## Addition and Subtraction with a Number Line

A number line is a great way to visualize positive and negative numbers.

Numbers that are less than zero are called "negative." On a number line, negative numbers are left of 0; positive numbers are right of 0. Notice that 4 and -4 are both four spaces from 0, the same distance. Positive numbers are not generally written with the "+" sign; a number without a sign is positive.

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    -5   -4   -3   -2   -1    0    1    2    3    4    5
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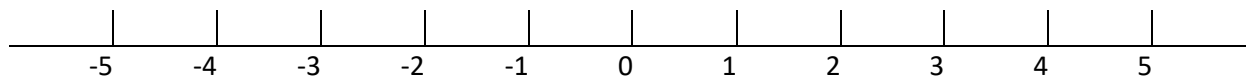
When you <u>add</u> a <u>positive</u> number to any number, you move <u>right</u> on the number line.

For example: -5 + 4 = -1 [Start at -5 ,move 4 places right, land on -1]

When you <u>add</u> a <u>negative</u> number to any number, you move <u>left</u> on the number line.

For example: -1 + -3 = -4 [Start at -1, move 3 places left, land on -4]

When you <u>subtract</u> a <u>positive</u> number to any number, you move <u>left</u> on the number line.

For example: 1 – 3 = -2 [Start at 1, move 3 places left, land on -2]

When you <u>subtract</u> a <u>negative</u> number from any number, you move <u>right</u> on the number line.

For example: 4 - -1 = 5 [Start at 4, move 1 place right, land on 5]

So, on the Number Line:

Add Positive	Move Right
Add Negative	Move Left
Subtract Positive	Move Left
Subtract Negative	Move Right

Addition and Subtraction with Rules

Another way to add and subtract positive and negative numbers is to use a standard set of rules. These rules work because subtracting a negative is the same as adding a positive, and subtracting a positive is the same as adding a negative.

Operation	Signs	Rule	Example
Addition	Same	Add, keep sign	-3 + -5 = -8
Addition	Different	Subtract, keep sign of larger number	-3 + 5 = 2
Subtraction	Same	1st – Convert to Addition 2nd – Change Sign of Number to Right 3rd – Follow Addition Rules	-3 - -5 becomes -3 + 5 = 2
Subtraction	Different		-3 – 5 becomes -3 + -5 = -8

Multiplication and Division

The rules for multiplication and division are simple: if the signs are the same, the answer is positive, if the signs are different, the answer is negative.

Operation	Signs	Rule	Example
Multiplication	Same	Answer is Positive	-3 x -5 = 15
Multiplication	Different	Answer is Negative	-3 x 5 = -15
Division	Same	Answer is Positive	-8 ÷ -2 = 4
Division	Different	Answer is Negative	-8 ÷ 2 = -4

Practice Problems

1. 7 + -4   2. -7 + 3   3. $8\frac{1}{2} + \frac{-1}{2}$ 4. 12 - -3   5. 12 – 110   6. -6.2 - .7

7. 1 + -2 - -2   8. 5 x -4   9. -2 x -4   10. -18 x 2   11. -24 ÷ 6   12. 121 ÷ -11

13. -2 ÷ -4   14. 3 x -4 ÷ -2

Answer Key for Practice Problems

1. 3   2. -4   3. 8   4. 15   5. -98   6. -6.9

7. 1   8. -20   9. 8   10. -36   11. -4   12. -11

13. $\frac{1}{2}$ 14. 6

Practice Problems Solved with Explanation

1. 7 + -4 = 3   Using the number line method, adding a negative means to move left. So, we start at 7, move 4 spaces left, and arrive at 3.
Or, using the rules, when we add numbers with different signs, we subtract the smaller from the larger [7 – 4 = 3]; and keep the sign of the larger, which is positive.

2. -7 + 3 = -4   Using the number line, adding a positive means to move right. So, start at -7, move 3 spaces right, land on -4. Or, to add numbers with different signs, we subtract the smaller from the larger [7 – 3 = 4]; and keep the sign of the larger, which is negative.

3. $8\frac{1}{2} + \frac{-1}{2} = 8$ Adding a negative is moving left on the number line. Start at $8\frac{1}{2}$, move $\frac{1}{2}$ a space left, and land on 8. Or, adding numbers with different signs, subtract $8\frac{1}{2} - \frac{1}{2}$ and the answer is 8.

4. 12 - -3 = 15 — Subtracting a negative is moving right on the number line. Start at 12, go 3 spaces right, land on 15. Or follow the rules for subtracting when the signs are different. Start with (12 - -3); Step 1, change to addition (that's 12 + -3); Step 2, change sign of number to right (that's 12 + 3); and Step 3, follow the rules for addition. In this case we adding with same signs. So add 12 + 3 = 15, and keep the positive sign.

5. 12 – 110 = -98 — Subtracting a positive means to go left on the number line. We probably won't have a complete number line this big, but we can visualize the result. Start at 12; move 110 spaces left, and land on -98. Or, using the rule for subtraction with same signs: Start with (12 – 110); Step 1, change to addition (now 12 + 110); Step 2, change sign of number to right (that's 12 + -110). Now follow the rule for addition with different signs, which is subtract, and keep the sign of the larger number. 110 – 12 = 98; -110 was negative, so our answer is negative.

6. -6.2 - .7 = -6.9 — Subtracting a positive is moving left on the number line. Starting at -6.2, we move 0.7 of a space, taking us down to -6.9. Or, subtracting with different signs means that we convert the expression from (-6.2 - .7) to (-6.2 + -.7). Now the problem is addition when the signs are the same (both negative), so we add the values and keep the negative sign; answer is -6.9.

7. 1 + -2 - -2   =
    (1+ -2) - -2 =
    -1 - -2 =
    -1 + 2 = 1
    — There are more than two terms in the problem, but each operation is either addition or subtraction. So following the order of operations PEMDAS, we just need to work left to right. 1 + -2 = -1. To that, we subtract negative 2 which is the same as adding positive 2, and the answer is 1.

8. 5 x -4 = -20 — This is a problem involving multiplication when the signs are different, which means that the answer will be negative.

9. -2 x -4 = 8 — Multiplication when the signs are the same results in a positive answer, so -2 x -4 = 8.

10. -18 x 2 = -36 — Multiplication with different signs results in a negative answer.

11. -24 ÷ 6 = -4 — Division with different signs means that the answer will be negative.

12. 121 ÷ -11 = -11 — Here is another example of division with different signs, and again the answer is negative.

13. -2 ÷ -4 = $\frac{-2}{-4} = \frac{1}{2}$ — Division of two numbers with the same signs will result in a positive answer. We can first rewrite the division problem as a fraction, then simplify the answer.

14. 3 x -4 ÷ -2 =
    (3 x -4) ÷ -2 =
    -12 ÷ -2 = 6
    — There are more than two terms, but all the operations are multiplication or division, so we can work left to right. Using the associative property, we can put parentheses around the first two terms to help isolate each step of the problem. The first grouping has different signs, so the result is negative. Then the second grouping has the same signs, so the result is positive.