Worksheet 5-3: Applications of Powers and Exponents

1. The intensity of an earthquake can range from 1 to 10 000 000. The Richter scale is a base-10 exponential scale used to classify the magnitude of an earthquake. An earthquake with an intensity of 100 000 or 10^5, has a magnitude of 5 as measured on the Richter scale. The chart shows how magnitudes are related.

Intensity	Magnitude	Earthquake Effects
Up to $10^{2.5}$	2.5 or less	Usually not felt, but can be recorded by seismograph.
$10^{2.5}$ to $10^{5.4}$	2.5 to 5.4	Often felt, but only causes minor damage.
$10^{5.5}$ to $10^{6.0}$	5.5 to 6.0	Slight damage to buildings and other structures.
$10^{6.1}$ to $10^{6.9}$	6.1 to 6.9	May cause heavy damage in very populated areas.
$10^{7.0}$ to $10^{7.9}$	7.0 to 7.9	Major earthquake. Serious damage.
$10^{8.0}$ and greater	8.0 or greater	Great earthquake. Can totally destroy communities near the epicentre.

An earthquake measuring 2 on the Richter scale can barely be felt, but one measuring 6 often causes damage. An earthquake with magnitude 7 is considered a major earthquake.

Note: Earthquakes are compared by dividing their intensities.

(a) How much more intense is an earthquake with magnitude 6 than one with magnitude 2?

$10^6 \div 10^2$
$= 10^{6-2}$
$= 10^4$
$= 10000$

An earthquake with magnitude 6 is 10000 times more intense than one with magnitude 2.

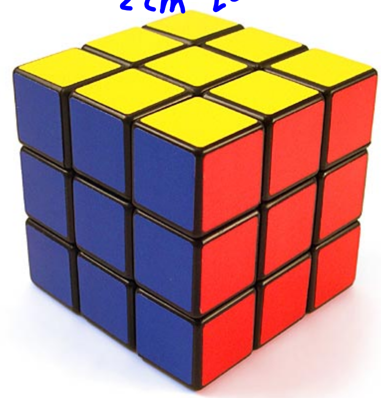
(b) How much more intense is an earthquake with magnitude 7 than one with magnitude 6?

$10^7 \div 10^6$
$= 10^1$
$= 10$

∴ An earthquake with magnitude 7 is 10 times as intense as one with magnitude 6.

2. Rubik's Cube® is a large cube made of small congruent cubes. Each small cube has edges about 2 cm long. The cubes on each face of the Rubik's Cube® are arranged in 3 rows of 3. What is the approximate volume of the Rubik's Cube®?

2cm 2cm



$l \times w \times h$

$= 2^3 \times 3^3$

$= 8 \times 27$

$= 216\ cm^3$

∴ The approximate volume is $216 cm^3$.

3. Mr. Chong-Yen presented his math class the following problem involving negative exponents. Every 80 million years, 2^{-1} of the mass of a sample of plutonium-244 decays to a different element. If the original mass of a sample of plutonium-244 was 16 g, determine the mass remaining after:

(a) 80 million years

$2^{-1} = \frac{1}{2}$ $6 \times \frac{1}{2}$

16×2^{-1}

$= 8$ Remaining mass is 8g.

(b) 240 million years

How many 80 million years are there in 240 million years. 3

$3 \times 80 = 240$

3 times the halfing process

$16 \times (2^{-1})^3$

$= 2$ Remaining mass is 2g.