Elementary Algebra
Skill-Builder # E – 6
Applying the Negative Exponent Rule

The following rule applies when an expression representing any nonzero real number is raised to a negative integer.

For any nonzero real number *a* and a positive integer *n*,

$$a^{-n} = \left(\frac{1}{a}\right)^{n} = \frac{1}{a^{n}}.$$

The rule says that raising a nonzero real number to a negative integer is the same as raising its reciprocal to the corresponding positive integer.

Examples

1. $4^{-2} = \left(\frac{1}{4}\right)^{2} = \frac{1}{4^{2}} = \frac{1}{16}$

2. $\left(\frac{1}{2}\right)^{-3} = 2^{3} = 8$

3. $\left(-\frac{2}{5}\right)^{-2} = \left(-\frac{5}{2}\right)^{2} = \left(-\frac{5}{2}\right)\left(-\frac{5}{2}\right) = \frac{25}{4}$

4. $x^{-5} = \left(\frac{1}{x}\right)^{5} = \frac{1}{x^{5}}$

5. $\frac{1}{y^{-3}} = \left(\frac{1}{y}\right)^{-3} = y^{3}$

6. $\frac{x^{-8}}{y^{-3}} = x^{-8} \cdot \frac{1}{y^{-3}} = \left(\frac{1}{x}\right)^{8}\left(\frac{1}{y}\right)^{-3} = \frac{1}{x^{8}} \cdot y^{3} = \frac{y^{3}}{x^{8}}$

Note from Examples 4, 5, and 6 that a shortcut for dealing with negative exponents is the following: An exponential expression with a negative exponent in the numerator goes to the denominator and the exponent becomes positive; likewise, an exponential expression with a negative exponent in the denominator goes to the numerator and the exponent becomes positive. We can then do the next examples faster.

7. $\frac{2^{-3}}{n^{-10}} = \frac{n^{10}}{2^{3}} = \frac{n^{10}}{8}$

8. $\frac{-5x^{-3}y^{2}}{z^{-4}} = \frac{-5y^{2}\mathbf{z^{4}}}{\mathbf{x^{3}}}$

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Simplify the following using the negative exponent rule.

1. 5^{-3}
2. $\dfrac{1}{6^{-2}}$
3. $\left(\dfrac{1}{3}\right)^{-4}$
4. $\left(-\dfrac{3}{2}\right)^{-3}$
5. w^{-20}
6. $\dfrac{1}{m^{-14}}$
7. $\dfrac{a^{-5}}{b^{-12}}$
8. $\dfrac{2}{x^{-3}}$
9. $\dfrac{a^{-8}}{12}$
10. $\dfrac{3y^{-6}}{w^{-9}}$
11. $\dfrac{3x^{-10}}{4y^{-12}z^{20}}$
12. $\dfrac{-16a^{-3}b^{5}}{27c^{2}d^{-1}}$

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Answer Key:

1. $\frac{1}{125}$

2. 36

3. 81

4. $-\frac{8}{27}$

5. $\frac{1}{w^{20}}$

6. m^{14}

7. $\frac{b^{12}}{a^5}$

8. $2x^3$

9. $\frac{1}{12a^8}$

10. $\frac{3w^9}{y^6}$

11. $\frac{3y^{12}}{4x^{10}z^{20}}$

12. $\frac{-16b^5d}{27c^2a^3}$

Prepared by: Teresa V. Sutcliffe
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