Mathematics 10

4.6 Applying the Exponent Laws

$a^m \cdot a^n = a^{m+n}$	$\frac{a^m}{a^n} = a^{m-n}$	$(a^m)^n = a^{mn}$
$(ab)^n = a^n b^n$	$\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$	$a^0 = 1 \quad (a \neq 0)$
$a^{1/n} = \sqrt[n]{a}$	$a^{m/n} = \left(\sqrt[n]{a}\right)^m = \sqrt[n]{a^m}$	$a^{-n} = \frac{1}{a^n} \quad (a \neq 0)$

Example: Simplify by writing each expression as a single power.
Your answer must have only **positive exponents** in it.

a) $0.6^4 \cdot 0.6^{-7}$

$= 0.6^{-3}$

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

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

b) $\left[\left(-\frac{4}{5}\right)^2\right]^{-3} \div \left[\left(-\frac{4}{5}\right)^4\right]^{-5}$

$= \left(-\frac{4}{5}\right)^{-6} \div \left(-\frac{4}{5}\right)^{-20}$

$= \left(-\frac{4}{5}\right)^{-26}$

$= \left(-\frac{5}{4}\right)^{26}$

c) $\frac{\left(1.5^{-3}\right)^{-5}}{1.5^5}$

$= \frac{1.5^{15}}{1.5^5}$

$= 1.5^{10}$

d) $\frac{9^{5/4} \cdot 9^{-1/4}}{9^{3/4}}$

$= \frac{9^{4/4}}{9^{3/4}}$

$= 9^{1/4}$

Example: Simplify by writing each expression as a single power.
Your answer must have only **positive exponents** in it.

a) $m^4n^{-2} \cdot m^2n^3$

$= m^6n^1$

b) $\frac{6x^4y^{-3}}{14xy^2}$

$= \frac{3}{7}x^3y^{-5}$

$= \frac{3x^3}{7y^5}$

c) $\left(25a^4b^2\right)^{3/2}$

$= 25^{3/2} \cdot a^{4 \cdot 3/2} \cdot b^{2 \cdot 3/2}$

$= (\sqrt{25})^3 a^6 b^3$

$= 5^3 a^6 b^3$

$= 125 a^6 b^3$

d) $\left(x^3y^{-3/2}\right)\left(x^{-1}y^{1/2}\right)$

$= x^2y^{-2/2}$

$= \frac{x^2}{y}$

e) $\frac{12x^{-5}y^{5/2}}{3x^{1/2}y^{-1/2}}$

$= 4x^{-11/2}y^{6/2}$

$= \frac{4y^3}{x^{11/2}}$

f) $\left(\frac{50x^2y^4}{2x^4y^7}\right)^{1/2}$

$= (25x^{-2}y^{-3})^{1/2}$

$= \sqrt{25}\, x^{-1} \cdot y^{-3/2}$

$= \frac{5}{xy^{3/2}}$

Example: Simplify each expression, then evaluate:

a) $\left(\frac{3}{2}\right)^{\frac{3}{2}}\left(\frac{3}{2}\right)^{\frac{1}{2}}$

$= \left(\frac{3}{2}\right)^{4/2}$

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

$= \frac{9}{4}$

b) $\frac{(-5)^{\frac{2}{3}}}{(-5)^{-\frac{4}{3}}}$

$= (-5)^{6/3}$

$= (-5)^{2}$

$= 25$

c) $\left[\left(\frac{-12}{5}\right)^{\frac{1}{3}}\right]^{6}$

$= \left(-\frac{12}{5}\right)^{6/3}$

$= \left(-\frac{12}{5}\right)^{2}$

$= \frac{144}{25}$

d) $\frac{0.16^{\frac{3}{4}}}{0.16^{\frac{1}{4}}}$

$= 0.16^{2/4}$

$= 0.16^{1/2}$

$= \left(\frac{16}{100}\right)^{1/2}$

$= \sqrt{\frac{16}{100}} = \frac{4}{10} = 0.4$

Example: A sphere has volume $425m^3$. What is the radius of the sphere to the nearest tenth of a metre?

$V = \frac{4}{3}\pi r^3$

$\frac{3}{4\pi} \cdot 425 = \frac{4}{3}\pi r^3 \cdot \frac{3}{4\pi}$

$r^3 = 101.4612762$

$r = 4.7m$

Example: Evaluate the expression for a = 2 and b = –3

$\left(\frac{a^{-8}b^{2}}{a^{-10}b^{5}}\right)^{-1} = \frac{a^{-10}b^{5}}{a^{-8}b^{2}} = a^{-2}b^{3} = \frac{b^3}{a^2}$

$\frac{(-3)^3}{(2)^2} = -\frac{27}{4}$