Purpose: Review concepts of decimals and scientific notation.

Content Objectives: Decimals, scientific notation, conversion.

Materials Needed: None (calculator optional).

Instructions: Go through the following exercises, and answer the given questions completely. You must show all work.

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Background:

**Base Ten System:**
- The Hindu-Arabic Numeration system was developed about 800AD.
- It uses 10 symbols (0 1 2 3 4 5 6 7 8 9) or *digits*.
- It is grouped by tens (also known as a decimal system), being that each digit has a place value of $10^n$.
- Each number can be broken down into what is called *expanded form*.
  - i.e. $542 = 5 \times 10^2 + 4 \times 10^1 + 2 \times 10^0$

**Question:**
Express 1,001 in expanded form

Solution: $1 \times 10^3 + 1 \times 10^0$

Express 1,012,234 in expanded form

Solution: $1 \times 10^6 + 1 \times 10^4 + 2 \times 10^3 + 2 \times 10^2 + 3 \times 10^1 + 4 \times 10^0$

**Form of the Decimal:**
- The decimal point is used for any values that are less than 1, it is our way of separating the powers of 10 from the positive (0, 1, 2, 3 etc) to the negative (-1, -2, -3, etc).

**Example**
$123.567 = 1 \times 10^2 + 2 \times 10^1 + 3 \times 10^0 + 5 \times 10^{-1} + 6 \times 10^{-2} + 7 \times 10^{-3}$

- In the above example, the 5 is in the tenths place, the 6 is in the hundredths place, and the 7 is in the thousandths place.

**Questions:**
Express 0.005 in expanded form

Solution: $5 \times 10^{-3}$

Express 34.0002 in expanded form

Solution: $3 \times 10^1 + 4 \times 10^0 + 2 \times 10^{-4}$

**Scientific Notation:**
- **Scientific notation** for a number is an expression of the form $N \times 10^m$, where $1 \leq N < 10$, $N$ is in decimal form, and $m$ is an integer.
- Large numbers have a positive exponent $m$, and small numbers have a negative exponent $m$. It has nothing to do with the sign of the number, only its size.
  - i.e. $4.5 \times 10^4 = 45,000$  $4.5 \times 10^{-4} = 0.00045$
To convert a number to scientific notation:
1. Move the decimal place to the left for large numbers (or right for small numbers)
2. Keep track of the number of moves you make
3. Stop when you reach a value of $N$ between 1 and 10 (say $m$ times)
4. This will be $+m$ (moving left) or $-m$ (moving right)

Example. Convert $1,670,000$ to scientific notation
The decimal moves 6 times to the right $1.67 \times 10^6$

Example. Convert $0.00000000514$ to scientific notation
The decimal moves 9 times to the left to yield $5.14 \times 10^{-9}$

To convert from scientific notation, write down $N$, move the decimal place $m$ units (to the left if negative, to the right if positive)

Example. Convert $3.15 \times 10^{-6}$ to decimal notation
Solution: $0.00000315$

Example. Convert $8.409 \times 10^{11}$ to decimal notation
Solution: $840,900,000,000$

Problem Set:
1. The average human head has about 100,000 hair follicles. Write this in scientific notation
   Solution: $1 \times 10^5$

2. Today’s world population is 6.5 billion, and the population of the U.S. is 298,444,215. Write both of these values in scientific notation. Find the percentage of U.S. to world population.
   Solution: $6.5 \times 10^9, 2.98 \times 10^8$
   Solution: $4.58\%$

3. The following are local populations: City of Las Vegas (478,434), City of Henderson (175,381), City of North Las Vegas (115,488), Clark County (1,375,765), Nevada (1,998,257)
   In scientific notation, how many residents in Clark County? Solution: $1.375765 \times 10^6$
   How many in Clark County that are NOT in the listed cities? Solution: $606,462$
   What is the percentage of Nevada’s population in Clark County? Solution: $68.84\%$

4. The mean distance to the sun is $150 \times 10^6$ km. Write this in decimal notation.
   Solution: $150,000,000$ km

5. 1 mile is about $1.6099344$ km. Convert the distance to the sun (above) to miles.
   Solution: $93,171,498.17$ miles

6. The circumference of the earth is approximately $24,900$ miles. How many times would you have to go around the earth to cover the distance to the sun?
   Solution: $3741.8$ times