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## Operations with Negative Numbers on the ISEE Middle and Upper Level

LESSON GOAL: Simplify expressions and solve problems that include negative numbers.

ISEE Middle-Level Problem: A set of 6 numbers has a mean of 7. What additional number must be included in this set to create a new set with a mean that is 2 less than the mean of the original set?
A) -2
B) -7
C) -12
D) -25

While this may seem like only an advanced average problem at first glance, you'll notice that all the answer choices are negative. This is also a negative number problem.

## Rules of Operations with Negative Numbers

Addition: To add two negative numbers, add the numbers the same way you would add two positive numbers, and then add a negative sign to the sum. $-7+-8=-15$

If one number is positive and one number is negative, subtract the numbers the way you would subtract two positives. Then add the sign (+ or -) of the number with the higher absolute value (further from zero).

$$
7+(-8) \rightarrow 8-7=1 \quad|-8|>|7| \therefore 7+(-8)=-1
$$

Subtraction: Any subtraction problem can be turned into an addition problem; subtracting a positive is the same as adding a negative. $3-7=3+(-7)=-4$

To subtract a larger positive from a smaller positive number, find the difference and then add a negative sign.

$$
3-7=3+(-7)=-4 \quad 10-17=-7
$$

Subtracting a negative number is the same as adding a positive number. To subtract a negative, change the two minus signs into a plus sign and then add.

$$
3-(-7)=3+7=10 \quad-7-(-3)=-7+3=-4
$$

Multiplication and Division: When multiplying and dividing negative numbers, it doesn't matter whether the positive or negative number has a higher absolute value, the same rules apply:

```
positive x positive = positive 6 x 8 = 48
positive x negative = negative 6x-8=-48
negative x positive = negative }-6\times8=-4
negative x negative = positive }-6x-8=4
```

```
positive }\div\mathrm{ positive = positive 48 % 8 = 6
positive }\div\mathrm{ negative = negative 48}\div-8=-
negative }\div\mathrm{ positive = negative }-48\div8=-
negative }\div\mathrm{ negative }=\mathrm{ positive }-48\textrm{x}-8=
```

The solution: Using the procedure for advanced averages, we can calculate that we need the total score to go from $42(6 \times$ 7) to $35(7 \times 5)$. To get from 42 to 35 by adding, we'll need to add -7 . The answer is B.

Helpful tip: When you calculate with negative numbers, think about whether your answer makes sense. If it doesn't, you might be forgetting or mixing up a negative sign.

