Adding and Subtracting with Scientific Notation

Let's add and subtract using scientific notation to answer questions about animals and the solar system.

13.1 Math Talk: Nonzero Digits

Decide mentally how many nonzero digits each number will have.

- $(3 \times 10^9)(2 \times 10^7)$
- $(3 \times 10^9) \div (2 \times 10^7)$
- $3 \times 10^9 + 2 \times 10^7$
- $3 \times 10^9 - 2 \times 10^7$

13.2 Measuring the Planets

Diego, Kiran, and Clare were wondering:

"If Neptune and Saturn were side by side, would they be wider than Jupiter?"

1. They start by trying to add 4.9×10^4 km and 1.2×10^5 km, the diameters of Neptune and Saturn. Here are the ways they approached the problem. Do you agree with any of them? Explain your reasoning.

   a. Diego says, "When we add the distances, we will get $4.9 + 1.2 = 6.1$. The exponent will be 9. So the two planets are 6.1×10^9 km side by side."

   b. Kiran wrote 4.9×10^4 as 49,000 and 1.2×10^5 as 120,000 and added them:

   $$\begin{array}{r} 120{,}000 \\ +49{,}000 \\ \hline 169{,}000 \end{array}$$

   c. Clare says, "I think you can't add unless they are the same power of 10." She adds 4.9×10^4 and 12×10^4 to get 16.9×10^4.

13.3 A Celestial Dance

object	diameter (km)	distance from the Sun (km)
Sun	1.392×10^6	0×10^0
Mercury	4.878×10^3	5.79×10^7
Venus	1.21×10^4	1.08×10^8
Earth	1.28×10^4	1.47×10^8
Mars	6.785×10^3	2.28×10^8
Jupiter	1.428×10^5	7.79×10^8

1. When you add the distances from the Sun of Mercury, Venus, Earth, and Mars, would you reach as far as Jupiter? Explain or show your reasoning.

2. Add the diameters of all the objects on the table except the Sun. Which is wider, all of these planets side-by-side, or the sun? Explain or show your reasoning.

Are you ready for more?

Standard aluminum foil has a thickness of about 6×10^{-3} inches. A sheet of tissue paper has a thickness of 3.9×10^{-4} inches. How thick would a stack of 1 sheet of aluminum foil and 2 sheets of tissue paper be, in inches?

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13.4 A Massive Farm

The table shows the average mass of one individual creature and an estimated total number of those creatures on Earth. Use the table to answer each question, and explain or show your reasoning.

creature	total number	mass of one individual (kg)
humans	7.5×10^9	6.2×10^1
cows	1.3×10^9	4×10^2
sheep	1.75×10^9	6×10^1
chickens	2.4×10^{10}	2×10^0
ants	5×10^{16}	3×10^{-6}
blue whales	4.7×10^3	1.9×10^5
antarctic krill	7.8×10^{14}	4.86×10^{-4}
zooplankton	1×10^{20}	5×10^{-8}
bacteria	5×10^{30}	1×10^{-12}

1. On a farm there was a cow. And on the farm there were 2 sheep. There were also 3 chickens. What is the total mass of the 1 cow, the 2 sheep, the 3 chickens, and the 1 farmer on the farm?

2. What is the total mass of a human, a blue whale, and 6 ants all together?

3. Which is greater, the number of bacteria, or the number of all the other animals in the table put together?

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Lesson 13 Summary

When adding decimal numbers, we need to pay close attention to place value. For example, when we calculate $13.25 + 6.7$, we need to make sure to add hundredths to hundredths (5 and 0), tenths to tenths (2 and 7), ones to ones (3 and 6), and tens to tens (1 and 0).

$$\begin{array}{r} 13.25 \\ +6.7 \\ \hline 19.95 \end{array}$$

We need to take the same care when we add or subtract numbers in scientific notation. For example, suppose we want to find how much farther Earth is from the Sun than Mercury is from the Sun. Earth is about 1.5×10^8 km from the Sun, while Mercury is about 5.8×10^7 km. In order to find

$$1.5 \times 10^8 - 5.8 \times 10^7$$

we can rewrite this as

$$1.5 \times 10^8 - 0.58 \times 10^8$$

Now that both numbers are written in terms of 10^8, we can subtract 0.58 from 1.5 to get

$$0.92 \times 10^8$$

Rewriting this in scientific notation, Earth is

$$9.2 \times 10^7$$

km farther from the Sun than Mercury is from the Sun.