

4.2 Integral Exponents

Example 1 Multiply or Divide Powers With the Same Base

Write each product or quotient as a power with a single exponent.

a) $(5^8)(5^{-3})$

a) $5^{8+(-3)} \rightarrow 5^5$

b) $(0.8^{-2})(0.8^{-4})$

b) $0.8^{(-2+(-4))} \rightarrow 0.8^{-6} \rightarrow \frac{1}{0.8^6}$

c) $\frac{x^5}{x^{-3}}$

d) $\frac{(2x)^3}{(2x)^{-2}}$

c) $x^{5+(-(-3))} \rightarrow x^8$

d) $(2x)^{(3+(-(-2)))} \rightarrow (2x)^5$
 $2^5 x^5$

Example 2 Powers of Powers

Write each expression as a power with a single, positive exponent. Then, evaluate where possible.

a) $(4^3)^{-2}$

$4^{3(-2)}$
 4^{-6}
 $\frac{1}{4^6}$
 $= \frac{1}{4096}$

b) $[(a^{-2})(a^0)]^{-1}$

$[a^{(-2+0)}]^{-1}$
 $[a^{-2}]^{-1}$
 a^2

c) $\left(\frac{2^4}{2^6}\right)^{-3}$

$(2^{4-6})^{-3}$
 $(2^{-2})^{-3}$
 $2^{-2(-3)}$
 $2^6 \rightarrow 64$

d) $\left[\left(\frac{3}{4}\right)^{-2} \left(\frac{3}{4}\right)^{-2}\right]^{-2}$

$\left[\left(\frac{3}{4}\right)^{-2+(-2)}\right]^{-2}$
 $\left[\left(\frac{3}{4}\right)^{-4}\right]^{-2}$
 $\left(\frac{3}{4}\right)^{-4(-2)}$
 $\left(\frac{3}{4}\right)^8 \rightarrow \frac{6561}{65536}$

Example 3 Apply Powers With Integral Exponents

It is estimated that there are 117 billion grasshoppers in an area of 39 000 km² of Saskatchewan. Approximately how many grasshoppers are there per square kilometre?

GH/km²

$\frac{117\,000\,000\,000\text{ GH}}{39\,000\text{ km}^2}$

$\Rightarrow \frac{117 \times 10^9}{39 \times 10^3}$

$= 3\,000\,000\text{ GH/km}^2$

$= 3 \times 10^{9-3}$

$= 3 \times 10^6$

$= 3 \times 10^6$

