YOU MUST BE ABLE TO DO THE FOLLOWING PROBLEMS WITHOUT A CALCULATOR!

Exponents

Exponents or powers indicate how many times a number is multiplied by itself.

Following are some examples:

- \(3^0\) indicates 1. The value of any number with an exponent of 0 equals 1. The only exception is 0. When raising it to the 0 power, its value is undefined.

- \(3^1\) indicates 3. It is customary in mathematics NOT to write the exponent 1.

- \(3^2\) indicates \(3(3) = 9\).

NOTE: Numbers that result form other numbers being raised to a power are also referred to as perfect powers!

- \(3^2\) is called an exponential expression and is read as "3 squared" or "three to the second power" or "three raised to the second power."

3 is called the base and 2 is called the exponent or power. The power indicates how many times the base is supposed to be multiplied by itself.

- \(3^3\) indicates \(3(3)(3) = 27\). It is read as "three cubed" or "three to the third power" or "three raised to the third power."

- \(3^4\) indicates \(3(3)(3)(3) = 81\). It is read as "three to the fourth power" or "three raised to the fourth power."
Finding a root reverses the operation of finding a power. The radical sign $\sqrt{\phantom{m}}$ indicates this process.

Following are some examples!

- To undo $3^4 = 81$, we write $\sqrt[4]{81} = 3$, where 4 is called the **index** and 81 is called the **radicand**. It is read as the "fourth root of 81." We call $\sqrt[4]{81}$ a radical expression.

- To undo $3^3 = 27$, we write $\sqrt[3]{27} = 3$. It is read as the "third root of 27" or the "cube root of 27."

- To undo $3^2 = 9$, we write $\sqrt{9} = 3$. It is read strictly as the "square root of 9." Please note when the index is 2 it is customarily left off.

What about $\sqrt{10}$. Here we don't immediately know a number that when multiplied by itself results in a product of 10. Usually, these radicals are evaluated using a calculator. If a calculator is not handy, we can make a rough estimate and say that the value of $\sqrt{10}$ must be slightly greater than 3 because we know that $\sqrt{9} = 3$.

**Problem 1:**

Evaluate $10^3$.

$10(10)(10) = 1,000$

**Problem 2:**

Evaluate $2^5$.

$2(2)(2)(2)(2) = 32$

**Problem 3:**

Evaluate $3.4^2$.

$3.4(3.4) = 11.56$

**Problem 4:**

Evaluate $5,982^0$.

The value of any number with an exponent of 0 equals 1.

$5,982^0 = 1$
Problem 5:

Evaluate $1^{23}$.

Since $1(1)(1)(1)\ldots(1)$ always equals 1 no matter how many times we multiply it by itself, we can say that

$1^{23} = 1$

Problem 6:

Evaluate $0^{41}$.

Since $0(0)(0)(0)\ldots()$ always equals 0 no matter how many times we multiply it by itself, we can say that

$0^{41} = 0$

Problem 7:

Evaluate $\left(\frac{1}{8}\right)^2$.

$\frac{1}{8}\left(\frac{1}{8}\right) = \frac{1(1)}{8(8)} = \frac{1}{64}$

Problem 8:

Evaluate $\left(\frac{2}{5}\right)^3$.

$\frac{2}{5}\left(\frac{2}{5}\right)\left(\frac{2}{5}\right) = \frac{2(2)(2)}{5(5)(5)} = \frac{8}{125}$

Problem 9:

Evaluate $\left(\frac{1}{3}\right)^0$.

The value of any number with an exponent of 0 equals 1.

$\left(\frac{1}{3}\right)^0 = 1$
Problem 10:

Evaluate $\sqrt{1}$.

Since $1(1) = 1$, no matter what the index, a radical expression containing a radicand of $1$ always has a value of $1$.

That is, $\sqrt{1} = 1$.

Problem 11:

Evaluate $\sqrt{0}$.

Since $0(0) = 0$, no matter what the index, a radical expression containing a radicand of $0$ always has a value of $0$.

That is, $\sqrt{0} = 0$.

Problem 12:

Evaluate $\sqrt{36}$.

Since $6(6) = 36$, we can say that $\sqrt{36} = 6$.

Problem 13:

Evaluate $\sqrt{100}$.

Since $10(10) = 100$, we can say that $\sqrt{100} = 10$.

Problem 14:

Evaluate $\sqrt{81}$.

Since $9(9) = 81$ we can say that $\sqrt{81} = 9$.

Problem 15:

Evaluate $\sqrt{400}$.

Since $20(20) = 400$, we can say that $\sqrt{400} = 20$. 
Problem 16:

Evaluate $\sqrt{0.64}$.

We know that $8(8) = 64$. Then $0.8(0.8) = 0.64$. Therefore, $\sqrt{0.64} = 0.8$

Problem 17:

Considering perfect squares, find two successive decimal numbers between which the value of $\sqrt{0.69}$ is located.

**NOTE:** Numbers that result from other numbers being raised to the second power are also referred to as "perfect squares"!

We know that $\sqrt{0.64} = 0.8$ and $\sqrt{0.81} = 0.9$. Please note that we would consider 0.64 and 0.81 perfect squares because they result from two numbers, namely 0.8 and 0.9, being raised to the second power.

Therefore, the value of $\sqrt{0.69}$ must be between 0.8 and 0.9.

Problem 18:

Considering perfect squares, find two successive decimal numbers between which the value of $\sqrt{0.55}$ is located.

We know that $\sqrt{0.49} = 0.7$ and $\sqrt{0.64} = 0.8$.

Therefore, the value of $\sqrt{0.55}$ must be between 0.7 and 0.8.