

$$10^2 = 10 \times 10 = 100$$

$$10^6 = 10 \times 10 \times 10 \times 10 \times 10 \times 10 = 1,000,000$$

$$10^6 < 10^{12}$$

$$10^{12} = 1,000,000,000,000$$

Lesson 7: Magnitude

$$10^{-2} = \frac{1}{10^2} = \frac{1}{100} = 0.01$$

$$10^{-6} = \frac{1}{10^6} = \frac{1}{1,000,000} = 0.000001$$

Classwork

Fact 1: The number 10^n , for arbitrarily large positive integers n , is a **big number** in the sense that given a number M (no matter how big it is) there is a power of 10 that exceeds M .

Fact 2: The number 10^{-n} , for arbitrarily large positive integers n , is a **small number** in the sense that given a positive number S (no matter how small it is), there is a (negative) power of 10 that is smaller than S .

Exercise 1

Let $M = 993,456,789,098,765$. Find the smallest power of 10 that will exceed M .

$$993,456,789,098,765 < 999,999,999,999,999 < 1,000,000,000,000,000 = 10^{15}$$

Exercise 2

Let $78,491 \frac{899}{987}$. Find the smallest power of 10 that will exceed M .

$$78,491 \frac{899}{987} < 78,492 < 99,999 < 100,000 = 10^5$$

Exercise 3

Let M be a positive integer. Explain how to find the smallest power of 10 that exceeds it.

- 1) change all digits to 9's $781 \rightarrow 999$
- 2) add 1 to that # $999 + 1 = 1000$
- 3) change to a power of 10 10^3

Exercise 4

The chance of you having the same DNA as another person (other than an identical twin) is approximately 1 in 10 trillion (one trillion is a 1 followed by 12 zeros). Given the fraction, express this very small number using a negative power of 10.

$$\frac{1}{10,000,000,000,000} = \frac{1}{10^{13}} = 10^{-13}$$

Exercise 5

The chance of winning a big lottery prize is about 10^{-8} , and the chance of being struck by lightning in the U.S. in any given year is about 0.000001. Which do you have a greater chance of experiencing? Explain.

$$10^{-8} = 0.00000001 = \frac{1}{100,000,000}$$

$$0.000001 = \frac{1}{1,000,000}$$

$$0.000001 > 10^{-8}$$

You have a greater chance of getting struck by lightning

Exercise 6

There are about 100 million smartphones in the U.S. Your teacher has one smartphone. What share of U.S. smartphones does your teacher have? Express your answer using a negative power of 10.