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Mass to mass stoichiometry practice problems

Balancing the following chemical reactions: Tip a. CO + O2 CO2 b. KNO3 KNO2 + O2 c. O3 O2 d. NH4NO3 N2O + H2O e. CH3NH2 + O2 CO2 + H2O + N2 Hint f. Cr(OH)3 + HClO4 Cr(ClO4)3 + H2O Write the balanced chemical equations of each reaction: a. Calcium carbide (CaC2) reacts with water to form calcium hydroxide (Ca(OH)2) and acetylene gas (C2H2). B. When potassium chlorate (KClO3) is heated, it degrades to form KCl and oxygen gas (O2). c. C6H6 combustion in air. Hint d. C5H12O burns in the air. Depending on the following reaction: Na2S2O3 + AgBr NaBr + Na3[Ag(S2O3)2] a. How many moles Na2S2O3 is needed for a full reaction with 42.7 g AgBr? B. What is the mass of NaBr to be produced from 42.7 g of AgBr? Tip From reaction: B2H6 + O2 HBO2 + H2O a. What mass of O2 will be required to incineration 36,1 g B2H6? B. How many moles do we make from 19,2 g B2H6? Calculate the mass (in kg) of water produced by burning 1,0 gallons (3,8 L) of petrol (C8H18). The density of petrol is 0,79 g/ml. One mole of aspartame (C14H18N2O5) reacts with two moles of water to produce one mole of asparanic acid (C4H7NO4), one methanol mole (CH3OH) and one mole of phenylalanic. A. What is the molecular formula of phenylalane? Tip b. What mass of phenylalane is produced from 378 g of aspartame? KO2 is used in the respiratory apparatus of the closed system. It removes carbon dioxide and water from the exhaled air. The reaction to remove water is: KO2 + H2O O2 + KOH. The KOH produced is used to remove carbon dioxide with the following reaction: KOH + CO2 KHCO3. A. What mass of KO2 produces 235 g O2? B. What mass of CO2 can be removed with 123 g KO2? Tip I want to send 250 grams of peeled walnuts to a friend (don't ask why – just go with the question). How many nuts do I have to buy in shells? To find out, I need to know how much walnut shell weighs (approximately \(40\%\) of the total weight of the unpeeled walnut). Then I can calculate the mass of nuts, which will give me 250 grams of shelled walnuts and then determine how many nuts I need to buy. Mass calculations are the most practical of all problems with stoyhyometry based on mass. Moles cannot be measured directly, while the mass of any substance can generally be easily measured in a laboratory. This type of problem is three steps and is a combination of two previous types. \[\text{mass of given} \rightarrow \text{mols of given} \rightarrow \text{mols of unknown} \rightarrow \text{mass of unknown}\] The mass of the substance given is converted to mole using the molar mass of that substance from the periodic table. The moles of a cedable substance are then converted into moles of the unknown using the ratio of whiting from a balanced chemical equation. In the end, the moles of the unknown are converted into mass using its molar mass. Example \(\PageIndex{1}\) Ammonia degraded to dinitrogen monoxide and water according to the following equation. \[\ce{NH_4NO_3} \left(\right) \rightarrow \ce{N_2O} \left(g \right) + 2 \ce{H_2O} \left(l \right)\] In a specific experiment, the ammonium nitrate is degraded in a specific experiment. Find the weight of each of the designed products. Solution step 1: Write known quantities and schedule the problem. Known given: \(45.7 \: \text{g} \: \ce{NH_4NO_3}\) \(1 \text{mol} \: \ce{NH_4NO_3} = 1 \text{mol} \: \text{mole} \: \: \: \text/mole if {N_2O} = 2 \text{mol} \: \ce{H_2O}\) Molar mass \(\ce{NH_4NO_3} = 80.06 \: \text{g/mol}\) Molar mass from \(\ce{N_2O} = 44.02 \: \text{g/mol}\) Molar mass from \(\ce{H_2O} = 18.02 \text{g/mol}\) UnkWn Mass \(\ce{N_2O} = : \: \text{g}\) Mass \(\ce{H_2O} = ? \: \text{g}\) Perform two separate mass calculations u three steps, how is displayed below. \\text{g} \: \ce{NH_4NO_3} \rightarrow \text{mol} \: \ce{NH_4NO_3} \rightarrow \text{mol} \: \ce{N_2O} \rightarrow \text{g} \: \ce{N_2O}\] \[\text] \[\text g} \: \ce{NH_4NO_3} \rightarrow \text{mol} \: \ce{NH_4NO_3} \rightarrow \text{mol} \: \ce{H_2O} \rightarrow \text{g} \: \ce{H_2O}\] Step 2: Solve. \[45.7 \: \text{g} \: \ce{NH_4NO_3} \times \frac{1 \: \text{mol} \: \if{NH_4NO_3}}{80.06 \: \text{g} \: \ce{NH_4NO_3}} \times \frac{1 \: \text{mol} \: \ce{N_2O }{1 \: \text{mol} \: \ce{NH_4NO_3}} \times \frac{44.02 \: \text{g} \: \ce{N_2O}}{1 \text{mol} \: \ce{N_2O}} = 25.1 \: \text]: \if{N_2O}\] \[[[[25.1\: \: \: ce{N_2O}\] 45.7 \: \text{g} \: \ce{NH_4NO_3} \times \frac{1 \: \text{mole} \: \ce{NH_4NO_3}}{80.06 \: \text{g} \: \ce{NH_4NO_3} \times \frac{2 \: \ce{H_2O}}}}1 \text{{ mol} \: \ce{NH_4NO_3}} \times \frac{18.02 \: \text{g} \: \ce{H_2O}}{1 \text{mol} \: \ce{H_2O}} = 20.6 \: \text{g} \: \ce{H_2O}\] Step 3: Consider the result. The total weight of the two products is equal to the mass of ammonium nitrate which has degraded, as evidenced by the law of mass conservation. Each answer has three important numbers. Summary Mass mass calculations include converting the mass of the reactionan into moles of the reactionan, and then using mole ratios to determine the mole of the product, which can then be converted into the mass of the product. The CK-12 Foundation, by Sharon Bewick, Richard Parsons, Therese Forsythe, Shonna Robinson and Jean Dupon. Prob #1-10 Prob #11-25 Return to the Stoichiometry Menu This is the most common type of stoyiometric problem in high school. Four steps are involved in solving these problems: make sure you're working with an appropriately balanced chemical equation. Convert grams of matter, made into a problem in mole. Construct two proportions - one from the problem and one from the chemical equation and set them the same. The relationship from the problem will have an unknown x. Convert mole matter that has just been salvated into grams. Comments Double-click the equation. ChemTeam has seen many students go right and solved with the unbalanced equations attached to the problem (or a test question for this matter). Do not use the same molar mass in steps 2 and 4. Your teacher is aware of this and will provide the answer that came with this error on the multi-option test. You've been warned! Do not amplue the molar mass of the substance by coefficient in the problem, BEFORE using it in one of the steps above. For example, if 2H2O says 2H2O in a chemical equation, do not use 36,0 g/mol, use 18,0 g/mol. Don't round up to the last answer. In other words, do not clear the calculator after step two and write down the value of 3 or 4 important numbers that you want to use in the next step. Round only once after calculations have been made. Stop!!! Go back to the beginning of this file and read it again. Notice that I gave four steps (and some tips) on how to solve the problem just below. My advice is to continue to return to those steps as you examine the examples below. Example #1: How many grams of hydrogen gas is needed for a complete reaction of 54.0 g of oxygen, depending on the following unbalanced chemical reaction: H2 + O2 ---> H2O Solution: 1) Balancing the chemical equation: 2H + O2 ---> 2H2O 2) Convert grams date substance: 54,0 g / 32,0 g/mol = 1.6875 mol from O2 Have an in-the-ind 32,0 i not 16,0. The chemical substance is O2. Students have been known to sometimes forget to write signature 2 on the diatomace element (H2, N2, O2, F2, Cl2, Br2, I2) 3) Build two molar proportions and set them up with each other. The first molar ratio is from the coefficients of the balanced chemical equation. There are two substances: and the numerical ratio is this: 4) The second ratio is found in the printout of the problem. H2 is our unknown because the problem says how many grams of hydrogen and the amount of O2 mole is another value. Here's how: I turned off the mole unit for convenience. Also note that I am not rounded. I'll do it in the end. 5) We need to determine two ratios that are identical to each other and resolve: x = 3,375 mol H2 requires 6) Convert the calculated mole from step #3 to grams: (3,375 mol) (2nd. 016 g/mol) = 6,80 g (up to three sig smoke) Note: that you have not balanced the equation, at the end you would end up with an untamisable molar ratio of 1:1, but not the correct ratio of 2:1. Example #2: How many grams of hydrogen gas is needed to produce 105,0 grams of water according to the following unbalanced chemical reaction: H2 + O2 ---> H2O Solution: 1) Balancing the chemical equation: 2H2 + O2 ---> 2H2O 2) Convert gramdate substance: 105.0 g / 18.015 g/mol = 5.82848 mole from H2O I rounded out some, Am I sorry to keep the digits from the digits to the hto i finally round it off. 3) Construct two molar ratios and set them together. Two substances in the first relationship are the following: and the numerical ratio from the is this: 4) The second relationship is derived from the information in the problem: 5) Setting the same and resolving: 2 x —— = ——— 2 5.82848 x = 5.82848 mol H2 required Note: this may be a confusion zone. Because the ratio is 1:1, the answer is 5.82848 mole easily arrived. Many students, however, will forget that the answer of 5.82848 mole is now those of another hydrogen substance. Since the number (5.82848) does not appear to have changed, the substance has not changed. As a result, the student will enter the next (and last) step, in mind that 5.82848 still refers to water. 6) Convert moles into grams: (5.82848 mol) (2,016 g/mol) = 11,75 g H2 (up to four pitches) Example #3: How many grams of hydrogen gas is required to produce 85,2 grams of ammonia, depending on the following unbalanced chemical reaction: N2 + H2 ---> NH3 Solution: 1) Chemical equation equine balance: N2 + 3H2 ---> 2NH3 2) Convert date grams u mole: 85.2 g / 17.0307 g/mol = 5.00273 mole 3) Construct two molar ratios i place it naturally. Dve snovi v naših razmerjih sta ti: 4) Dva razmerja, ki sta enaka ena drugi, sta: 3 x —— = ——— 2 5.00273 x = 7,504095 mol H2 5) Pretvori izračunane mole do grama: (7,504095 mol) (2.016 g/mol) = 15,8 g (do tri sig smoke) Primer #4: Koliko grama klora se sme da se osvobodi od razgradnjenja od 64,0 g. od AuCl3 po tej reakciji: AuCl3 ---> Au + Cl2 Solution: 1) Data enačba mora biti pravilno uravnotežena: 2AuCl3 ---> 2Au + 3Cl2 2) Pretvoriti grame AuCl3 u mole: Let x = mols of AuCl 3 64,0 g x = ———————— 303,32 g/mol x = 0.210998 mol AuCl3 ChemTeam je zaslišala mnoge varijabilnosti za to: Ali, kako ste vi grame AuCl3-a pretvorili u mole? I chose AuCl3 to convert from grams to moles because gram quantity of AuCl3 was guaranteed in problem. 3) Use two molar ratios that include AuCl3 and Cl2: 4) Two molar ratios identical to each other: 2 0.210998 —— = ——— 3 x x x = 0.316497 mol Cl2 This is the most difficult step. Constructing the appropriate ratio and proportion can cause a lot of confusion. 5) Convert calculated moles into grams: (0.316497 mol) (70,906 g/mol) = 22.4 g (to three sig figs) One question I often get is where did the value come from 303.32? The answer- that's the molar mass of AuCl3. Keep this answer in mind when you wonder where the other numbers in a given solution come from. You may also want to consider addressing a solution to the problem and try to include it in the list of steps listed above. I know what I'm suggesting is horrible and mean, but then I'm a teacher. What the hell do I know? Example #5: Calculate the mass of agCl that you can prepare from 200. g alCl3 and enough AgNO3 using this equation: 3AgNO3 + AlCl3 ---> 3AgCl + Solution: 1) Since the chemical equation is already balanced, convert alCl3 grams to mole: 200. g ———————— = 1.499914 mol AlCl3 133,341 g/mol I chose AlCl3 because the substance has a gram amount associated with it in the problem. 2) Use a portion with molar ratios including AgCl and AlCl3: 3 x —— = ——— 1 1.499914 x = 4.499742 mol AgCl Ratio x in the right side is related to the substance for which we are trying to calculate the amount (AgCl). Look for phrases like Calculate Mass . . . or Specify mass . . . in the problem statement. 3) Convert moles to grams: (4.499742 mol) (143,323 g/mol) = 645 g (three sig figs) By the way, what if you used a ratio of 1 over 3, with an AlCl3 value in the counter? Then the second relationship would be reversed and the answer would be the same. The ratio and proportion would look like this: 1 1.499914 —— = ——— 3 x Example #6: According to this equation: 2KI + Pb(NO3) ---> PbI2 + 2KNO3 calculates the mass of PbI2 produced by a reaction of 30,0 g OF CA with excess Pb(NO3)2 Solution: 1) The equation is balanced. You used to get an unbalanced equation on the test when all the classroom examples used already balanced equations. Make sure you make these problems with a balanced chemical equation. 2) We give us 30.0 g KI. Change it into moles: 30,0 g ———————— = 0,180725 mol KI 165,998 g/mol 3) Construct the ratio and proportion: This ratio: comes from the coefficients of the balanced equation. This ratio: stems from taking into account the data in the problem. Setting two equals gives us a share to the resolution: 2 0.180725 —— = ——— 1 x x = 0.0903625 mol 2 Substance associated with x is not the substance for which grams are given in the problem statement. x is associated with a substance for which the word book is, such as Specify, how much . . . applicable. You notice that the third substance (Pb(NO3)2 is listed), but the word excess is used to describe it. When you learn more about stoihyometrics, excess matter will be insoud in the calculations. But not yet. Look for it in a section called reagent limiting. 4) Convert moles to grams: (0,0903625 mol) (461,01 g/mol) = 41,6 g (three sig figs) Example #7: If 92.0 g of aluminium is produced, how many grams of aluminium nitrate has reacted? Al(NO3)3 + Mg ---> Mg(NO3)2 + Al Solution: 1) An unbalanced equation was in difficulty. It should be balanced: 2Al(NO3)3 + 3Mg ---> 3Mg(NO3)2 + 2Al 2) Grams of aluminium. Convert it into moles: 92,0 g ———————— = 3.4099 mol al 26.98 g/mol 3) Use ratio and aluminium share 2 3.4099 —— = ——— 2 x x = 3.4099 mol 3)3, NOT mols of Al Warning: the next step will be a real temptation to use the wrong molar mass 4) Specify the grams of the unknown, Aluminium nitrate: (3.4099 mol) (212,994 g/mol) = 726 g (up to three sig smoke) Comments on the final step of case #7: U problem, for example, is a good congratulations that student u this step benefits molar mass Al. I think it's because in this step they see the same value (3.4099 mole) as in step two. The conclusion is that it has to be the same substance. And that's a mistake. In the second step we had 3.4099 mol aluminum, and after the ratio and share solution we now have 3.4099 mol aluminum nitrate. Be careful about the point, especially if the amount you got is ultimately equal to the amount you had at the beginning (92 grams). Example #8: How many grams of AuCl3 can be made from 100.0 grams of chlorine with this reaction: 2Au + 3Cl2 ---> 2AuCl3 Solution: 1) The equation is balanced. Yay! 2) 100.0 g of chlorine is in difficulty. Convert it to moles: 100,0 g ———————— = 1.41032 mol Cl2 70,906 g/mol You notice that the chlorine element is diatomic. Students sometimes forget to write seven diatoms with two overwritten. There are seven diatoms: H2, N2, O2, F2, Cl2, Br2, I2 3) Ratio and proportional to turn off Cl2 i AlCl3: 3 1.41032 mol —— = ———————— 2 x x = 0,940213 mol Uočiti that the chlorine-related values (3 i 1.41032) and values associated with gold(III) chloride (2 i x) are used to the denominator. If we were to re-spin one relationship, we'd have to turn the other one around. 4) Convert AuCl3 moles into grams: (0,940213 mol) (303,329 g/mol) = 285 g Example #9: Aluminium foil 1,00 cm square and 0,540 mm thick with bromide reacting to form aluminium bromide. (a) How many grams of bromine have been consumed? (b) How many grams of aluminium bromide have been produced? Solution: 1) Determine the weight, then the moles, Al present: volume of Al ---> (1,00 cm) (1,00 cm) (0,0540 cm) = 0,0540 cm3 Note the change mm per cm. Mass Al ---> (2,70 g/cm3) (0,0540 cm3) = 0,1458 g Faint the use of aluminium density. mol al ---> 0.1458 g / 26.98154 g/mol = 0.0054037 mol 2) The equation for the reaction is: 2Al + 3Br2 ---> 2AlBr3 Molar ratio Al to Br2 2:3 will be used to answer (a). For reply (b), the molar ratio of Al to AlBr3 2:2 will be used. 3) Use the Al to Br2 mole ratio to determine the moles consumed Br2: 2 0.0054037 mol —— = ———————— – 3 x x = 0,00810555 mol (with Br2) 4) Define grams Br2 : (0,00810555 mol) (159,808 g/mol) = 1,30 g (up to three sig smoke) 5) Use the molar ratio Al to AlBr3 for the determination of alBr3 moles produced: 2 0.0054036 mole = ———————— 2 x x = 0,0054037 mol (from AlBr3) 6) Determination of alBr3 grams: (0,0054037 mol) (266. 694 g/mol) = 1,44 g (up to three sig smoke) Example #10: How many grams of oxygen does u sample Ca3(PO4)2, 66,0 g of calcium? Comment: stoiiometric problems are usually I have one chemical substance, how many other chemical substances? Different. But they don't have to be. Here is an example of a mass stoihiometric problem based on relationships within one chemical substance. Solution: 1) Determine the calcium moles: 66,0 g / 40,078 g/mol = 1.6468 mol 2) Determine the oxygen moles in the sample, based on a ratio of 3:8 between Ca and O: 3 8 ———— = -—— 1.6368 mol x = 4.4.8 3648 mole 3) Determine the oxygen mass: (4.3648 mol) (16,00 g/mol) = 69,8 g Bonus Example: Solid lithium hydroxide is used in spacecraft to remove exhaled carbon dioxide from the environment by forming solid lithium-carbonate flowing water. (a) What mass of gaseous carbon dioxide can absorb 1,00 kg of lithium? (b) In the TTP, what is the amount of CO2 produced? Solution: 1) Write a balanced chemical equation for the described reaction: 2LiOH + CO2 ---> Li2CO3 + H2O 2) However, there is a possible problem. The question is 1.00 kg of lithium, not lithium hydroxide. We need to know about the molar connection between Li and CO2. So, we make LiOH from Li: 2Li + 2H2O ---> 2LiOH + H2 3) If I add two reactions, I get this: 2Li + CO2 + H2O ---> Li2CO3 + H2 Note that two LiOH and one H2O vain. This third reaction gives me Li on CO2 as 2 to 1, so I am now ready to proceed. 4) Determine the mole Li reacting: 1000 g / 6,941 g/mol = 144,07 mol 5) Using a mole ratio of 2:1, I can determine the CO2 moles consumed: 2 144,07 mol —— = -—— ——— —— 1 x x = 72,035 mol (from CO2) 6) Convert mole u grams to get an answer for (a): (72,035 mol) (44,009 g/mol) = 3170 g 7) To determine the volume on the STP, Benefit from PV = nRT or molar volume: PV = nRT (1.00 atm) (V) = (72,035 mol) (0.08206 L atm/ mol K) (273,15 K) V = 1614,6 L (up to three smoke sig, this would be 1610 L) molar volume (22,414 L/mol) (72,035 mol) = 1614.6 L (1610 L to three sig smokeg) Prob #1-10 Prob #11-25 Return to Stoichiometry Menu Menu Menu

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