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Unit 7 worksheet 1 mole relationships answer key

Learning Objectives To use a balanced chemical reaction to determine the molar relationships between substances. Previously, you learned how to balance chemical equations by comparing the numbers of each atom type in the reagents and products. The coefficients ahead of chemical formulas represent the number of molecules or units of formula (depending on the type of substance). Here, let's extend the meaning of coefficients into a chemical equation. Consider the simple chemical equation \[\ce{2H_2 + O_2 → 2H_2O}\] The convention for writing balanced chemical equations is to use the smallest integer ratio for coefficients. However, the equation is balanced as long as the coefficients are in a ratio of 2:1:2. For example, this equation is also balanced if we write it as \[\ce{4H_2 + 2O_2 → 4H_2O}\] The ratio of the coefficients is 4:2:4, which reduces it to 2:1:2. The equation is also balanced if we were to write it as \[\ce{22H_2 + 11O_2 → 22H_2O}\] because 22:11:22 also reduces to 2:1:2. Suppose we want to use larger numbers. Consider the following coefficients: \[12,044\times 10^{23}\; H_2 + 6,022 \times 10^{23}\; O_2 → 12,044 \times 10^{23}\; H_2O\] These coefficients also have the ratio 2:1:2 (check and see), so this equation is balanced. But 6,022 × 1023 is 1 mol, while 12,044 × 1023 is 2 mol (and the number is written this way to make this more obvious), so we can simplify this version of the equation by writing it as \[\ce{2 \;mol\; H_2 + 1\; mol\; O_2 → 2 \;mol\; H_2O}\] We can leave out the word mol and not write coefficient 1 (as is our habit), so that the final form of the equation, still balanced, is \[\ce{2H_2 + O_2 → 2H_2O}\] We now interpret the coefficients as referring to molar amounts, not individual molecules. The lesson? Balanced chemical equations are balanced not only at the molecular level, but also in terms of molar amounts of reagents and products. Thus, we can read this reaction as two hydrogen warts react with an oxygen mole to produce two water moles. 2 molecules H2 1 molecule O2 2 molecules H2O 2 mols H2 1 mole O2 2 moles H2O 2 x 2.02 g=4.04 g H2 32.0 g O 2 2 x 18.02 g=36.04 g H2O \Figure (\PageIndex{1}\): This representation of water production from oxygen and hydrogen shows several ways to interpret the quantitative information of a chemical reaction. By the same token, the proportions we build to describe the reaction of molecules can also be constructed in terms of mols rather than molecules. For the reaction in which hydrogen and oxygen combine to make water, for example, we can build the following proportions: \[\mathrm{\dfrac{2\: mol\: H_2}{1\: mol\: O_2}\: or\: \dfrac{1\: mol\: O_2}{2\: mol\: H_2}}\] \\mathrm{\dfrac{2\: mol\: H_2O}{1\: mol\: O_2}\: \dfrac{1\: mol\: O_2}{2\: mol\: H_2O}}\] \[\mathrm{\dfrac{2\: mol\: H_2}{2\: mol\: H_2O}\: or\: \dfrac{2\: mol\: H_2O}{2\: mol\: H_2}}\] We can use these proportions to determine how much substance, in mols, it will react with or produce a certain number of mols of a different substance. The study of numerical relationships between reagents and products in balanced chemical reactions is called stoquiometry. The ratio of coefficients in a balanced chemical equation, used in calculations that relate amounts of reagents and products is called stochiometric factor. Example \(\PageIndex{1}\) How many oxygen mols react with hydrogen to produce 27.6 mol of H2O? The balanced equation is as follows: \[\ce{2H2 + O2 -> 2H2O} onumber\] Solution Because we are dealing with amounts of H2O and O2, we will use the stochiometric ratio that relates these two substances. As we are given a quantity of H2O and we want to determine a quantity of O2, we will use the ratio that has H2O in the denominator (so cancels) and O2 in the numerator (so it is entered in the response). Thus, \(\mathrm{27.6\: mol\: H_2O\times\dfrac{1\: mol\: O_2}{2\: mol\: H_2O}=13.8\: mol\: O_2}\) Produce 27.6 mol of H2O, 13.8 mol of O2 react. Exercise \(\PageIndex{1}\) Using 2H2 + O2 → 2H2O, how many hydrogen moles react with 3.07 mol of oxygen to produce H2O? Answer \(\mathrm{3.07\: mol\: O_2\times\dfrac{2\: mol\: H_2}{1\: mol\: O_2}=6.14\: mol\: H_2}\) Concept review exercise How do we relate molar amounts of substances in chemical reactions? Response Amounts of substances in chemical reactions are related by their coefficients in the balanced chemical equation. Key Takeaway The balanced chemical reaction can be used to determine the molar relationships between substances. Exercises List the molar ratios that you can derive from this balanced chemical equation: NH3 + 2O2 → HNO3 + H2O List the molar ratios that you can derive from this balanced chemical equation 2C2H2 + 5O2 → 4CO2 + 2H2O Given the following balanced chemical equation, 6NaOH + 3Cl2 → NaClO3 + 5NaCl + 3H2How many NaCl warts can be formed if 3.77 mol of NaOH reacts? Given the following balanced chemical equation, C5H12 + 8O2 → 5CO2 + 6H2O how many H2O warts can be formed if 0.0652 mol of C5H12 reacts? Balance the following unbalanced equation and determine how many H2O mols are produced when 1.65 mol of NH3 reacts. NH3 + O2 → N2 + H2O Trinitrotoluene [C6H2(NO2)3CH3], also known as TNT, it is formed by the nitric acid reaction (HNO3) with toluene (C6H5CH3): HNO3 + C6H5CH3 → C6H2(NO2)3CH3 + H2O Balance the equation and determine how many TNT mols are produced when 4,903 mols of HNO3 react. Chemical reactions are balanced in terms of molecules and in terms of mols. Are they balanced in terms of tens? your answer. Explain how a balanced chemical reaction in terms of mols mols the law of conservation of the matter. 1 mol NH3:2 mol O2:1 mol HNO3:1 mol H2O 2. 2 mol C2H2:5 mol O2:4 mol CO2:2 mol H2O 4. 0.3912 mol 4NH3 + 3O2 → 2N2 + 6H2O; 2.48 mol 6. 3HNO3 + C6H5CH3 → C6H2(NO2)3CH3 + 3H2O; 1,634 mol 7. yes, they're still balanced. 8. A chemical reaction, balanced in terms of mols, contains the same number of atoms of each element, before and after the reaction. This means that all atoms and their masses are conserved. 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