TRS 92 Homework: Equivalent Expression

- Review reading from Section 5.5 p. 452-457 & Section 5.6 p. 463-465
- Complete MML: Multiplying Polynomials

Thinking Back about Percentages

1. The *Population Reference Bureau* estimates that the population of the "less developed" nations in mid-2009 was 5,578,000,000 people and that will grow by 45% by 2050.
   a. *Estimate* the population in 2050. Explain your estimation strategy.

   b. *Calculate* the population in 2050. Show your work.

   c. Write your answer in scientific notation.

2. The *Population Reference Bureau* estimates that approximately 331 million of the 828 million people living in the world's least developed countries in 2009 were under the age of 15.
   a. *Estimate* the percentage of people under the age of 15. Explain your estimation strategy.

   b. *Calculate* the percentage. Show your work.

Preparing to work with Roots

Operations that reverse each other are called **inverse operations**. For example, addition and subtraction "undo" each other so they are inverse operations:

$8 + 7 = 15 \quad \leftrightarrow \quad 15 - 8 = 7$

Suppose we had to describe the second number sentence above without the concept of subtraction. We could say: What number added to 8 gives you 15?

The same goes for multiplication and division:

$6 \times 5 = 30 \quad \leftrightarrow \quad 30 \div 5 = 6$

We could describe the division problem above as: "What number divided by 5 gives you 6?"

How can you reverse an exponent? Start by answering the following questions **using a calculator for guess and check**. TI calculators use "^", called a "carat" for a power. To calculate 6^4, type 6^4. The "^" key is above the ÷ symbol on the calculator.

1. What number(s) raised to the 5^{th} power gives you 32? __________
2. What number(s) raised to the 3^{rd} power gives you -64? __________
3. What number(s) raised to the 4^{th} power gives you 625? __________

You can see that writing out the question in words is long and confusing. So there is a name for the operation. The inverse of an exponent is called **a root**. With exponents, we have to designate the power that is being used -- 3^{rd} power, 4^{th} power, etc. The same is true with roots. A *third root* is the inverse of a 3^{rd} power, a *fourth root* is the inverse of a 4^{th} power.

So another way to ask the questions above would be to say:

- What is the 5^{th} root of 32?
- What is the 3^{rd} root of -64? (A third root is commonly called a "**cube root**".)
- What is the 4^{th} root of 625?

Answer the following questions **using a calculator for guess and check purposes**.

4. What is the 2^{nd} root of 100? __________
   Note: A second root is commonly called a "square root".

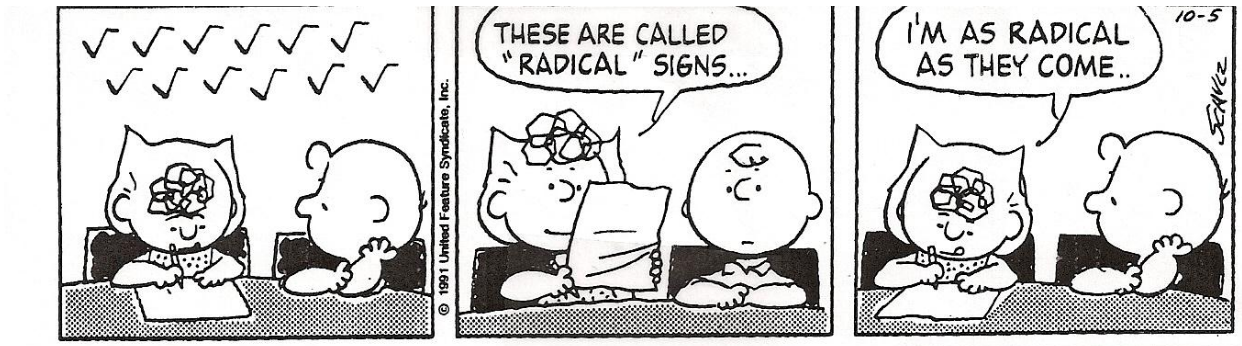
5. What is the cube root of 27? __________

6. What is the 6^{th} root of x^6? __________

But writing out the question in words is still time-consuming and it can't be used in equations, so we need a notation for the operation of reversing an exponent. The notation is called a **radical sign**. Open your textbook to page 647.

7. Record here the parts of the radical notation shown on page 647.

In this notation, the index indicates the "power" of the root and the radicand is the number you are taking a root of. So the examples above can be written with radical notation as shown below.



Written as an question about an inverse operation…	**Written as a root…**	**Written with radical notation…**
What number(s) raised to the 5th power gives you 32?	What is the 5th root of 32?	$\sqrt[5]{32}$
What number(s) raised to the 3rd power gives you -64?	What is the 3rd (cube) root of -64?	$\sqrt[3]{-64}$
What number(s) raised to the 4th power gives you 625?	What is the 4th root of 625?	$\sqrt[4]{625}$

Many people call the radical sign a "square root sign" because the square root is the most commonly used root. Because it is used so much, people got in the habit of not writing the index for a square root. A root with no index is assumed to have an index of 2:

$$\sqrt[2]{81} = \sqrt{81}$$

Connection to previous learning: You have seen other examples of "assumed" notation before. Here are some examples:

- 3 is assumed to be positive → +3
- 10 is assumed to have denominator of 1 → $\frac{10}{1}$
- x is assumed to have a coefficient of 1 → 1x
- 5y is assumed to indicate multiplication → 5·y

As in the last example in the box above, multiplication with a radical sign can be indicated without a multiplication symbol:

$2\sqrt[3]{216}$ means *2 times the cube root of 216.*

8. Write the following expressions using radical notation.
   a. 5 times the square root of 40

   b. cube root of 756

   c. sixth root of a^{12}

The roots of some numbers are integers. These numbers are called "perfect". For example 25 is a "perfect square" because $\sqrt{25}$ is an integer. But 27 is not a perfect square (although it is a *perfect cube*). $\sqrt{27}$ is an ***irrational number*** meaning that it cannot be represented as a fraction (many people think of this as a number that has decimal places that go on forever with no repeating pattern). You can also take the root of an algebraic term. As with numbers, some terms are "perfect" and others are not.

9. **Use estimation** to select the best answer from the numbers given. Circle your selection.

a.	$\sqrt{61}$	is about…	30	12	3	8
b.	$\sqrt{95}$	is about…	10	5	50	2
c.	$\sqrt[3]{30}$	is about	10	3	5	6
d.	$\sqrt[3]{60}$	is about	10	4	20	3