3.4 - Negative Exponents

Warm Up:

1. Evaluate each power.

a) $7^2 =$ $= 7 \cdot 7$ $= 49$

b) $-7^2 =$ $= -7 \cdot 7$ $= -49$

c) $(-7)^2 =$ $= (-7)(-7)$ $= 49$

d) $-(7)^2 =$ $= -(7)(7)$ $= -49$

e) $-(-7)^2 =$ $= -(-7)(-7)$ $= -(49)$ $= -49$

Brackets influence the solution by changing the base of the power.

2. Write the reciprocal. → flip fraction!

a) $\frac{2}{1} \Rightarrow \frac{1}{2}$ b) $6 \Rightarrow \frac{1}{6}$ c) $\frac{1}{2} \Rightarrow 2$ d) $\frac{1}{100} \Rightarrow 100$

Product of reciprocals equal one:

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

NEGATIVE EXPONENT LAW

$\frac{2^2}{2^5} = \frac{2 \cdot 2}{2 \cdot 2 \cdot 2 \cdot 2 \cdot 2} = \frac{1}{2^3}$ OR $\frac{2^{2-5}}{2^5} = 2^{-3}$

$\frac{1}{2^3} = \frac{2^{-3}}{1}$

We can evaluate a negative exponent by writing the reciprocal of the base with a positive exponent!

Algebra: $\frac{x^{-n}}{1} = \frac{1}{x^n}$ where x can be any number but 0.

A power with negative exponent is equal to the reciprocal of base with a positive exponent.

ex $\frac{3^{-2}}{1} = \left(\frac{1}{3}\right)^2 = \frac{1^2}{3^2} = \frac{1}{3^2}$

$= \left(\frac{1}{3}\right)\left(\frac{1}{3}\right)$

Ex #1 : Evaluate:

a) 3^{-2} simplified

$= \left(\frac{1}{3}\right)^{2} = \frac{1}{3^2}$

$= \boxed{\frac{1}{9}}$

b) $(-3)^{-2}$

$= \left(\frac{1}{-3}\right)^{2}$

$= \boxed{\frac{1}{9}}$

c) 0.3^{-4} $\cdot 10$ / $1 \cdot 10$

$= \left(\frac{3}{10}\right)^{-4}$

$= \left(\frac{10}{3}\right)^{4}$

$= \boxed{\frac{10000}{81}}$

Algebra: $\left(\frac{a}{b}\right)^{-n} = \left(\frac{b}{a}\right)^{+n}$ where a, b can be any number but 0.

A power with a negative exponent is equal to power with reciprocal base with a positive exponent.

Ex #2 – Evaluate:

a) $\left(\frac{5}{4}\right)^{-2}$

$= \left(\frac{4}{5}\right)^{2}$

$= \boxed{\frac{16}{25}}$

b) $\left(-\frac{3}{4}\right)^{-3}$

$= \left(\frac{4}{-3}\right)^{3}$

$= \frac{+64}{-27}$

$= \boxed{-\frac{64}{27}}$

c) $\left(\frac{10}{3}\right)^{-3}$

$= \left(\frac{3}{10}\right)^{3}$

$= \boxed{\frac{27}{1000}}$

Ex #3 – Evaluate without using a calculator. **Remember $x^{\frac{m}{n}} = \sqrt[n]{x^m}$

a) $8^{-\frac{2}{3}}$ flip base

$= \left(\frac{1}{8}\right)^{\frac{2}{3}}$ ← index of root

$= \sqrt[3]{\left(\frac{1}{8}\right)^{2}}$

$= \frac{\left(\sqrt[3]{1}\right)^{2}}{\left(\sqrt[3]{8}\right)^{2}}$

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

$= \boxed{\frac{1}{4}}$

b) $\left(\frac{9}{16}\right)^{-\frac{3}{2}}$

$= \left(\frac{16}{9}\right)^{\frac{3}{2}}$

$= \left(\sqrt{\left(\frac{16}{9}\right)}\right)^{3}$

$= \frac{\left(\sqrt{16}\right)^{3}}{\left(\sqrt{9}\right)^{3}}$

HW p233 #3-10

$= \frac{(4)^3}{(3)^3}$

$= \boxed{\frac{64}{27}}$

c) $(-0.027)^{-\frac{2}{3}}$ $\cdot 1000$ / $1 \cdot 1000$

$= \left(\frac{-27}{1000}\right)^{-\frac{2}{3}}$

$= \left(\frac{1000}{-27}\right)^{\frac{2}{3}}$

$= \left(\sqrt[3]{\frac{1000}{-27}}\right)^{2}$

$= \frac{\left(\sqrt[3]{1000}\right)^{2}}{\left(\sqrt[3]{-27}\right)^{2}}$

$= \frac{(10)^2}{(-3)^2}$

$= \boxed{\frac{100}{9}}$