



## *The Almighty* **Sanity Check**

A **sanity check** is a final check whenever you solve a problem. It's an informal test to see whether your answer makes sense in the context of the problem. It won't prove that an answer is perfectly correct, but many errors produce answers that cannot possibly be right. There are a few different ways in which a sanity check can be used.

### **SIGN OF AN ANSWER**

Some measurements, like time and distance, don't usually make any sense if they're negative. If a question asks how long it takes for some process to happen, and you get a negative answer, that answer can't be right.

There are situations when a distance can be negative. In physics, when we deal with measurements like forces that have direction, we can have a negative answer; it simply means that the distance is in the opposite direction to the one we've decided to call positive, but this is a rare case. No math problems work like this.

### **SCALE OF AN ANSWER**

Most of the word problems you are given will be like real-world problems. This means you can generally tell whether the scale of an answer matches what your problem is asking for. If your physics problem asks, what is the mass of the earth based on a gravitational observation, and your answer is 2000 kg or so, this is not a sensible answer to the question. That's a clue that you should check your work, because the correct answer to the question is most likely an accurate value (or at least a close approximation).

Another way to check the scale of an answer, especially if you are converting from one unit to another, is to check whether the answer you get is larger or smaller than the number you started from.

Consider a metric conversion. A question asks for 200 g in kilograms, and we multiply by 1000 to get 200,000 kg. Is this reasonable? When you convert 200 grams to kilograms, should the answer be larger or smaller than 200? If you're not sure, ask yourself what you know about those units. An object that weighs 200 g is very light, but 200,000 kg is very heavy! The 200 grams isn't an entire kilogram, so our answer should get smaller. Our conversion did the opposite; we got an answer much higher than 200. That means we multiplied when we should have divided.

### **ANSWERING THE QUESTION THAT WAS ASKED**

By now you know that many word problems are actually algebra problems. You set up an equation and solve for an unknown variable. Sometimes, it is simpler to set up a problem so that the variable isn't the thing we've been asked for, however.



Consider an upstream/downstream question:

A motorboat travels upstream from a boating ramp to a campsite in 6 hours in a current that is  $2 \text{ km/h}$ . The camper travels back to the ramp going downstream in 4 hours. How far from the ramp is the campsite?

To solve the problem we create a distance/rate/time table and enter the information. Because the distance for each trip is the same, we express that distance in terms of rate and time, with  $r$  representing the rate at which the motorboat moves in still water:

$$\begin{aligned}d &= d \\r_{\text{up}} \cdot t_{\text{up}} &= r_{\text{down}} \cdot t_{\text{down}} \\(r - 2) \cdot 6 &= (r + 2) \cdot 4 \\6r - 12 &= 4r + 8 \\2r &= 20 \\r &= 10\end{aligned}$$

So the answer to the question is 10. Isn't it? Well, no. We said  $r$  was the rate of the motorboat, but that's not what the question was asking for. It wants the distance to the campsite. Getting  $r$  was a necessary step — we couldn't calculate distance without it — but we can't forget the question while we do the algebra. The answer is  $(10 - 2) \cdot 6 = 48 \text{ km}$ . (If we had written down the units for the calculation, this would have been another clue that our answer wasn't complete.)

It is worthwhile, especially if you have extra time on a test, to reread the last sentence of a word problem to make sure the answer you got was the answer you needed.

### EXERCISES

A. Decide whether these measurements can have a negative answer.

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|--------------------------------------|--------------------------------------|
| 1) temperature in $^{\circ}\text{C}$ | 4) area in $\text{m}^2$              |
| 2) time in days                      | 5) directed velocity in $\text{m/s}$ |
| 3) number of people in a room        | 6) amount of money a business earns  |

B. Decide which of the two suggested values is the correct answer to the question. You do not have to do the math yourself — one answer is not sensible or out of scale.

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|---|--|
| 1) Convert 28 weeks to months.<br>M) 112      N) 7                      | 5) Find the height of the flagpole.<br>V) 1.3 cm      W) 1.3 m                   |
| 2) Find the price of the new shirt.<br>I) \$24.40      J) \$2.40        | 6) Convert 5 miles to inches.<br>O) 26 300      P) 0.000951                      |
| 3) Find the number of passengers on the airplane.<br>C) 56      D) 76.2 | 7) Find the number of math problems Chris can do in an hour.<br>Q) 100      R) 7 |
| 4) Convert 12.0 m to millimeters.<br>E) 12 000      F) 0.012            | 8) Find the speed of the train.<br>K) $32 \text{ km/h}$ L) 300 km                |

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### SOLUTIONS

A. (1) yes (2) no (3) no (4) no (5) yes (6) yes B. (1–8) N I C E W O R K

