Sample Multiple Choice Question from *Preparing for the CSET – Multiple Subject Mathematics*

Which of the following sets is not closed under addition?

a) Natural Numbers
b) Whole Numbers
c) Integers
d) Odd Integers

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Solution

Let's begin by talking about the sets of Real Numbers.
Natural Numbers are the counting numbers: {1, 2, 3, . . . }.
Whole Numbers are the Natural Numbers and 0: {0, 1, 2, 3, . . .}
Integers are the Whole Numbers and their negatives: {. . ., -2, -1, 0, 1, 2, . . .}

The "Closure Property of Real Numbers" is the one property that is most often skipped in beginning algebra classes. A set of numbers is said to be closed under an operation if when you begin the operation with numbers from that set, your answer is also a member of that set.

For example, the set "Natural Numbers" is closed under multiplication since whenever you multiply two Natural Numbers, the answer is also a Natural Number. The set "Natural Numbers" is not closed under division since it is possible to divide two Natural Numbers and get an answer that is not a Natural Number (if we divided 4 by 5 we would get 4/5 which is not a Natural Number). We need only one exception to prove that a statement is false.

In this problem, we are adding two numbers together. Let's try out each of the answer choices:

a) Any time we add two Natural Numbers together, we get a Natural Number.
Therefore the set "Natural Numbers" **is** closed under addition.

b) Any time we add two Whole Numbers together, we get a Whole Number.
Therefore the set "Whole Numbers" **is** closed under addition.

c) Any time we add two Integers together, we get an Integer.
Therefore the set "Integers" **is** closed under addition.

d) Any time we add two Odd Integers together, the answer is not an Odd Integer – it is an even integer: (3 + 5 = 8). So the set "Odd Integers" **is not** closed with respect to addition since whenever you add two Odd Integers together, the result is not always an Odd Integer. (In fact the answer never is odd, but we needed to show only one example to disprove closure.)