Chem 1311Ch3Ep1Transcript

00:00:01

Hello and welcome to the first episode of mass relationships in chemical reactions.

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In today's episode.

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We will learn the mole concept and how it ties in with mass relationships in various compounds.

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We will learn Avogadro's number and the concept of molar mass.

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We will use a compound formula to the right of various relationships in terms of mass particles and moles.

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The periodic table.

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This is where it all begins.

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You may remember using mass numbers in Chapter 2 to determine the number of neutrons in an isotope.

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And you may also remember.

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That the average of the mass numbers of the isotopes of a single element is called the atomic mass.

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But we can also look at the atomic mass from a different perspective.

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The atomic mass is also the average mass of a single atom of that element.

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Therefore, the average mass of a sodium atom is 22.99 amu.

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Or atomic mass units.

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And the mass of a mole of sodium atoms.

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Also known as the molar mass.

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It's also 22.99, grams.

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But before we.

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Talk about molar masses.

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We need to define the term mole.

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This is not the type of mole that is sometimes called the beauty mark.

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And neither is it the kind of mole that is so very good at digging holes.

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Nope, not even the one that tastes like chocolate.

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The mole I speak of.

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It's a unit that represents a rather large number of items.

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Just like a dozen represents 12.

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A pair represents 2.

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Or a gross represents 144.

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The mole is officially defined using carbon as a reference.

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But a more useful definition is 6.022 * 10 to the 23rd items.

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This is also known as Avogadro's number.

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As we stated earlier, a molar mass is the mass of a mole of atoms.

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Or a mole of molecules.

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Or a mole formula units.

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A formula unit is what you call the atoms that form an empirical formula.

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Think of it as a molecule for ionic compounds who would otherwise not have a molecule.

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One mole of carbon atoms has 6.022 * 10 to the 23rd atoms and has a mass of 12.011 grams.

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One carbon atom has a mass of 12.011 AMU or atomic mass units.

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It's the same value but different unit.

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The molar mass, that is the mass of 1 mole of carbon atom matches exactly the atomic mass in AMU.

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The same, of course, is true for a mole of atoms of any element, like lithium for example.

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The mass of 1 atom of any element in AMU.

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Is equal to the mass of 1 mole of atoms of that same element in grams.

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This illustration shows you a mole of each of the elements carbon,

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Sulfur, copper, mercury, and iron.

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There is no need.

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For the mole to be a mysterious quantity.

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This is what it looks like.

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The molar mass of any element differs from the molar mass of every other element because elements have different sizes and weights.

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But a mole will always have 6.022 * 10 to the 23rd atoms.

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Think of it this way.

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It's like a specialty donut shop with Donuts of all different sizes and weights. Every box will contain exactly the same number of Donuts, 6.022 * 10 to the 23rd.

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But they will have different weights because the Donuts themselves have different weights.

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Similarly, 12.011 grams of carbon is a mole of carbon and 6.022 * 10 to the 23rd atoms of carbon.

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15.999 grams of oxygen will be equal to 1 mole of oxygen and also to 6.022 * 10 to the 23rd atoms of oxygen.

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And 55.845.

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Grams of iron will be equal to 1 mole of iron and also to 6.022 * 10 to the 23rd atoms of iron.

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Because you can measure your element, or even a compound really, by the particle, that is the atom, by the mole, or by the gram.

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You will need to deal with those three quantities in different word problems.

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Now, this little reference is going to be very helpful to you because it lets you know that if you need mass or grams then you will be using your periodic table to obtain the molar mass.

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If, on the other hand, the problem asks for atoms molecules or formula units, you know that your go to quantity will be Avogadro's number.

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If you're asked for moles, well, that's a matter of using subscripts and coefficients.

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Knowing this can greatly simplify stoichiometry, word problems.

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Stoichiometry word problems are too wordy.

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That's a bad pun, and it was intended.

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But no matter how confusing I try to make the word problem, there are only two things.

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That you have to consider?

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The given.

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And the ask.

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To further simplify word problems, there are only three options.

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Grams or mass.

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Particles and moles.

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If either the given or the ask use the word mass or grams, or really any other unit of mass.

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You will be using the molar mass value from the periodic table.

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If the word atoms, molecules or formula units is in either one of the given quantity or the ask, you will be using Avogadro's number in your conversion.

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And if moles are given or asked for.

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You will be using subscripts and coefficients in your conversion.

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Let's look at an example here to clarify this.

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We will be using helium to draw a quick diagram for our conversion.

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Here's helium.

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The ask, is moles of helium.

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And because there are no subscripts or coefficients.

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Helium represents only one mole.

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The given quantity has units of grams of helium.

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So according to our guideline, we use the molar mass from the periodic table.

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This is our conversion factor.

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To solve, we start with a given quantity.

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6.46 grams of helium

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And we place it in the 1st frame.

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We place the conversion factor on the 2nd frame.

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So as to cancel the grams of helium.

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And just like that, we have an answer.

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Remember that for any ask and for any given, there are only three options.

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You will use the molar mass.

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Avogadro's number.

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Or the subscripts and coefficients.

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Depending on the unit.

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Quick disclaimer, your textbook uses a different method leading back to the Revolutionary War in which the simplest issue must be explained in the most complicated way possible.

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It could really save time.

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Uh, if your text were honest and it admitted that whatever the ask is, it always goes on the top of the frame.

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However, your textbook eventually gets to the right answer.

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Our next example problem has to deal with zinc.

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Here's the zinc.

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The ask is “how many grams”, so molar mass of zinc it is.

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The given quantity has units of moles and we have no subscripts or coefficients, so it is one mole.

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There's our conversion factor.

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Next, we write the given quantity in the 1st frame.

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And the conversion factor in the 2nd frame.

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And the final answer is 23.3 grams of zinc.

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0h! One   more thing.

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Yes, significant digits still count.

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However, when you are using the number of moles from either subscripts or coefficients in a formula, you will consider those numbers to be exact.

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So don't you be rounding to one significant digit.

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As before, your textbook will want to add a couple of unnecessary steps, because that's the way we have always done it.

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But eventually they do get to the right answer, and they make almost no mistakes.

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I know that you're thinking, do I really have to be that petty and such a jerk?

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Why am I pointing out the mistakes?

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It's not like I don't make any mistakes, right?

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But that is exactly the point that I'm trying to make, statistically more steps is going to be equal to more chances to make a mistake.

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So it is better to keep it simple.

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To the minimum number of steps.

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And this problem makes me uncomfortable because I don't like confrontations.

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This problem is about sulfur.

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Here's our sulfur.

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The ask is how many atoms, which of course means Avogadro's number.

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And the given quantity has units of grams which is going to mean molar mass.

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There's our conversion factor.

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Now to solve, we place the given quantity on the 1st frame.

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And we place the conversion factor.

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In the 2nd frame.

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Notice that I translated Avogadro's number to 6.022 * 10 to the 23rd atoms of sulfur because I have that number memorized.

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You should do.

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That gives us 3.06 * 10 to the 23rd atoms of sulfur.

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And now to that dreaded confrontation with your textbook.

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Your textbook says that what we just did is highly impossible.

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That, that some direct conversions in stoichiometry cannot be done.

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I really hate being confrontational, so I asked some friends to give my response to this fib.

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Now that's a damn lie.

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It’s a damn lie.

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Damn lie.

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The truth is we only need one conversion factor to solve any stoichiometry problem.

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So there.

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Now I will make myself a tea to try to calm down.

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Because confrontations are very stressful for me.

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And that's all there is.

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There isn't any more.