

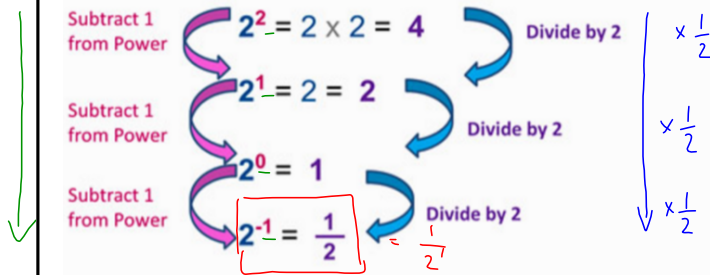
Consolidate-Exploring Exponent Rules (p4)

Pull 3

Reflect: What did you notice about powers with negative exponents?

Negative Exponents - Patterns

Negative Exponents, using patterns of Powers works out like this:



Negative Exponents Produce Fractions:  $a^{-m} = 1/a^m$

\* change the power: (1) reciprocal of  $a^{-m}$  ( $\frac{1}{a^{-m}}$ )  
 (2) Change the sign of the exp. ( $\frac{1}{a^m}$ )

Pull 1

Pull 2

$2^{-2} = \frac{1}{4} = \frac{1}{2^2}$   
 $2^{-2} = \frac{1}{2^2}$

Negative Exponent Rule: If  $b$  is any real number other than 0 and  $n$  is a natural number, then

$b^{-n} = \frac{1}{b^n}$  and  $\frac{1}{b^{-n}} = b^n$

exponents?

Negative Exponents - Fractions

Pull 1

Pull 2

Pull 3

(1)  $\frac{2^2}{2^3} = \frac{2 \times 2}{2 \times 2 \times 2} = \frac{1}{2}$  ✓  
 (2)  $\frac{2^2}{2^3} = 2^{2-3} = 2^{-1} = \frac{1}{2}$  ✓

We have two correct answers, but they are different to each other. This means that the following must be true:

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

$\frac{2 \times 2 \times 1}{2 \times 2 \times 2} = \frac{1}{2}$   
 $= \frac{1}{2} \times \frac{2}{2} \times \left(\frac{1}{2}\right)$   
 $= \frac{1}{2}$

*Guided Examples & Practice-Basic Principles in Action*

**E.g., 1.** Evaluate. Express your answers as whole numbers or fractions.

a)  $10^3, 10^{-3}$

$$10^3 = 1000$$

$$10^{-3} = \frac{1}{10^3} = \frac{1}{1000}$$

b)  $(-3)^3, (-3)^4$  *even = +ve*

$$(-3)^3 = -27$$

$$= (-3)(-3)(-3)$$

$$= -27$$

$$(-3)^4 = -27 \times (-3)$$

$$= +81$$

$$(-3)^{-4} = \frac{1}{(-3)^4} = \frac{1}{81}$$

*Guided Examples & Practice-Basic Principles in Action*

**E.g., 2.** Suppose that  $y = 3^2$  and  $x = 3^3$ . Write the following expression as a power with a single base of 3.

$$\begin{aligned} \frac{xy}{x^2y^{-1}} &= \frac{3^3 \cdot 3^2}{(3^3)^2 \cdot (3^2)^{-1}} = \frac{3^5}{3^6 \cdot 3^{-2}} = \frac{3^5}{3^{6+(-2)}} = \frac{3^5}{3^4} = 3^1 \text{ or } 3 \end{aligned}$$

### Guided Examples & Practice-Measurement

**E.g., 3.** The volume of a pyramid can be expressed with the following formula:

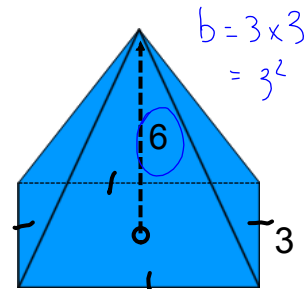
$$V = \frac{1}{3}bh$$

where  $b$  = base area and  $h$  = height of the pyramid.

Determine the volume of a pyramid with the given dimensions:

$$\begin{aligned} V &= \frac{1}{3}bh \\ &= \frac{1}{3} \cdot 3^2 \cdot 6 \\ &= 3^{-1+2} \cdot 6 \\ &= 3 \cdot 6 \\ &= 18 \text{ units}^3 \end{aligned}$$

$$\begin{aligned} &\rightarrow \frac{1}{3} \cdot 9 \cdot 6 \\ &= 3 \cdot 6 \\ &= 18 \text{ units}^3 \end{aligned}$$



### Guided Examples & Practice-Finance

**E.g., 4.** Jonathan has a loan for \$6000 that is due in 8 years. He wants to try and pay off his debt early. His bank is willing to discount the loan at an interest rate of 8%/year, compounded semi-annually. How much would the bank be will to accept today?

$$\begin{aligned} P &= \overset{\substack{\text{loaned} \\ \text{amount}}}{6000} (1.04)^{-16} \quad \text{Formula} \\ &= 6000 \times (1.04)^{-16} \\ &= \frac{6000}{1} \times \frac{1}{1.04^{16}} \\ &= \frac{6000}{1.04^{16}} \leftarrow \\ &= \$3203.45 \end{aligned}$$

*Present value* (with arrow pointing to P)

## Your Next Opportunity to Learn:

i) p440 #3abc (REQ), 1ac

ii) Solve for the volume of a cone using the following details:

$$V = \frac{1}{3} \pi r^2 h$$

$r = 3$ ,  $h = 6$ , estimate with  $\pi \approx 3$

iii) p367 #1, 2aceg, 11ace, 12, 17ace