

A-REI Zero Product Property 1

Alignments to Content Standards: A-REI.A.1

Task

In each of the following equations, the variables represent real numbers. Assuming each equation is true, what can you conclude about the values of the variables? Explain each step in your reasoning.

a. $2z + 3 = 0$

b. $7x = 0$

c. $7(y - 5) = 0$

d. $ab = 0$

IM Commentary

This task is the first in a series that leads students to understand and apply the zero product property to solving quadratic equations. The emphasis is on using the structure of a factorable expression in order to justify the steps in a solution (rather than memorizing steps without understanding). Teachers should feel free to skip any tasks in the series that students have already mastered.

In this particular task, we ask question that lead up to getting students to, in part (d), state the zero product property: If the product of two numbers is zero, then one of the two numbers must be zero. In symbols, where a and b represent numbers, if $ab = 0$, then $a = 0$ or $b = 0$.

In tasks that follow in this series, students will prove this property and then apply it to solving quadratic equations. In using this task, there should be a strong emphasis on explaining each step in solving the equation.

In part (c), students who have rehearsed procedures for solving linear equations may be inclined to first distribute the 7, then add 35 to both sides, then divide both sides by 7. This procedure will likely result in the correct solution $y = 5$, and students often adopt an attitude of "anything that gets the right answer is okay." However, it is worth taking the time to inspect both solution methods, and for students to understand how one can take advantage of the structure of $7(y - 5) = 0$ to reason that y must be 5 without going through the hassle of multiplying by 7 and then turning around and dividing by 7. Not only is exploiting the structure of the factored expression more efficient in this case, but it's crucial to reasoning about the solutions to quadratic and (later) polynomial equations in factored form.

Other tasks in this series:

- Zero Product Property 2
- Zero Product Property 3
- Zero Product Property 4

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Solution

a. In $2z + 3 = 0$, we are adding 3 to some number, $2z$, and getting 0; therefore that number must be equal to -3 . So we can write $2z = -3$. In $2z = -3$, -3 is double some number z , so z must be half of -3 , so we can write $z = \frac{-3}{2}$.

b. If $7x = 0$, that means 7 times some number is 0. The only number we can multiply 7 by to get 0 is 0. Therefore, $x = 0$.

c. Just like in part (b), this equation is saying "7 times something is 0." Except in this case, the "something" is $(y - 5)$. Therefore we can write $y - 5 = 0$, and y must be 5.

d. In $ab = 0$, we are multiplying two things together and getting a result of 0. If that is true, at least one of those numbers must be 0. So it must be true that either $a = 0$ or $b = 0$ or both.



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