

Exponent Rules & Percentage Error

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

Why does this work?

What is the difference between approximation and estimation?

What is the inverse of square root?

1. Product Rule: $a^m \cdot a^n = a^{m+n}$

$$4^2 \cdot 4^3 = 4^5 \approx 1024$$

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: $(ab)^n = a^n \cdot b^n$

$$(2 \cdot 5)^2 = 2^2 \cdot 5^2 \approx 100$$

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

$$1002^0 = 1$$

6. Negative Exponent: $a^{-n} = \frac{1}{a^n}$

$$5^{-2} = \frac{1}{5^2} \approx \frac{1}{25}$$

7. Fractional Exponent: $a^{\frac{m}{n}} = \sqrt[n]{a^m}$

$$4^{\frac{2}{3}} = \sqrt[3]{4^2} \approx \sqrt[3]{16}$$

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

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

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 $\pm \frac{1}{2}$ the smallest division of the scale

Example) $\pm \frac{1}{2} \text{ Kg}$ of $1.4 \text{ Kg} + .5 = 1.9 \text{ Kg}$
 $.5 \text{ Kg}$ $1.4 \text{ Kg} - .5 = .9 \text{ Kg}$

Range
.9 Kg to 1.9 Kg

Practice Side: Exponent Rules & Percentage Error

$$x \cdot x \cdot x \cdot x = x^4$$

$$x+x+x+x = 4x > \text{NOT THE SAME!}$$

Power of 2: 32
 $= 2^5$

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

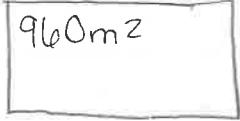
Power of 3: 243
 $= 3^5$

$$(2\frac{3}{5})^{-3} = \left(\frac{13}{5}\right)^{-3} = \frac{13^{-3}}{5^{-3}} = \frac{5^3}{13^3} = \frac{125}{2197} \approx 0.0567$$

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

m  $\cdot 4 \text{ Km} \left(\frac{1000 \text{ m}}{1 \text{ Km}}\right) = 400 \text{ m} \cdot 500 \text{ m} = 200,000 \text{ m}^2$
 Estimate - 250,000 m²

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

mm  $\cdot 30 \text{ Km} \left(\frac{1000 \text{ m}}{1 \text{ Km}}\right) = 300 \text{ m} \quad 3200 \text{ mm} \left(\frac{1 \text{ m}}{1000 \text{ mm}}\right) = 3.2 \text{ m}$
 $\text{PE} = \frac{1,000 - 960}{1,000} \times 100 = 4.16\% \approx 4.17\%$

1.5m  $39.5 \text{ m} = 40.5 \text{ m}$
 5m $\pm .5 \text{ m}$ Low: $39.5 \times 74.5 = 2942.75 \text{ m}^2$
 High: $40.5 \times 75.5 = 3057.75 \text{ m}^2$