4.5 Negative Exponents and Reciprocals

Compare the following pairs of numbers:

- 2^{-1} and 2^{1}
- 2^{-2} and 2^{2}
- 2^{-3} and 2^{3}

What relationships do you notice?

Powers with Negative Exponents

When x is any non-zero number and n is a rational number, x^{-n} is the reciprocal of x^{n}.

That is, $x^{-n} = \dfrac{1}{x^{n}}$ and $\dfrac{1}{x^{-n}} = x^{n}$, $x \neq 0$

Example 1 — Evaluating Powers with Negative Integer Exponents

Evaluate each power.

a) 3^{-2} 　　 b) $\left(-\dfrac{3}{4}\right)^{-3}$ 　　 c) 0.3^{-4}

Example 2 — Evaluating Powers with Negative Rational Exponents

Evaluate each power without using a calculator.

a) $8^{-\frac{2}{3}}$ 　　 b) $\left(\dfrac{9}{16}\right)^{-\frac{3}{2}}$

2. Evaluate each power without using a calculator.

a) $16^{-\frac{5}{4}}$ 　　 b) $\left(\dfrac{25}{36}\right)^{-\frac{1}{2}}$

Example 3 Applying Negative Exponents

Paleontologists use measurements from fossilized dinosaur tracks and the formula $v = 0.155 s^{\frac{5}{3}} f^{-\frac{7}{6}}$ to estimate the speed at which the dinosaur travelled. In the formula, v is the speed in metres per second, s is the distance between successive footprints of the same foot, and f is the foot length in metres. Use the measurements in the diagram to estimate the speed of the dinosaur.