

- 1 Simplify the following expressions, writing them as monomials in standard form. (Show at least one intermediate step for each.)

a $(-3p^7q^2)^4$

Treat each kind of factor (constant, p , q) separately; distribute the outer exponents to each factor inside; a negative number raised to the power of an even number becomes positive; raise a power to a power by multiplying exponents.

$$(-3p^7q^2)^4 = (-3)^4(p^7)^4(q^2)^4 = 3^4p^{7 \cdot 4}q^{2 \cdot 4} = 81p^{28}q^8.$$

b $(10a^3)(-4a^7)$

Treat each kind of factor (constant, a) separately; multiply powers by adding exponents.

$$(10a^3)(-4a^7) = (10 \cdot -4)a^{3+7} = -40a^{10}.$$

- 2 Consider the expression

$$\frac{-27xy^3z^4}{18x^4y^3z}.$$

- a Simplify this expression. (Show at least one intermediate step.)

Treat each kind of factor (constant, x , y , z) separately; divide powers by subtracting exponents; a missing exponent is 1; an exponent of 0 means that a variable doesn't have to appear; a negative exponent becomes a positive exponent in the denominator.

$$\frac{-27xy^3z^4}{18x^4y^3z} = -\frac{27}{18} \frac{x^1}{x^4} \frac{y^3}{y^3} \frac{z^4}{z^1} = -\frac{3}{2} x^{1-4} y^{3-3} z^{4-1} = -\frac{3}{2} x^{-3} y^0 z^3 = -\frac{3z^3}{2x^3}.$$

- b **Extra credit:** Evaluate the original expression when $x = 1$, $y = 2$, and $z = 0$. Then evaluate the simplified expression when $x = 1$, $y = 2$, and $z = 0$. Are these results the same?

For the original expression,

$$\frac{-27xy^3z^4}{18x^4y^3z} = \frac{-27(1)(2)^3(0)^4}{18(1)^4(2)^3(0)} = \frac{0}{0},$$

which is **undefined**. For the simplified expression,

$$-\frac{3z^3}{2x^3} = -\frac{3(0)^3}{2(1)^3} = -\frac{0}{2} = 0.$$

These are **different**. To avoid this, a more complete way to express the simplified form is

$$-\frac{3z^3}{2x^3} \text{ for } y, z \neq 0.$$