Chemistry college essay

The Mole General, Organic, and Biological Chemistry Copyright © 2010 Pearson Education, Inc. 1 Collection Terms A collection term states a specific number of items. ? 1 dozen donuts = 12 donuts ? 1 ream of paper = 500 sheets ? 1 case = 24 cans General, Organic, and Biological Chemistry 2 A Mole of Atoms A mole is a collection that contains ? the same number of particles as there are carbon atoms in 12. 0 g of carbon 12C ? 6.

02 x 1023 atoms of an element (Avogadro’s number) 1 mole of Element 1 mole of C = 1 mole of Na = 1 mole of Au = Number of Atoms 6. 02 x 1023 C atoms 6. 2 x 1023 Na atoms 6. 02 x 1023 Au atoms General, Organic, and Biological Chemistry Copyright © 2010 Pearson Education, Inc. 3 A Mole of a Compound A mole ? of a covalent compound has Avogadro’s number of molecules 1 mole of CO2 = 6. 02 x 1023 CO2 molecules 1 mole of H2O = 6.

02 x 1023 H2O molecules ? of an ionic compound contains Avogadro’s number of formula units 1 mole of NaCl = 6. 02 x 1023 NaCl formula units 1 mole of K2SO4 = 6. 02 x 1023 K2SO4 formula units General, Organic, and Biological Chemistry Copyright © 2010 Pearson Education, Inc. 4 Avogadro’s Number Define Avogadro’s number, NA. ? NA = 6. 02 x 1023 particles/moleDefine the mole as ? 1 mole = 6.

02 x 1023 atoms/molecules/ions 5 Using Avogadro’s Number Avogadro’s number is used to convert moles of a substance to particles. How many Cu atoms are in 0. 50 mole of Cu? Rearrange formula Number of atoms = Number of moles x NA = 0. 5 x 6. 02 x 1023 Cu atoms = 3.

0 x 1023 Cu atoms 6 Using Avogadro’s Number (continued) Avogadro’s number is used to convert particles of a substance to moles. How many

moles of CO2 are in 2. 50 x 1024 molecules of CO2? Number of moles = 2. 5 x 1024 NA = 4.

15 moles of CO2 General, Organic, and Biological Chemistry Copyright © 2010 Pearson Education, Inc. Subscripts and Moles The subscripts in a formula give ? the relationship of atoms in the formula ? the moles of each element in 1 mole of a compound Glucose C6H12O6 In 1 molecule: 6 atoms of C 12 atoms of H 6 atoms of O In 1 mole: 6 moles of C 12 moles of H 6 moles of O General, Organic, and Biological Chemistry Copyright © 2010 Pearson Education, Inc. 8 Subscripts State Atoms and Moles 1 mole of C9H8O4 = 9 moles of C 8 moles of H 4 moles of O General, Organic, and Biological Chemistry 9 Chemical Reactions and Quantities Molar Mass General, Organic, and Biological Chemistry Copyright © 2010 Pearson Education, Inc. 0 Molar Mass The molar mass is ? the mass of one mole of a substance ? the atomic mass of an element expressed in grams General, Organic, and Biological Chemistry Copyright © 2010 Pearson Education, Inc.

11 Molar Mass of CaCl2 ? For a compound, the molar mass is the sum of the molar masses of the elements in the formula. We calculate the molar mass of CaCl2 to the nearest 0. 1 g as follows. Element Number of Moles Atomic Mass Total Mass Ca 1 40. 1 g/mole 40. 1 g Cl CaCl2 2 1 35.

5 g/mole 71. 0 g 111. 1 g General, Organic, and Biological Chemistry Copyright © 2010 Pearson Education, Inc. 12 Molar Mass of K3PO4Determine the molar mass of K3PO4 to 0.

1 g. Element Number of Moles Atomic Mass Total Mass in K3PO4 K P 3 1 39. 1 g/mole 31. 0 g/mole 117.

3 g 31. 0 g O K3PO4 4 1 16. 0 g/mole 64. 0 g 212. 3 g General, Organic, and Biological Chemistry Copyright © 2010 Pearson Education, Inc. 13 One-Mole Quantities 32.

1 g 55. 9 g 58. 5 g 294. 2 g 342. 3 g General, Organic, and Biological Chemistry Copyright © 2010 Pearson Education, Inc.

14 Guide to Calculating Molar Mass General, Organic, and Biological Chemistry 15 Moles and the molar mass Example: Aluminium is often used for the structure of bicycle frames. How many grams are in 3. 00 moles of Al? Rearrange formula Mass = moles x molar mass = 3 moles x 27g/mol = 81 g 16 Guide to Calculations Using Molar Mass General, Organic, and Biological Chemistry 17 Percentage composition Example: What is the percentage composition of ethanol (C2H60) Solution: Step 1: Determine molar mass of substance Mass of 2 carbon atoms Mass of 6 Hydrogen atoms Mass of 1 oxygen atom Mass of 1 C2H60 molecule = 2 x 12 g/mol = 24 g/mol = 6 x 1 g/mol = 6 g/mol = 1 x 16 g/mol = 16 g/mol = 46 g/mol 18 Step 2: Now calculate individual percentages of all elements in substance Step 2: Now calculate individual percentages of all elements in substanceTake note: percentages must add up to 100% 19 Chemical Reactions and Quantities Chemical Reactions General, Organic, and Biological Chemistry 20 Chemical Change In a chemical change, ? reacting substances form new substances with different compositions and properties ? a chemical reaction takes place General, Organic, and Biological Chemistry 21 Writing equations for reactions Reactants on LH-side of arrow Products on RH-side of arrow Symbols used in chemical equations + ; ? (g) (l) (s) (aq) (^) (v) separates two or more formulas. reacts to form products.

heat is supplied to the reaction mixture. gaseous state. liquid state. olid state. Aqueous.

product is released as a gas. product is in the form of a precipitate 22 Chemical Equations are Balanced In a balanced chemical reaction, ? atoms are not lost or gained ? the number of atoms in the reactants is equal to the number of atoms in the products General, Organic, and Biological Chemistry 23 A Balanced Chemical Equation In a balanced chemical equation, ? there must be the same number of each type of atom on the reactant side and on the product side ? numbers called coefficients are used in front of one or more formulas. Al + S Al2S3 Not balanced 2Al + 3S Al2S3 Balanced 2Al 3S = = 2Al 3SCopyright © 2010 Pearson Education, Inc. 24 General, Organic, and Biological Chemistry BALANCING CHEMICAL EQUATIONS E.

g. P4 + Cl2 ? PCl4 – list all elements on LH and RH LH : 4 P, 2 Cl RH 1 P, 4 Cl – start with most complicated (PCl4) by adding more P (4 PCl4) LH : 4 P, 2 Cl RH 4 P, 16 Cl – adjust LH to compensate by adding Cl (8 Cl2) LH : 4 P, 16 Cl RH 4 P, 16 Cl Equation is now balanced P4 + 8Cl2 ? 4PCl4 Guide to Balancing Equations General, Organic, and Biological Chemistry 26 Equations with Polyatomic Ions General, Organic, and Biological Chemistry 27 Balancing with Polyatomic Ions STEP 1 Write the equation with the correct formulas. Na3PO4(aq) + MgCl2(aq) NaCl(aq) + Mg3(PO4)2(s) STEP 2 Determine if the equation is balanced. No, not all atoms are balanced. 3Na+ 1Na+ 1PO43? 2PO43 ? 1Mg2+ 3Mg2+ 2Cl? 1Cl? STEP 3 Balance with coefficients in front of formulas. Balance PO43? as a unit.

2Na3PO4(aq) Mg3(PO4)2(s) General, Organic, and Biological Chemistry Copyright © 2010 Pearson Education, Inc. 28 Balancing with Polyatomic Ions (continued) STEP 3 (continued) Balance Mg 3MgCl2(aq) Balance Na and Cl 3MgCl2(aq) + 2Na3PO4(aq) Mg3(PO4)2(s) 6NaCl(aq) + Mg3(PO4)2(s) STEP 4 Check that atoms of each element are equal in reactants and products. PO43– = 2PO43– 3Mg2+ = 3Mg2+ 6Na+ = 6Na+ 6Cl? = 6Cl? General, Organic, and Biological Chemistry Copyright © 2010 Pearson Education, Inc. 29 Chemical Reactions and Quantities Types of Reactions General, Organic, and Biological Chemistry Copyright © 2010 Pearson Education, Inc.

30 Types of Reactions combination reactions Decomposition single replacement reactions double replacement reactions 31 Chemical Reactions and Quantities Oxidation–Reduction Reactions General, Organic, and Biological Chemistry 32 Everyday Oxidation-Reduction Reactions An oxidation–reduction reaction ? provides us with energy from food ? rovides electrical energy in batteries ? occurs when iron rusts 4Fe(s) + 3O2(g) 2Fe2O3(s) General, Organic, and Biological Chemistry 33 Rules for the assignment of oxidation numbers 1. The oxidation number of an element in the elemental state is zero 2. The oxidation number of a monatomic ion is the same as the charge of the ion 3. Metals have positive oxidation numbers in compounds 4. Most hydrogen compounds contain hydrogen with a +1 oxidation number 5.

Most oxygen compounds contain oxygen with a -2 oxidation number 6. The oxidation number of fluorine in compounds is -1 7. The oxidation number of chlorine, bromine, nd iodine in compounds is -1 except when combined with oxygen. 8. The algebraic sum of the oxidation numbers of atoms in a

compound is zero 9. The algebraic sum of the oxidation numbers of atoms in a 34 polyatomic ion is the same as the charge of the ion Assigning oxidation numbers Example: 1.

Assign oxidation numbers to elements in H2SO4 H = +1(rule 4) O = -2 (rule 5) S = ?? Sulphur as per rule 8: 2x(+1) + S + 4x(-2) = 0 2+ + (-8) = 0 S = +6 35 Transfer of Electrons An oxidation–reduction reaction transfers electrons from one reactant to another Oxidation Is a Loss of electrons Increase in oxidation number Zn(s) Zn2+(aq) + 2e? Reduction Is a Gain of electrons Decrease in oxidation number Cu2+(aq) + 2e? Cu(s) General, Organic, and Biological Chemistry (OIL) (RIG) Copyright © 2010 Pearson Education, Inc. 36 Oxidizing Agent and Reducing Agent Oxidizing Agent substance that is reduced in a redox reaction (caution – must be a reactant) Reducing Agent substance that is oxidized in a redox reaction (caution – must be a reactant) 37 Example 3P + 5 HNO3 Step 1: Assign oxidation numbers 5 NO + 3 H2PO4 What is oxidized, reduced and identify OA and RA in the reaction LH P= 0 H = +1 O = -2 N = +5 RH N = +2 O = -2 H = +1 P = +6P: increase in oxidation number N: decrease in oxidation number P is oxidised, Reducing Agent HNO3 is reduced, Oxidizing Agent 38 Chapter 6 Chemical Reactions and Quantities Mole Relationships in Chemical Equations General, Organic, and Biological Chemistry Copyright © 2010 Pearson Education, Inc. 39 Reading Equations with Moles Consider the following equation: Fe + O2 Fe2O3, balancing equation ? 4Fe(s) + 3O2(g) 2Fe2O3(s) An equation can be read in “ moles” by placing the words “ moles of” between each coefficient and formula. 4 moles of Fe + 3 moles of O2 2 moles of Fe2O3 General, Organic, and Biological ChemistryCopyright © 2010

Pearson Education, Inc. 40 Learning Check Consider the following equation: 3H2(g) + N2(g) 2NH3(g) 3 moles of H2 + 1 mole N2 ? 1 mole H2 + mole N2 ? If I want 1mole NH3 ? If I have 3 moles N2 ? 2 moles NH3 mole NH3 Moles H2 + moles N2 Need 9 moles H2 ? 6 moles NH3 41 Guide to Using Mole–Mole Factors General, Organic, and Biological Chemistry 42 Chapter 6 Chemical Reactions and Quantities Mass Calculations for Reactions General, Organic, and Biological Chemistry Copyright © 2010 Pearson Education, Inc.

43 Guide to Calculating the Masses of Reactants and Products General, Organic, and Biological Chemistry 4 Chapter 6 Chemical Reactions and Quantities Percent Yield General, Organic, and Biological Chemistry Copyright © 2010 Pearson Education, Inc. 45 Theoretical, Actual, and Percent Yield Theoretical yield: ? the maximum amount of product, which is calculated using the balanced equation. Actual yield: ? the amount of product obtained when the reaction takes place Percent yield: ? the ratio of actual yield to theoretical yield Percent yield = actual yield (g) x 100 theoretical yield (g) Copyright © 2010 Pearson Education, Inc. 46 General, Organic, and Biological Chemistry Guide to Calculations for Percent YieldGeneral, Organic, and Biological Chemistry 47 Calculating Percent Yield Suppose you have prepared cookie dough to make 5 dozen cookies. The phone rings and you answer. While you talk, a sheet of 12 cookies burns, and you have to throw them out.

The rest of the cookies you make are okay. What is the percent yield of edible cookies? Theoretical yield: 60 cookies possible Actual yield: 48 cookies to eat Percent yield: 48 cookies x 100% = 80. % yield 60 cookies General, Organic, and Biological Chemistry Copyright © 2010 Pearson Education, Inc.

48 Chapter 6 Chemical Reactions and Quantities Energy Changes in Chemical ReactionsGeneral, Organic, and Biological Chemistry 49 Reaction Conditions Reaction conditions for a chemical reaction require ? collisions between reacting molecules ? collisions with sufficient energy to break the bonds in the reactants ? the breaking of bonds between atoms of the reactants ? the forming of new bonds to give products General, Organic, and Biological Chemistry Copyright © 2010 Pearson Education, Inc. 50 Chemical Reactions In the reaction H2(g) + I2(g) ? the reactants H2 and I2 collide ? the bonds of H2 and I2 break ? the bonds for HI form 2HI(g), H2 + I2 collision bonds break new bonds form Copyright © 2010 Pearson Education, Inc.

HI 51 General, Organic, and Biological Chemistry Activation Energy Activation energy ? is the minimum energy required upon collision for a reaction to take place General, Organic, and Biological Chemistry Copyright © 2010 Pearson Education, Inc. 52 Heat of Reaction The heat of reaction ? is the amount of heat absorbed or released during a reaction ? is the difference in the energy of the reactants and the products General, Organic, and Biological Chemistry Copyright © 2010 Pearson Education, Inc. 53 Exothermic Reactions In an exothermic reaction, ? the energy of the products is less than the energy of the reactants ? eat of reaction is released ? heat is a product General, Organic, and Biological Chemistry Copyright © 2010 Pearson Education, Inc. 54 Endothermic Reactions In an endothermic reaction, ? heat is absorbed ? the energy of the products is greater than the energy of the reactants ? heat is a reactant General, Organic, and Biological Chemistry Copyright © 2010 Pearson Education, Inc.

55 Summary Reaction Type Endothermic Exothermic Energy Change Heat absorbed Heat released Heat in Reaction Reactant side Product side General, Organic, and Biological Chemistry Copyright © 2010 Pearson Education, Inc. 56 Chapter 9 Chemical EquilibriumRates of Reactions General, Organic, and Biological Chemistry 57 Collision Theory of Reactions A chemical reaction occurs when ? collisions between molecules have sufficient energy to break the bonds in the reactants ? molecules collide with the proper orientation ? bonds between atoms of the reactants (N2 and O2) are broken and new bonds (NO) form General, Organic, and Biological Chemistry Copyright © 2010 Pearson Education, Inc. 58 Collision Theory of Reactions (continued) A chemical reaction does not take place if the ? collisions between molecules do not have sufficient energy to break the bonds in the reactants ? olecules are not properly aligned General, Organic, and Biological Chemistry Copyright © 2010 Pearson Education, Inc. 59 Activation Energy The activation energy ? is the minimum energy needed for a reaction to take place upon proper collision of reactants General, Organic, and Biological Chemistry 60 Reaction Rate and Temperature Reaction rate ? is the speed at which reactant is used up ? is the speed at which product forms ? increases when temperature rises because reacting molecules move faster, thereby providing more colliding molecules with energy of activation General, Organic, and Biological ChemistryCopyright © 2010 Pearson Education, Inc. 61 Reaction Rate and Concentration Increasing the concentration of reactants ? increases the number of collisions ? increases the reaction rate General, Organic, and Biological Chemistry 62 Reaction Rate and Catalysts A catalyst ? speeds up the rate of a reaction ? lowers the energy of activation ? is not used up during the reaction General, Organic, and Biological Chemistry

63 Reaction rate and surface area Increasing the reacting surface ? speeds up the reaction rate E.

G. Granulated sugar dissolves faster than sugar cube Laundry that are hanged and spread would dry faster than when bundled up 64