqrt{2}$$

Powers Continued

This is true of all numbers greater than or equal to zero:

$$6^{\frac{1}{2}} = \sqrt{6} \quad 10^{\frac{1}{2}} = \sqrt{10} \quad 22^{\frac{1}{2}} = \sqrt{22}$$

Powers Continued

This is true of all numbers greater than or equal to zero:

$$6^{\frac{1}{2}} = \sqrt{6} \quad 10^{\frac{1}{2}} = \sqrt{10} \quad 22^{\frac{1}{2}} = \sqrt{22}$$

Calculator sequence: to find the value of $2^{\frac{1}{2}}$ is:

$$2 \quad x^y \quad [(- - - \qquad 1 \quad \div \quad 2 \qquad - - -)] \quad =$$

Powers Continued

This is true of all numbers greater than or equal to zero:

$$6^{\frac{1}{2}} = \sqrt{6} \quad 10^{\frac{1}{2}} = \sqrt{10} \quad 22^{\frac{1}{2}} = \sqrt{22}$$

Calculator sequence: to find the value of $2^{\frac{1}{2}}$ is:

$$2 \quad x^y \quad [(--- \qquad 1 \quad \div \quad 2 \qquad ---)] \quad =$$

The result should be 1.414213562, the first few digits of $\sqrt{2}$

Powers Continued

This is true of all numbers greater than or equal to zero:

$$6^{\frac{1}{2}} = \sqrt{6} \quad 10^{\frac{1}{2}} = \sqrt{10} \quad 22^{\frac{1}{2}} = \sqrt{22}$$

Calculator sequence: to find the value of $2^{\frac{1}{2}}$ is:

$$2 \quad x^y \quad [(- - - \qquad 1 \quad \div \quad 2 \qquad - - -)] \quad =$$

The result should be 1.414213562, the first few digits of $\sqrt{2}$

A more obvious way to find $\sqrt{2}$ is the sequence:

2 SHIFT $\sqrt{}$