

THE CHEF'S HOT AND COLD CUBES

A Mathematical Story



In a land far away, there once was a team of amazing chefs who cooked the most marvelous food imaginable. They prepared their meals over a large cauldron, and their work was very delicate and complex.

During the cooking process, they frequently had to **change the temperature** of the cauldron in order to bring out the flavors and cook to perfection. They adjusted the temperature of their cooking either by adding special hot cubes or cold cubes, or by removing some of the hot or cold cubes that were already in the mixture.

The **cold cubes** were similar to ice cubes except that they didn't melt and glowed a shade of brilliant blue. The **hot cubes** were similar to charcoal briquettes, except that they stayed fiery red and never lost their heat. If the number of cold cubes in the cauldron was the same as the number of hot cubes in the cauldron, the temperature of the mixture was 0 degrees on their temperature scale.

For each hot cube that was put into the cauldron, the temperature went up one degree. For each hot cube removed, the temperature went down one degree. Similarly, each cold cube lowered the temperature one degree, and each cold cube removed raised it one degree.

The chefs used **positive and negative numbers** to keep track of the changes in their cooking. For example, if they dumped 4 hot cubes and 10 cold cubes into the pot, the temperature would be lowered by 6 degrees, since 4 of the 10 cold cubes would balance out the 4 hot cubes, leaving 6 cold cubes to lower the temperature 6 degrees. They could write this as

$$+4 + -10 = -6$$

One day the chefs decided to add 3 hot cubes and then remove 2 cold cubes. By doing so, they raised the temperature of the mixture 5 degrees. On this day, they wrote

$$+ 3 - (-2) = 5$$

If the chefs wrote $(-5) - (+6) = -11$, it would tell us that they first added 5 cold cubes and then removed 6 hot cubes. These two moves together would lower the temperature 11 degrees.

Sometimes, of course, they wanted to raise or lower the temperature by a large amount and did not want to toss the cubes into the cauldron one at a time. In these cases, they would add or take out **bunches of cubes**.

For example, if the chefs wanted to raise the temperature 100 degrees, they might toss five bunches of 20 hot cubes into the cauldron, instead of 100 cubes one at a time. This saved a lot of time because they could have assistant chefs do the bunching of cubes. When they used bunches, the chefs used a **multiplication sign** to record their activity. To show tossing five bunches of 20 hot cubes, they would write

$$(+5)(+20) = 100$$

where the 5 meant five bunches were being added, and the +20 meant that there were 20 hot cubes in each bunch.

The chefs could also lower the temperature by removing bunches. When they wrote

$$(-3)(+5) = -15$$

the -3 signaled that three bunches were being removed, and the +5 showed that there were five hot cubes in each bunch.

YOUR ASSIGNMENT

You and your team must decode and re-write the chefs' notations, so that chefs all around the world can create the same delicious concoctions.

Complete Parts 1 and 2 on the next page, and be prepared to present your findings to a committee of other chefs.



PART 1

Each of the following represents an action taken by the chefs. Write an equation to describe the action and result. Be sure to include the final temperature after each action.

1. Three cold cubes were added and 5 hot cubes were added.
2. Five hot cubes were added and four cold cubes were removed.
3. Seventeen cold cubes were added and nine hot cubes were removed.
4. Two bunches of six cold cubes were each added.
5. Seven bunches of four hot cubes were removed.
6. Three bunches of six cold cubes were removed.
7. Nine bunches of three cold cubes were added, then eight hot cubes were removed.
8. Ten bunches of four hot cubes were removed, then seven more hot cubes were removed.

PART 2

Describe in words how many of what kinds of cubes the chefs added or removed in each action. Then state how the temperature would change overall.

1. $+4 - (-3) =$
2. $-6 + (-4) =$
3. $(-10)(-5) =$
4. $(+4)(-8) =$
5. $+7 - 9 - (-3) =$
6. $(-7)(+16) + 5 - (-3) =$