

4.2 Biff and Baff Calculate Mass - What?

Biff teaches Baff how to calculate mass number and atomic number and the difference between the two.

Biff: What are you trying to do?

Baff: *(looking at a homework assignment)* I'm trying to figure out the difference between mass number and atomic mass.

Biff: *(wrinkles brow)* That's tough

Baff: *(puts head in hand)* It really is. I don't get the difference. I mean, aren't they both just the mass of an atom?

Biff: You'd think so because of the name, but they aren't the same.

Baff: Could you help me?

Biff: *(smiles)* Sure! Let's start with mass number.

Baff: Ok. I know that has some thing to do with protons and neutrons.

Biff: Right! If you are looking at a single atom, the mass number is the number of protons plus the neutrons in that one atom's nucleus.

Baff: *(sitting up)* That's pretty easy. *(looking at Biff)* Just add up the protons and neutrons?

Biff: Yep. Add up the protons and neutrons in the single atom and that is the mass number.

Baff: *(confused)* So what is atomic mass?

Biff: That's a little trickier. Let's look at your first semester grade.

Baff: *(confused)* Huh? I thought we were looking at atoms.

Biff: We are. But calculating atomic mass is like calculating your semester grade.

Baff: *(cautious)* Oooooookaaayyyy.

Biff: Our grades are based on 40% 1st quarter, 40% 2nd quarter and 20% exam, right?

Baff: Yes, but I'm not seeing how this is the same.

Biff: *(pointing to the numbers)* Well, each part is worth a percentage of your final grade. It's called a weighted average because each item is weighted differently.

Baff: *(confused)* So how do I calculate it?

Biff: Well, you would take 0.40, which is 40%, times your quarter 1 grade. Then add 0.40 times your quarter 2 grade. Then add 0.20 times your exam grade.

Baff: Let me write this down. I had a 74% for quarter one, an 82% for quarter two and an 85% on the exam.

Biff: So how would you calculate your grade?

Baff: *(writing)* I would take $(0.40 \times 76) + (0.40 \times 82) + (0.20 \times 85)$. That's an 80.2%

Biff: Right! So because your quarter grades are worth more than your exam, you have to make them worth more by using this equation.

Baff: Ok. I get that, so how do I apply this to atoms?

Biff: Atoms have isotopes. There can be the same type of atom, but in the sample there are some with different numbers of neutrons in the nucleus. Some isotopes are more common than others, meaning there is a higher percentage of them on our planet so you have to weigh them more in your calculation.

Baff: *(sounding really confused)* Ok...I'm still not getting you.

Biff: *(taking pencil and writing down the numbers)* Say you have a sample of carbon. We know that on our planet, 98.9% of that sample has a mass number of 12 (6 protons and 6 neutrons) and 1.1% of that sample has a mass number of 13 (6 protons and 7 neutrons).

Baff: *(starting to get it)* To calculate, do I do the same equation as for my semester grade?

Biff: *(sounding excited)* Yes! Try it out.

Baff: Ok. So I would take $(0.989 \times 12) + (0.011 \times 13) = 12.011\text{g/mol}$.

Biff: *(really excited)* Exactly! You can check your work on the periodic table. That's the average atomic mass. It takes into account not only the mass but how much of each isotope exists on our planet.

Baff: *(relieved)* That helps so much! So mass number looks at an individual element.

Biff: Yes, and that number is NOT on the periodic table.

Baff: Right, and average atomic number looks at the weighted average of all the possible isotopes and how much exists on the planet.

Biff: *(smiling)* Exactly, and that number IS on the periodic table.

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