

## 1.1 Skip and Chip Do Something Significant: Part 1

*Skip and Chip are learning how to do significant digits and get a little overwhelmed with all the rules.*

Skip: Hey Chip. I have this great new calculator that has a screen that can scroll down so I can see all of the numbers beyond the decimal point when I calculate something. I'm going to be so precise now!!!

Chip: I like the calculator, but I don't think it will help you to write all those numbers beyond the decimal in chemistry class.

Skip: Why not, they are in the answer?

Chip: Because chemistry, like all measured sciences, has uncertainty built into the measurements.

Skip: Kind of like human error?

Chip: Nope, kind of like limits on the instrument's precision level. Many of our measurement tools even have the words "approximate values" or " $\pm .50$  ml" or something like that. Admit it or not, every measurement tool has some uncertainty, and that can give us a false sense of security regarding our calculated answers.

Skip: Okay. I suppose we need to talk about these rules. How do they work?

Chip: Well, for addition and subtraction it is really easy. Just count the places to the right of the decimal point in all the measured numbers to be used in the calculation. Add or subtract them, then round the answer to the number of decimals found in the measured number with the LEAST!!!

Skip: Least!?! I hate that idea. Why the least?

Chip: Use the least. The answer cannot be more precise than the weakest measurement.

Skip: That's not the American way Chip. I always like to look my BEST, not my LEAST. I mean who wants to get the LEAST for their money? My answer has the least significant digits?

Chip: You are sounding a little too much like a 'light beer' commercial there Skip. Science is about reality, not perception, deception or any other marketing trick. We are about accuracy and precision so we can replicate our results to prove what we learned.

Skip: Ok. I understand. So the addition and subtraction rules do seem pretty easy.

Chip: *(yelling)* THE ONLY THING HARD ABOUT THE ADDITION AND SUBTRACTION RULES IS YOU NEED TO REMEMBER TO USE THEM WHEN YOU ADD AND SUBTRACT. NEVER USE THEM FOR MULTIPLICATION AND DIVISION, AND NEVER USE THE MULTIPLICATION AND DIVISION RULES FOR ADDITION AND SUBTRACTION.

Skip: Geez Chip, you don't have to yell. I think it is pretty obvious that you only use addition and subtractions rules when you add or subtract.

Chip: You would think so, but many students forget this and when they do, they write down an answer, think it is right and then get it wrong.

Skip: Kind of like calculator betrayal huh?

Chip: What?

Skip: You know, when my calculator tells me the answer, I write it down and the darn teacher marks it wrong anyway. Calculator betrayal - that's what I call it.

Chip: Call it like you see it Skip. But, if you follow the simple addition and subtraction rules you will not experience your calculator betrayal thing. It's about you thinking about what the numbers are instead of just mindlessly entering them into the calculator.

Skip: I guess I do enter them mindlessly sometimes. I'll try my best to remember the addition and subtraction rules and use them in chemistry when I add or subtract anything.

Chip: Not just anything Skip. You only need to use the rules when the numbers are measured data. If you get a counted number or a constant, you simply ignore how many digits are in them because they do not have uncertainty.

Skip: Ok, so I'm pretty certain I get it. Use the rules for measured data, use them only for addition and subtraction, but don't use them for numbers that are not measured.

Chip: Nice summary Skip, I think you have it.

Skip: But what if I have to multiply or divide to get an answer? Can I use the same easy rules?

Chip: Sadly no Skip. And sadly, the bell just rang, so we will have to talk about that another time.

Skip: O.K. Chip, it all adds up for me.

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