Unit 7, Lesson 8

Representing Large Numbers on the Number Line

Let's visualize large numbers on the number line using powers of 10.

8.1 Base-Ten Representations Matching

Match each expression to one or more diagrams that could represent it. For each match, explain what the value of a single small square would have to be.

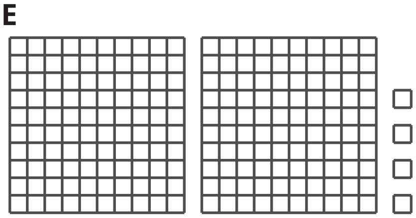
A. $2 \cdot 10^{-1} + 4 \cdot 10^{-2}$

B. $2 \cdot 10^{-1} + 4 \cdot 10^{-3}$

C. $2 \cdot 10^{3} + 4 \cdot 10^{1}$

D. $2 \cdot 10^{3} + 4 \cdot 10^{2}$

E



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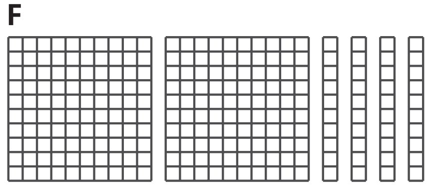

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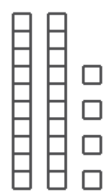
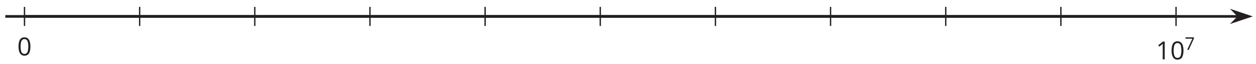


8.2 Comparing Large Numbers with a Number Line



1. Place the numbers on the number line. Be prepared to explain your reasoning.
   a. 4,000,000
   b. $5 \cdot 10^6$
   c. $5 \cdot 10^5$
   d. $75 \cdot 10^5$
   e. $(0.6) \cdot 10^7$

2. Which is larger, 4,000,000 or $75 \cdot 10^5$? Estimate how many times larger.

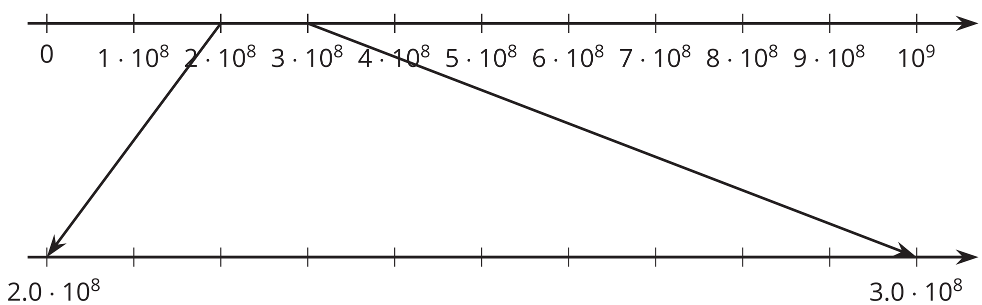
3. Compare number lines with a partner, and discuss how you each decided where each point should go. If you disagree about a placement, work to reach an agreement.

8.3 The Speeds of Light

The table shows how fast light waves can travel through different materials.

	material	speed (meters per second)
A	space	300,000,000
B	water	$(2.25) \cdot 10^8$
C	copper wire (electricity)	280,000,000
D	diamond	$124 \cdot 10^6$
E	ice	$(2.3) \cdot 10^8$
F	olive oil	200,000,000

Let's zoom in to highlight the values between $(2.0) \cdot 10^8$ and $(3.0) \cdot 10^8$.



1. Label the tick marks between $(2.0) \cdot 10^8$ and $(3.0) \cdot 10^8$. Then plot a point for the speed of light through each material A–F on one of the number lines.
2. There is one material whose speed you cannot plot on the bottom number line. Which is it? If you haven't already, plot the point for this material on the top number line.
3. Which travels faster—light through a diamond or light through ice? How can you tell from the given expressions for the speed of light? How can you tell from the number line?

Are you ready for more?

Find a four-digit number using only the digits 0, 1, 2, or 3 and all of the following are true:

- The first digit tells you how many zeros are in the number.
- The second digit tells you how many ones are in the number.
- The third digit tells you how many twos are in the number.
- The fourth digit tells you how many threes are in the number.

The number 2,100 is close, but doesn't quite work. The first digit is 2, and there are 2 zeros. The second digit is 1, and there is 1 one. The fourth digit is 0, and there are no threes. But the third digit, which is supposed to count the number of 2's, is zero.

1. Can you find more than one number like this?
2. How many solutions are there to this problem? Explain or show your reasoning.

Lesson 8 Summary

Suppose we want to compare the number of pennies the U.S. Mint made in 2020, about 7,600,000,000, to the number of one dollar bills printed by the U.S. Bureau of Engraving and Printing in the same year (about 1.6 billion). There are many ways to do this.

We could write 1.6 billion as a decimal value, 1,600,000,000, and then we can tell that in 2020 there were more pennies made than one dollar bills printed.

Or we could use powers of 10 to write these numbers:

$(7.6) \cdot 10^9$ for the number of pennies and

$(1.6) \cdot 10^9$ for the number of one dollar bills.

Since both numbers are written using the same power of 10, we can compare 7.6 to 1.6 and confirm that there were more pennies made than one dollar bills printed in 2020.

We could also plot these two numbers on a number line. We would need to carefully choose our end points to make sure that both numbers can be plotted. Here is a number line with the two values plotted: