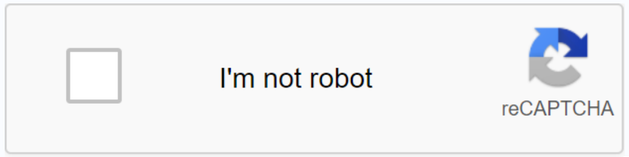

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Chapter 11 stoichiometry worksheet answers

CHAPTER 11 Stechiometry11.1 Definition of stechiometryStoichiometry is a study of the quantitative relationship between the reagents used and the products resulting from the chemical reaction. The stoichiometer is based on the Law on Mass Protection. The Law on the Protection of Mass States is that the issue is neither created nor destroyed. Thus, in the chemical reaction, the mass of reagents is equal to the mass of the products. You can use stoichiometry to answer questions about the amount of reagents or reactions used. For example, look at a balanced chemical equation for the formation of tableythrin (NaCl). 2Na(s) Cl2(g) 2NaCl(s)You can use sthyichiometry to answer these questions about the technical reaction. How much sodium is needed to produce a certain amount of table salt? How much chlorine is needed to produce a certain amount of table salt? Depending on the amount of sodium or chlorine, how much edible salt can be produced? When you look at a balanced equation, there are two ways to interpret the coefficients. The coefficients indicate how many individual particles interact in a chemical reaction. For example, from the chemistry above, you will learn that two sodium atoms react with one chlorinemolecule shaped two pieces of formula table salt. You will also learn that bi-dium sodium reacts with one chlorine clay to form two moles. What factors do not tell you directly are tencreitic mass and chemical reaction products. Example Problem 1Interpreting Chemical EquationsInterpretate a balanced chemical equation for particles, moles andmass. Show compliance with the law on mass conservation. Chemistry: Material and change 1 problem solving: Chemical manualChapter 11 (continued) 4NH3 5O2 4NO 6H2OS factors reflect the number of particles and the number of moles interacting in a chemical reaction. 4 molecules NH3 5 molecules O2 4 molecules NO 6 molecules H2O 4 molecules NH3 + 5 moles O2 4 moles NO + 6 moles H2OYou can calculate the mass of each reagent and product, multiplying the number of moles by the molar mass of the conversion factor.1 NH3 17,03 g NH3 = 68,12 g NH3 1 mol NH3 5 mol O2 32,00 g O2 = 160,0 g O2 1 mol O2 4 mol NO 30.01 g NO = 120,0 g NO 1 mol NO6 mol H2O 18,02 g H2O = 108,1 g H2O 1 mol H2OSseside is observed, because the mass of the pollutants (68,12 g NH3 + 160,0 g O2 = 228,1 g) is equal to the mass of the products (120,0 g NO + 108,1 g H2O = 228,1 g). Practice problems 1. Interpret each balanced equation from the point of view of particles, moles and mass. Show compliance with the law on mass conservation. a. 2H2O2(l) O2 (g) 2H2O(l) b. H2CO3(aq) H2O(l) CO2(g) c. 4HCl(aq) O2(g) 2H2O(l) 2Cl2(g)As you know, balancing factores for a chemical indicates that there is a link between reactives and products that are there in the action. You can use coefficients to write clay relations. The molar ratio is the ratio between the number of moles of any two substances in the abalanised chemical equation. What mole relationship can be written for this chemical equation? Chemistry: Material and change 2 troubleshooting: Chemical manual 11 (conts)2H2O2(l) O2(g) 2H2O(l)2 mol H2O2 and 2 mol H2O2 1 mol 1 mol O2 mol H2O 1 mol O2 and 1 mol O22 mol H2O2 2 mol H2O 2 mol H2O 2 mol H2O and 2 mol H2O2 mol H2O2 1 mol O2To determine the number of mole relationships , defining a specific chemical reaction , multiply the number of species in the equation by a different number. Thus, a chemical reaction with the three species involved can be defined by six molar relationships (3 2 = 6); chemical reaction with four species of fish can be defined in 12 molar relationships (4 3 = 12). Why learn to write clay ratio? They are the key to calculations, whichare based on chemical equations. Using a balanced chemical equation,mole ratios derived from the equation, and a certain quantity of one of the tenants or products, you can calculate the amount of any other participant in the reaction. Practice problems 2. Determine all clay ratios for these balanced chemical equations. A. N2(g) O2(g) 2NO(g) b. 4NH3(aq) 5O2(g) 4NO(g) 6H2O(l) c. 4HCl(aq) O2(g) 2H2O(l) 2Cl2(g)11.2 Stoichiometric calculationsThere are three main stoichiometric calculations: clay and clay conversions, mole mass conversions and mass and mass conversions. All stoichiometric calculations begin with a balanced equation and moleratios. Stoichiometric molar conversion How can you determine the number of edible salt (NaCl) moles made from 0.02 mole chlorine (Cl2)? Chemistry: Matter and change 3 solving problems: Chemical GuideChapter 11 (sequel)First, write a balanced equation. 2Na(s) Cl2(g) 2NaCl(s)Then use the breakwater ratio to convert the known number of chlorine moles into the number of edible salt moles. Use the formula below.known unknown ◄ unknown moles known 0.02 mol Cl 2 mol NaCl = 0.04 mol Cl 2 1 mol Cl 2 2Example Problem 2Stoometric mole-to-mole conversionA magnesium burns presence oxygen, formingmagine oxide (MgO). How many oxygen moles should be produced with 12 moles of magnesium oxide? Write a balanced equation to the molo ratio associated with molO2 and mol MgO. 2mg + O2 (g) 2MgO 1 mol O2 mol MgOSDaugly known MgO number of moles by clay ratio. 1 mol O12 mol MgO 2 = 6 mol O2 2 mol MgOSix oxygen moles are needed for the production of 12 moles of magnesium oxide. Practice problems 3. The carbon dioxide ehaled by astronauts can be removed from the spacecraft in response to lithium hydroxide (LiOH). The reaction is CO2(g) 2LiOH Li2CO3 H2O(l). The average person exhales about 20 moles of CO2 per day. How many Mole LiOH would be required to keep two astronauts on a spacecraft for three days? Chemistry: Matter and change 4 problem solving: Chemical GuideChapter 11 (sequel) 4. Balance this equation and answer the questions below. KClO3 KCl O2 (g) a. How many O2 moles are made of 10 KClO3 moles? B. How many KCl moles are produced using 3 KClO3 moles? C. How many KClO3 moles are needed to produce 50 moles O2? Stoichiometric clay into mass conversion Molly to mass conversion allows the calculation of the mass of the product or reagent in the achemical reaction, taking into account the number of moles of the reagent or product. Example Problem 3Stoichiometric Mole-to-Mass conversionSIo reaction occurs in plants undergoing photosynthesis. 6CO2(g) 6H2O(l) C6H12O6(s) 6O2(g)How much grams of glucose (C6H12O6) is produced when 24,0 moles react to excess water? Determine the number of glucose moles produced from carbon dioxide.24.0 mol CO2 1 mol C6H12O6 = 4,00 mol C6H12O6 6 mol CO2, using molar MASS in addition. 180,18 g C H O4.00 mol C6H12O6 6 12 6 = 721 g C6H12O6 1 mol C6H12O6721 g of glucose is obtained from 24,0 mole carbon dioxide. Practice problems 5. Calculate the mass of sodium chloride (NaCl) produced when 5,50 moles of sodium react to excess chlorine gas. Chemistry: Matter and change 5 problem solving: Chemical GuideChapter 11 (sequel) 6. How many grams of chlorine gas should be reacted with excess sodium iodide (NAI) to produce 6,00 moles of sodium chloride? A. Balance equation: NaI(aq) Cl2(g) NaCl(aq) I2(s). B. Perform the calculation. 7. Calculate the mass of hydrochloric acid (HCl) needed to react with 5.00 moles of zinc. A. Balancing equation: Zn HCl(aq) ZnCl2(aq) H2(g). B. Perform a calculation. Stoichiometric mass conversion to mass If you are about to perform a chemical reaction in the laboratory, you will need to estimate how much each reagent is used to produce a particular mass of the product. This is one case where you could use mass conversion to mass. In this calculation, you can find the mass of the non-inscible substance in the chemical equation if you have a balanced chemical equation and you know the mass of one substance in the equation. Example Problem 4Stoichiometric mass mass conversionHow many grams of sodium hydroxide (NaOH) need to be fully reacted with 50,0 g of sulphuric acid (H2SO4) to formodium sulfate (Na2SO4) and water? Write a balanced equation. 2NaOH(aq) + H2SO4(aq) Na2SO4 + 2H2O(g)Convert the grams of sulphuric acid to moles NaOH.50.0 g H2SO4 1 mol H2SO4 = 0,510 mol H2SO4 98,09 g H2SO40.510 mol H2SO4 2 mol NaOH = 1,02 mol 1 mol H2SO4Calculates the required naOH mass.1.02 mol NaOH 40,00 g NaOH = 40,8 g NaOH 1 mol NaO H50.0 grams of H2SO4 reacts completely with 40.8 grams of NaOH.Chemistry: Matter and Change 6 Solving Problems: A Chemistry HandbookChapter 11 (continued)Practice Problems 8. Balance each equation and solve the problem. A. If 40.0 g of magnesium reacts with excess hydrochloric acid (HCl), how many grams of magnesium chloride (MgCl2) are produced? Mg(s) HCl(aq) MgCl2(aq) H2(g) b. Determine the mass of copper required to react completely with a solution containing 12,0 g of silver nitrate (AgNO3). Cu(s) AgNO3(aq) Cu(NO3)2(aq) Ag(s) c. How many grams of hydrochloric acid (HCl) are formed when 15,0 g of sodium chloride (NaCl) reacts with excess sulphuric acid (H2SO4)? NaCl(aq) H2SO4(aq) Na2SO4 HCl(g) d. Calculate the mass of silver phosphate (Ag3PO4) obtained if 30,0 g of silver acetate (AgCH3COO) reacts with excess sodium phosphate (Na3PO4). AgCH3COO(aq) Na3PO4(aq) Ag3PO4(s) NaCH3COO(aq) Stoichiometric calculations Perform the following basic steps for stoichiometric calculations. 1. Write a balanced equation. 2. Set moles for a specific material using the conversion of mass into a mole. The inverse molar mass factor shall be used as a conversion factor. 3. Determine moles of unknown material from moles of the specified material. Use the breakwater ratio from a balanced equation as a conversion factor. 4. Determine the mass of unknown material from moles of unknown material using mol-to-mass conversion. Molar mass shall be used as a conversion factor. Chemistry: Substance and Change 7 solving problems: Chemical GuideChapter 11 (continued)11.3 Limiting reactions are chemical reactions contained in the exact moleratios indicated in a balanced equation reacts. Usually, one or more tenactants are too much, and the reaction happens until all onereactant is consumed. The reactant used is called restrictive response. Restrictive reactant limits the reaction and thus determineshow many forms of the product. Left reactful actresses are called exces transponders. How can you determine which chemical reaction reagent ismamening? First, find the number of moles in each reagent by multiplying the specified mass of each jet by the reverse molar mass. Then determine whether reactive reactions are in the jet ratio specified in a balanced equation. A reagent that is available in a sumsmaler than the required clay ratio is a restrictive reagent. After a limited reactive response is established, calculate the quantity of the product that can ideally result from a certain restrictive response amount. To do this, multiply the specified number of limiting fluids of the restrictive reactant by the breakwater ratio associated with the Product. Then convert the product moles to mass using the mole mass of the product as a conversion factor. Example Problem 5Setting of limited reactionAt if the following reaction is released, 40,0 g of sodium hydroxide (NaOH) reacts with 60,0 g of sulphuric acid (H2SO4). 2NaOH(aq) H2SO4(aq) Na2SO4 2H2O(g) a. Which reagent is limiting the reaccante? B. What mass of Na2SO4 can be produced using a specified amount of countermeasures? C. To determine the restrictive reactant, calculate the actual molar ratio of the available reagents. 40.0 g NaOH 1 mol NaOH = 1.00 mol NaOH 40.0 g NaOHChemistry: Matter and Change 8 Solving Problems: A Chemistry HandbookChapter 11 (continued))) 60,0 g H SO 1 mol H2SO4 = 0,612 mol H SO 2 4 98,09 g H2SO4 24 1,00 mol NaOHSo. Compare this ratio with mole 0.612 mol H2SO4ratio of a balanced equation: 2 mol NaOH 1 mol NaOH . , or 1 mol H2SO4 0,5 mol H SO 24You can see that when 0.5 mol H2SO4 reacts, all 1.00 mol ofNaOH will be used. Some H2SO4 would remain unsponsive. Thus, NaOH is restrictive reactant.d. To calculate the mass of Na2SO4 that may be formed from the following reagents, multiply the number of moles from the clay ratio of the product to the limiter and multiply by the molar mass of the product.1.00 1 mol NaSO4 142,00 04 g Na2SO4 mol NaOH 2 mol NaOH 1 mol Na SO 24 = 71,0 g Na2SO44 may be formed from the specified levels of retaliation. Practice problems 9. Ammonia (NH3) is one of the most common chemicals produced in the United States. It is used in the manufacture of fertilisers and other products. Ammonia is produced by the following chemical reaction: N2(g) 3H2(g) 2NH3(g) a. If you have 1,00□103 g N2 and 2,50□103 g of H2, which is a limiting reaction reaction? B. How many grams of ammonia can be produced from a limited amount of the agent? C. Calculate the mass of the excess reagent that remains after the reaction has been completed. Chemistry: Matter and change 9 problem solving: Chemical GuideChapter 11 (continued)10. Aluminum reacts with chlorine to create aluminum chloride. A. Balance the equation: Al(s) Cl2(g) AlCl3(s). B. If you start with 3.2 g of aluminium and 5.4 g of chlorine, which is a limiting reagent? C. How many grams of aluminum chloride can be made from a limited amount of react? D. Calculate the mass of the excess reagent that remains after the reaction has been completed. Reactions do not always continue until all reagents are exhausted. Using the cheapest reagent excess reactions can ensure that all the more expensive reagent is used, making chemical reactions more efficient and cost-effective. Using a single jet surplus may also accelerate some reactions.11.4 Percent yieldMost chemical reactions do not cause predicted characteristics of the product. While your work so far with stoichiometric problems can cause you to believe that chemical reactions continue under balanced eco-administration and always produce a calculated amount of product, this is not true. Many reactions stop before using all reagents, resulting in lessproduct than expected. In addition, products other than those expected are sometimes due to competing chemical reactions, thereby reducing the quantity of the desired product. The theoretical harvest is the maximum quantity of the product which, ideally, can be obtained from a certain quantity of reagent. This is the amount you have calculated in practice so far. Chemical reactions are unlikely to ever cause a theoretical harvest. The actual application is the quantity of the product that is actually produced when a chemical reaction is performed in the experiment. It is determined by measuringthe mass of your product. The percentage of output of a product is the ratio of tax output to theoretical fertility expressed as a percentage. Percentage yield ◄actuate yield (from the experiment) 100thalseal (from stoichiometric calculations)Chemistry: Matter and change 10 problem solving problems: Chemical GuideChapter 11 (cont's)Percent yield will tell you how effective the chemical reaction is to producenore product. Example Problem 6Caling percentage yieldAspirin (C9H8O4) can be produced from salicylic acid (C7H6O3) and acetichydride (C4H6O3). Let's say you mix 13.2 g of salicylic acid with acetic anhydride excesy and you get 5.9 g of aspirin and some water. Calculate the percentage yield of aspirin in this reaction. Write a balanced equation. 2C7H6O3 C4H6O3(l) 2C9H8O4(s) + H2O(l)Calculate theoretical yield. Salicylic acid is a limiting reactant.13.2 g C7 H 6O3 1 mol C7H6O3 = 0,0956 mol C7H6O3 138,1 g C7H6O3 2 mol C H O0.0956 mol C7H6O3 138,1 g 2 9 84 = 0.0956 mol C9H8O4 mol C7H6O3 180,2 g C H O0.0956 mol C9H8O4 9 84 = 17,2 g C9H8O4 1 mol C9H8O4Count percentage. 5.9 g C9H8O4 100 = 34% 17.2 g C9H8O4Practice problems11. The percentage of yield of each chemical reaction shall be calculated on the basis of the data provided. a. Theoretical yield: 25 g; actual yield: 20 g b. theoretical yield: 55 g; actual yield: 42 g c. theoretical yield: 5,2 g; actual yield: 4,9 g12. The actual yield of each chemical reaction shall be calculated from the data provided. a. Theoretical yield: 20 g; percentage yield: 95 % b. theoretical yield: 75 g; percentage yield: 88 % c. theoretical yield: 9,2 g; percent yield: 62%Chemistry: Matter and change 11 solving problems: Chemical GuideChapter 11 (continued)13. In the experiment, 10,0 g of magnesium reacted with an excess hydrochloric acid, which formed magnesium chloride. Mg(s) 2HCl(aq) MgCl2(aq) H2(g) 29,5 g magnesium chloride was obtained after the reaction was complete. Calculate theoretical yield and percentage efficiency in industrial processes is important. Manufacturers must reduce the cost of production of products to the lowest possible level. For example, sulphuric acid (H2SO4) is the raw material for many products, including fertilisers, detergents, pigments and textiles. The price of sulfuric acid affects the price of many side elements that use sulphuric acid as a raw material. The production of sulfuric acid is sometimes achieved by using a two-step process called a contact process. These two steps are as follows. S8 8O2(g) 8SO2(g) 2SO2(g) O2(g) 2SO3(g)The last step determines sulphuric acid as a product. SO3(g) H2O(l) H2SO4(aq)The first step produces a yield of almost 100 percent. The second step will also give a high yield if a catalyst is used. A catalyst is a substance that accelerates a chemical reaction but is not used in chemical reaction and is not included in the chemical equation. Chapter 11 Overview14. What is stechiometry?15. Write two questions that stiichiometry can help you answer about this chemical equation. 4HCl(aq) O2(g) 2H2O(l) 2Cl2(g)16. Link the Mass Conservation Act to stechiometry.17. What is the difference between restrictive responders and excess responders? Chemistry: Matter and Change 12 Problem Solving: Chemical GuideAnswer KeyChapter 11Practice Problems1. a. 2H2O2(l) O2(g) 2H2O(l) molecule 2 H2O2 1 molecule O2 2 molecule H2O 2 moles H2 1 mole O2 2 moles H2O 68,04 g H2O2 = 32,00 g O2 36,04 g H2O, as shown below. 68,04 g reagent = 68,04 g products2 mol H2O2 34,02 g H2O2 = 68,04 g H2O2 1 mol H2O21 mol O2 32,00 g O2 = 32,00 g O2 1 mol O22 mol H2O 18,02 g H2O = 36,04 g H2O 1 mol H2Ob. H2CO3(aq) H2O(l) CO2(g) Formula Unit H2CO3 1 molecule H2O 1 molecule CO2 1 moler H2CO3 1 molar H2O 1 molar CO2 62,03 g H2CO3 = 18,02 g H2O 44,01 g CO2 as shown below. 62,03 g reagent = 62,03 g products1 mol H2CO3 62,03 g H2CO3 = 62,03 g H2CO3 1 mol H2CO31 mol H2O 18,02 g H2O = 18,02 g H2O 1 mol H2O1 mol CO2 44,01 g CO2 = 44,01 g CO2 1 mol CO2Chemistry: Material and change 13 Problem solving: Chemical GuideAnswer Key (cont's)c. 4HCl(aq) O2(g) 2H2O(l) 2Cl2(g) 4 moleculeS HCl 1 molecule O2 2 molecule H2O 2 molecules Cl2 4 mole HCl 1 mol O2 2 mol H2O 2 mol Cl2 146 g HCl 32,00 g O2 = 36,04 g H2O 142 g Cl2 as shown below. 177,84 g reagents = 177,84 g products4 mol HCl 36,46 g HCl = 145,84 g HCl 1 mol HCl1 mol O2 32,00 g O2 = 32,00 g O2 1 mol O22 mol H2O 18,02 g H2O = 36,04 g H2O 1 mol H2O2 mol Cl2 70,90 g Cl2 = 141,80 g Cl2 1 mol Cl22. N2(g) O2(g) 2NO g) 1 mol N2 ; 1 mol N2 ; 1 mol O2 ; 1 mol O2 ; 1 mol O2 2 mol NO 1 mol N2 2 mol NO 2 mol NO 2 mol NO 2 mol NO 2 mol NO ; 1 clay N2 1 O2Chemistry: Matter and Change 14 Solving Problems: A Chemistry HandbookAnswer Key (below)b. 4NH3(aq) 5O2(g) 4NO(g) 6H2O(l) 4 mol NH3 , 4 mol NH3 , 4 mol NH3 , 5 mol O2 , 5 mol O2 4 mol NO 6 mol H2O 4 mol NH3 5 mol O2, 5 mol O2 , 4 mol NO, 4 mol NO, 4 mol NO 6 mol H2O 4 mol NH3 5 mol O2 4 mol NO , 6 mol H2O , 6 mol H2O , 6 mol H2O 6 mol H2O 4 mol NH3 5 mol O2 4 mol NOc. 4HCl(aq) O2(g) 2H2O(l) 2Cl2 4 mol HCl , 4 mol HCl , 4 mol HCl , 1 mol O2 , 1 mol O2 2 mol H2O 2 mol Cl2 4 mol HCl 1 mol O2, 1 mol O2, 2 mol H2O, 2 mol H2O, 2 mol Cl2 2 mol H2O 4 mol HCl 1 mol O2 2 mol H2O 2 mol Cl2, 2 mol Cl2, 2 mol Cl2 2 mol Cl2 4 mol HCl 1 mol O2 2 mol H2O3. 240 mol LiOH. 2KClO3(s) 2KCl(s) 3O2(g) a. 15 mol O2 b. 3 mol KCl c. 33 mol KClO3 or 30 mol KClO3 using significant figures5. Reaction 2Na Cl2(g) 2NaCl(s) obtained from 321 g NaCl.6. a. 2NI(aq) Article 2(g) 2L(aq) I2(a) b. 213 g Cl27. Zn 2HCl(aq) ZnCl2(aq) H2(g) b. 365 g HCl8. a. Mg(s) 2HCl(aq) MgCl2(aq) H2(g); 157 g MgCl2 b. Cu(s) 2AgNO3(aq) Cu(NO3)2(aq) 2A;(s); 2,24 g Cu c. 2NaCl(aq) H2SO4(aq) Na2SO4 2HCl(g); 9,36 g HCl d. 3AgCH3COO(aq) Na3PO4(aq) Ag3PO4 3NaCH3COO(aq); 25,1 g Ag3PO49. a. N2Chemistry: Material and replacement 15 Problem solving: Chemical manualAnswer Key (continued) b. 1.22□103 g NH3 c. 34 g H210. a. 2L2(g) 3Cl2(g) 2AlCl3(s) b. Cl2 c. 6.8 g AlCl3 d. 1,8 g Al11. a. 80 % b. 76 % appe on 94 %12. a. 19 g b. 66 g c. 5,7 g13. theoretical yield: 39,2 g; percentage yield: 75.3%11 Chapter Overview14. Stechiometry is a study of quantitative relationships between the quantity of reagents used and products resulting from a chemical reaction.15. Sample questions: What mass of HCl needs to be fully responded with known mass O2? How much water will be produced if a certain mass of HCl is used for the reaction?16. The Law on the Conservation of Mass States states that the issue is neither created nor destroyed; thus, in the case of a chemical reaction, the mass of reagents must be equal to the mass of the products.17. The limiting reagent limits the amount of product that can be formed from the reaction. The excess reagent remains after the reaction is complete and all the limited reactant has been exhausted. Chemistry: Matter and Change 16 Problem Solving: Chemical Guide Guide Guide Guide