
INTRO TO SIGNED NUMBERS

If you look at an equation like $x + 2 = 10$, you easily see that x must be 8, since $8 + 2 = 10$. But what about an equation like

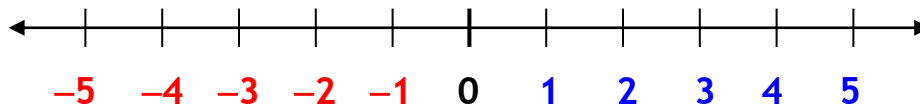
$$x + 9 = 7?$$

Is there a number x that when you add 9 to it, you get a sum of 7? You might already know that there is such a number, but it requires us to define some new numbers that will have to be smaller than zero. We call these the ***negative numbers***.



□ POSITIVE AND NEGATIVE NUMBERS

Let's begin with a picture of the positive and negative numbers (and zero) called the ***number line***.



The ***positive*** numbers are to the right of zero, while the ***negative*** numbers are to the left of zero. The positive number 4 could be written +4, but it's not necessary; we know that the plus sign is understood. By the way, 0 is neither positive nor negative — it's considered neutral, and is called the ***origin*** of the number line.

The arrows at each end of the number line indicate that it keeps going forever in both directions. We might even say that the line goes toward

positive infinity ($+\infty$) to the right and toward negative infinity ($-\infty$) to the left.

If a number x is further to the right on the number line than a number y , we say “ x is **greater** than y .” So, for instance, 5 is greater than 1; 2 is greater than -5 ; and -3 is greater than -12 . Notice that 0 is greater than any negative number and less than any positive number. Is it clear that if x is *greater* than y , then y is **less** than x ?

There are other numbers on the number line besides the kind you see labeled on the line. For example, the fraction $\frac{3}{2}$ is halfway between the 1 and the 2. And if you remember your circles, you should know that the number π would lie a little to the right of 3, and that $-\pi$ would lie a little to the left of -3 . If you’ve seen square roots before, the number $\sqrt{2}$ (which has infinitely many non-repeating digits in it) is about 1.414, so it’s also on the number line.

The **opposite** of a number is the “mirror image” of the number on the number line. It’s on the opposite side of the origin but the same distance from the origin. For example, the opposite of 5 is -5 , and the opposite of -12 is 12. We will agree that the opposite of 0 is 0, since 0 and 0 are mirror images of each other. (Do you buy that?) Notice that every number has an opposite.

The opposite of x is $-x$.

The opposite of $-x$ is x .

❑ PRACTICAL USES FOR NEGATIVE NUMBERS

In your savings account, a deposit could be represented by a positive number and a withdrawal by a negative number.

A temperature of 14° *below* zero on the Fahrenheit scale might be written -14°F .

The nation’s lowest elevation is 282 feet *below* sea level, which could be written -282 ft.



Death Valley

If the electric charge of a *proton* is **+1**, then the charge of an *electron* would be written **−1**, and the charge of a *neutron* (which has no electric charge at all) is **0**.

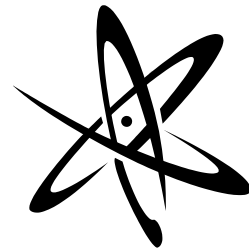
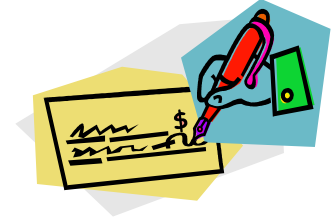
You could even extend the concept to football — a quarterback sack could result in a “gain” of **−9** yards.

Homework

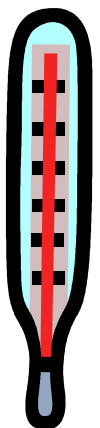
1. When a number has no sign in front of it, it's assumed to be ____.
2. How many numbers are there between 2 and 3?
3. True/False?
 - a. 9 is greater than 4
 - b. 3 is greater than 14
 - c. 7 is greater than 0
 - d. −5 is greater than 0
 - e. 2 is greater than −1
 - f. 3 is greater than −100
 - g. −9 is greater than −2
 - h. −5 is greater than −29
 - i. If x is greater than y , then x is positive.
 - j. If x is positive and y is negative, then x is greater than y .
4.
 - a. $\frac{2}{9}$ lies between what two consecutive whole numbers?
 - b. $\frac{17}{3}$ lies between what two consecutive whole numbers?
 - c. 2π lies between what two consecutive whole numbers?
5. Find the *opposite* of each number:
 - a. 99
 - b. −17
 - c. $\sqrt{2}$
 - d. $-\pi$
 - e. 0
6. True/False?
 - a. The opposite of a negative number must be positive.
 - b. The number 0 does not have an opposite.
 - c. Every number has an opposite.
7. What's the opposite of the opposite of 99?

8. Write a number which best describes the situation:

- a. a savings account deposit of \$800
- b. a withdrawal in the amount of \$17.50
- c. a credit card service charge of \$10
- d. savings account interest of \$141
- e. 8° above zero on the Fahrenheit scale
- f. 17° below zero on the Celsius scale
- g. 8 miles above sea level
- h. 6000 meters below sea level
- i. the electric charge of 7 protons
- j. the electric charge of 12 electrons
- k. the electric charge of 137 neutrons
- l. the fullback gains 12 yards
- m. a 10-yard penalty



- 9.
- a. Yesterday's checking account balance was \$20. Today Jodie wrote a check for \$6 and made a \$13 deposit. What is the current balance?
 - b. Yesterday's checking account balance was \$25. Today Mike wrote a check for \$60 and made a \$15 deposit. What is the current balance?
 - c. The morning temperature was -25°F , and rose 20° during the day. What was the temperature at the end of the day?
 - d. The morning temperature was -15°F , and rose 17° during the day. What was the temperature at the end of the day?
 - e. Carrie started at an elevation of 420 ft, and descended 600 ft into the canyon. What is Carrie's current elevation?
 - f. Anthony started at an elevation of -320 ft, and ascended 600 ft. What is Anthony's current elevation?
 - g. Margaret began at an elevation of -200 meters, and ascended 125 meters. What is Margaret's current elevation?



- h. Jarod started at 300 ft below sea level, and then descended 150 ft. What is Jarod's current elevation?
- i. One proton (+) and one electron (−) cancel each other out. What is the net charge of 8 electrons and 4 more electrons?
- j. What is the net charge of 10 electrons and 7 protons?
- k. What is the net charge of 20 electrons and 22 protons?
- l. What is the net charge of 189 protons and 189 electrons?
- m. A 42-yard passing gain was offset by a 15-yard penalty. Find the net gain.
- n. A 3-yard running gain was offset by a 10-yard penalty. Find the net gain.
- o. To add insult to injury, a quarterback sack which resulted in a 12-yard loss was also accompanied by both a 5-yard penalty and a 15-yard penalty. Find the net gain.



Review Problems

- 10.
 - a. T/F -5 is greater than -2 .
 - b. T/F Every number has an opposite.
 - c. What is the opposite of each number? 7 $-\sqrt{2}$ 0
- 11. What two consecutive whole numbers does each of the following numbers lie between?
 - a. $\frac{4}{9}$
 - b. $\frac{40}{3}$
 - c. 2.05
 - d. 5π
 - e. $\frac{122}{7}$

12. Write a number which best describes
- 35° below zero on the Celsius scale.
 - 2 miles below sea level.
 - a checking account service charge of \$12.
13. Joe started at an altitude of 200 ft, and then descended 600 ft. What is Joe's current elevation?
14. The morning temperature was -30°C and then rose 26° . What's the current temperature?
15. Some people take out a mortgage (home loan) which involves "*negative amortization*." Research this loan option.

Solutions

1. positive 2. infinitely many
3. a. T b. F c. T d. F e. T f. T
 g. F h. T i. F (it might be true, but not necessarily)
 j. T
4. a. 0 and 1 b. $\frac{17}{3} = 5\frac{2}{3}$ is between 5 and 6 c. between 6 and 7
5. a. -99 b. 17 c. $-\sqrt{2}$ d. π e. 0
6. a. T b. F, the opposite of 0 is 0 c. T
7. 99
8. a. 800 b. -17.50 c. -10 d. 141 e. 8
 f. -17 g. 8 h. -6000 i. 7 j. -12
 k. 0 l. 12 m. -10
9. a. \$27 b. -\$20 c. -5°F d. 2°F e. -180 ft
 f. 280 ft g. -75 m h. -450 ft i. -12 j. -3
 k. 2 l. 0 m. 27 yd n. -7 yd o. -32 yd

10. a. False b. True c. $-7; \sqrt{2}; 0$
11. a. 0 & 1 b. 13 & 14 c. 2 & 3
d. 15 & 16 e. 17 & 18
12. a. -35°C b. -2 miles c. $-\$12$
13. -400 ft
14. -4°C

“Intelligence
plus
character
– that is the goal
of true education.”

Martin Luther King, Jr.

