# Exponent Rules & Percentage Error

EQ: How can we use exponent rules to simplify complex math problems in Algebra?

Why does this work?

1. Product Rule: $a^m \cdot a^n = a^{m+n}$
   $4^2 \cdot 4^3 = 4^5 \approx 1024$

What is the difference between approximation and estimation?

2. Quotient Rule: $\frac{a^m}{a^n} = a^{m-n}$
   $\frac{5^9}{5^3} = 5^6 \approx 15,625$

3. Power Rule: $(a^m)^n = a^{m \cdot n}$
   $(3^2)^3 = 3^6 \approx 729$

4. Power of a Product: $(ab)^n = a^n \cdot b^n$
   $(2 \cdot 5)^2 = 2^2 \cdot 5^2 \approx 100$

What is the reverse of square root?

5. Zero Exponent: $a^0 = 1$
   $1002^0 = 1$

6. Negative Exponent: $a^{-n} = \frac{1}{a^n}$
   $5^{-2} = \frac{1}{5^2} \approx 1/25$

7. Fractional Exponent: $a^{\frac{m}{n}} = \sqrt[n]{a^m}$
   $4^{2/3} = \sqrt[3]{4^2} \approx \sqrt[3]{16}$

$\frac{8x^5}{4x^2} = 2x^2$ This works because the bases are the same and it is divisible

Error = $V_A - V_E$ Percentage Error = $\frac{|V_A - V_E|}{V_E} \times 100\%$

We can use exponent rules as a way of chunking out the problem to make simplifying easier. We are able to manipulate the equations into easier operations to solve the exponent.

$V_E$: exact value    $V_A$: approximate value

- **Approximation:** value given to a number which is close to, but not equal to, its true value

- **Estimation:** value which has been found by judgement or prediction instead of carrying out a more accurate measurement

- **Error:** difference between measurement and the actual value

## Accuracy of Measurement

A measurement is accurate to +/- 1/2 the smallest division of the scale

Example) ± 1/2 Kg of 1.4 Kg + .5 = 1.9 Kg
.5 Kg    1.4 Kg - .5 = .9 Kg

Range
.9 Kg to 1.9 Kg

# Practice Side: Exponent Rules & Percentage Error

$x \cdot x \cdot x \cdot x = x^4$ > NOT THE SAME!
$x + x + x + x = 4x$

Power of 2 : 32
$= 2^5$

$\frac{125x^4y^3z^{-2}}{5xy^{-2}z} = 25x^3y^5z^{-3}$

Power of 3: 243
$= 3^5$

$(2\frac{3}{5})^{-3} = (\frac{13}{5})^{-3} = \frac{13^{-3}}{5^{-3}} = \frac{5^3}{13^3} = 125/2197 \approx .0567$

$(4\frac{2}{3})^{-2} = (\frac{14}{3})^{-2} = \frac{14^{-2}}{3^{-2}} = \frac{3^2}{14^2} = 9/196 = .0459 \approx .046$

m | 200,000m2 | .4Km

$.4Km \left(\frac{1000m}{1Km}\right) = 400m \cdot 500m = 200,000m^2$

Estimate - 250,000m²

$PE = \frac{200,000 - 250,000}{200,000} \times 100 = 25\%$

0mm | 960m2 | .30Km

$.30Km \left(\frac{1000m}{1Km}\right) = 300m$ $\quad 3200mm \left(\frac{1m}{1000mm}\right) = 3.2m$

$PE = \frac{1,000 - 960}{960} \times 100 = 4.16\% \approx 4.17\%$

39.5m - 40.5m

40m

±.5m | 5m | .5m

±.5m

Low: $39.5 \times 74.5 = 2942.75m^2$
High: $40.5 \times 75.5 = 3057.75m^2$