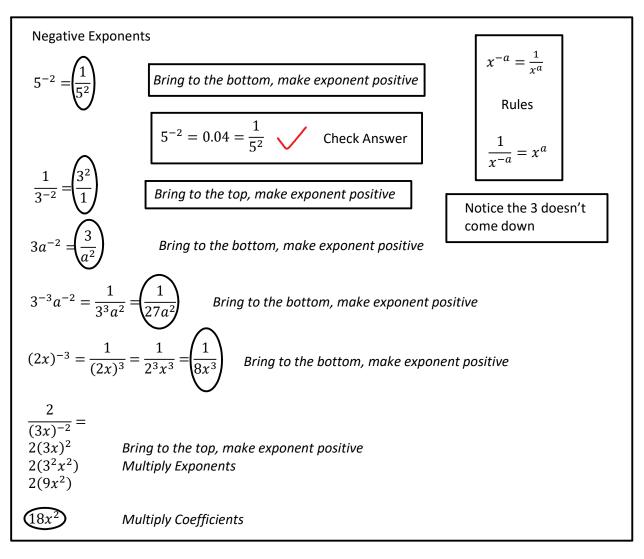# M9 - 3.4 - Negative Laws Notes

Negative Exponents

$5^{-2} = \left(\dfrac{1}{5^2}\right)$

Bring to the bottom, make exponent positive

$5^{-2} = 0.04 = \dfrac{1}{5^2}$ ✓ Check Answer

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

Bring to the top, make exponent positive

$3a^{-2} = \left(\dfrac{3}{a^2}\right)$ *Bring to the bottom, make exponent positive*

$3^{-3}a^{-2} = \dfrac{1}{3^3 a^2} = \left(\dfrac{1}{27a^2}\right)$ *Bring to the bottom, make exponent positive*

$(2x)^{-3} = \dfrac{1}{(2x)^3} = \dfrac{1}{2^3 x^3} = \left(\dfrac{1}{8x^3}\right)$ *Bring to the bottom, make exponent positive*

$\dfrac{2}{(3x)^{-2}} =$

$2(3x)^2$ *Bring to the top, make exponent positive*
$2(3^2 x^2)$ *Multiply Exponents*
$2(9x^2)$

$\left(18x^2\right)$ *Multiply Coefficients*

Rules

$x^{-a} = \dfrac{1}{x^a}$

$\dfrac{1}{x^{-a}} = x^a$

Notice the 3 doesn't come down

Theory

Theory on "Bring it to the Bottom" and Vice Versa

$3^3 = 27$
  $\div 3$
$3^2 = 9$
  $\div 3$
$3^1 = 3$
  $\div 3$
$3^0 = 1$
$3^{-1} = \dfrac{1}{3^1} = \dfrac{1}{3}$ $\div 3$
$3^{-2} = \dfrac{1}{3^2} = \dfrac{1}{9}$ $\div 3$

The exponents on the left are going down by 1,

The numbers on the right are being divided by 3,

This pattern must continue

$\dfrac{3^2}{3^2} = 3^{2-2} = 2^0 = 1$ $\dfrac{3^2}{3^2} = \dfrac{8}{8} = 1$

$\dfrac{3}{9} = \dfrac{3 \div 3}{9 \div 3} = \dfrac{1}{3}$ $\dfrac{3}{3^2} = \dfrac{1\,\cancel{3}}{\cancel{3} \times 3} = \dfrac{1}{3}$

$\dfrac{3^1}{3^2} = 3^{-1} = \dfrac{1}{3^1} = \dfrac{1}{3}$ $\dfrac{\cancel{3}}{\cancel{3}} = 1$
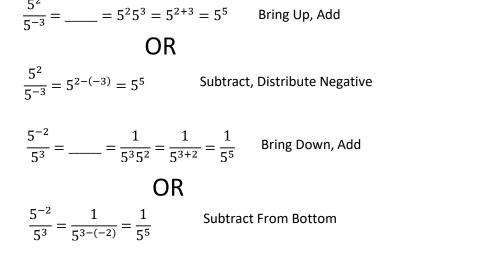
Fractions Division Theory vs Exponents

M9 - 3.4 - Negative Laws Notes

Negative Exponents

$$\left(\frac{5^1}{3^1}\right)^{-2} = \frac{5^{-2}}{3^{-2}} = \underline{\quad} = \frac{3^2}{5^2}$$

Multiply Exponents
Start off with an "OVER"
Bring to the bottom, make exponent positive
Bring to the top, make exponent positive

When you can flip it!

$$\left(\frac{5}{3}\right)^{-2} = \left(\frac{3}{5}\right)^2 = \frac{3^2}{5^2}$$

Flip it and make the exponent positive

Check Answer

$$\left(\frac{5}{3}\right)^{-2} = 0.36 = \frac{3^2}{5^2} \checkmark$$

Alternate Subtraction Methods   **OR**   **OR**

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

$$\frac{5^2}{5^5} = \frac{1 \; \cancel{5 \times 5}}{\cancel{5 \times 5} \times 5 \times 5 \times 5} = \frac{1}{5^3}$$

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

Subtract from the top   Division Theory   Subtract from the bottom

$$\frac{5^2}{5^5} = 0.008 = \frac{1}{5^3} \checkmark \quad \text{Check Answer} \quad \frac{5^2}{5^5} = \frac{25 \div 25}{3125 \div 25} = \frac{1}{125} = \frac{1}{5^3} \quad \text{Division Theory}$$

$$\frac{5^2}{5^{-3}} = \underline{\quad} = 5^2 5^3 = 5^{2+3} = 5^5 \qquad \text{Bring Up, Add}$$

OR

$$\frac{5^2}{5^{-3}} = 5^{2-(-3)} = 5^5 \qquad \text{Subtract, Distribute Negative}$$

$$\frac{5^{-2}}{5^3} = \underline{\quad} = \frac{1}{5^3 5^2} = \frac{1}{5^{3+2}} = \frac{1}{5^5} \qquad \text{Bring Down, Add}$$

OR

$$\frac{5^{-2}}{5^3} = \frac{1}{5^{3-(-2)}} = \frac{1}{5^5} \qquad \text{Subtract From Bottom}$$

Step 1

$$\underline{\quad\quad} \leftarrow \text{Over}$$

$$\frac{2x^5 y^{-2}}{z^{-3}} = \underline{\quad} = \frac{2x^5 z^3}{y^2}$$

When working with negative exponents:

Start with a fraction "Over" sign.
Put anything not moved!
Move whatever needs to be moved.
If nothing is left on the top, put a 1.