Using Scientific Notation in Calculations, Part 1

Example 1. How many times bigger is one number than another?

You can easily tell that \$60 is three times as much as \$20. But what about \$500,000 and \$150,000,000? Scientific notation makes these types of comparisons very straightforward.

First we write the numbers in scientific notation: $\$500{,}000 = 5 \cdot 10^5$ and $\$150{,}000{,}000 = 1.5 \cdot 10^8$. Next we divide them, using the quotient rule for exponents: $\dfrac{1.5 \cdot 10^8}{5 \cdot 10^5} = \dfrac{1.5}{5} \cdot \dfrac{10^8}{10^5} = 0.3 \cdot 10^3 = 0.3 \cdot 1000 = 300.$

So, the larger number is 300 times the other. No calculator needed, and in fact, if the exponents had been larger, a regular calculator would not handle the numbers in decimal notation.

Don't confuse the above with simple comparisons where we determine which number is greater, such as $32{,}000 < 6 \cdot 10^4$. The above is a *multiplicative* comparison: how many *times* bigger is one number than another?

Do not use a calculator in the problems on this page.

1. The mass of the sun is about $2 \cdot 10^{30}$ kg. The mass of the Earth is about $6 \cdot 10^{24}$ kg. About how many times more massive is the sun than the earth?

2. **a.** How many times bigger is $6 \cdot 10^{-20}$ than $3 \cdot 10^{-30}$?

   b. How many times bigger is $2 \cdot 10^4$ than $8 \cdot 10^{-4}$?

3. The speed of light is approximately $3 \cdot 10^5$ km/s. The distance from earth to sun is approximately 150 million kilometers.

   a. Write the distance in scientific notation.

   b. Now use the two numbers that are in scientific notation, and calculate how long it takes for sunlight to travel from the sun to the earth.

   Give thought to *which* unit of time you will use for the answer; in other words, which unit makes most sense considering the context.