Self Test for Unit 5: Chemical Quantities and Calculations

Part I: Multiple Choice with explanation: Choose the best answer and give an explanation that supports your choice

1. How many oxygen atoms are in 10 formula units of $Al_2(SO_4)_3$? (a) 10 atoms O (b) 7 atoms O (c) 70 atoms O (d) 120 atoms O

2. The mass of a mole of NaCl is the: (a) gram formula mass. (b) gram atomic mass. (c) gram molecular mass. (d) atomic mass.

3. What is the molar mass of $MgCl_2$? (a) 59.8 g (b) 95.3 g (c) 125.8 g (d) 76.4 g

4. A large weather balloon filled with helium has a volume of 7.00×10^2 L at STP. Which expression should be used to find the mass of helium in the balloon? (a) $\frac{22.4\text{ L}}{\text{mol}} \times \frac{4\text{ g He}}{\text{mol}}$ (b) $\frac{7.00 \times 10^2}{\text{L}} \times \frac{4\text{ g He}}{\text{mol}}$ (c) $\frac{22.4\text{ L/mol}}{7.00 \times 10^2\text{L}} \times \frac{4\text{ g He}}{\text{mol}}$

   (d) $\frac{7.00 \times 10^2\text{L}}{22.4\text{ L/mol}} \times \frac{4\text{ g He}}{\text{mol}}$

5. Which of the following is *not* an empirical formula? (a) Na_2SO_4 (b) C_6H_5Cl (c) N_2H_4 (d) $Sn_3(PO_4)_4$

6. Which expression represents the percent by mass of nitrogen in NH_4NO_3? (a) (14.0 g/80.0 g) x 100% (b) (28.0 g/80.0 g) x 100% (c) (80.0 g/14.0 g) x 100% (d) 80.0 g/28.0 g) x 100%

7. The empirical formula of a compound is CH_2F. The gram formula mass of this compound is 66.0 g. The molecular formula of the compound is: (a) $C_4H_8F_4$ (b) $C_4H_4F_4$ (c) $C_2H_4F_2$ (d) CH_2F

8. In a chemical reaction: (a) mass is conserved. (b) atoms are conserved. (c) moles are conserved. (d) both mass and atoms are conserved.

9. If 3.0 moles of HCl are consumed in the reaction below, how many moles of $FeCl_3$ are produced? $6HCl + Fe_2O_3 \rightarrow 2FeCl_3 + 3H_2O$ (a) 0.50 mol (b) 1.0 mol (c) 2.0 mol (d) 4.0 mol

10. Which of the following is a correct interpretation of this balanced equation? $2\,Al(s) + 3\,Pb(NO_3)_2(aq) \rightarrow 2\,Al(NO_3)_3\,(aq) + 3Pb(s)$

    a) 2 grams Al + 3 grams $Pb(NO_3)_2$ → 2 grams $Al(NO_3)_3$ + 3 grams Pb

    b) 2 atoms Al + 3 units $Pb(NO_3)_2$ → 2 units $Al(NO_3)_3$ + 3 atoms Pb

    c) 2 moles Al + 3 moles $Pb(NO_3)_2$ → 2 moles $Al(NO_3)_3$ + 3 moles Pb

    d) both b and c

11. Given the equation $2H_2O \rightarrow 2H_2 + O_2$, how many moles of H_2O would be required to produce 2.5 moles of O_2? (a) 2.0 mol (b) 2.5 mol (c) 4.0 mol (d) 5.0 mol

12. Given the balanced equation $16HCl + 2KMnO_4 \rightarrow 2KCl + 2MnCl_2 + 5Cl_2 + 8H_2O$, if 1.0 mol of $KMnO_4$ reacts, how many moles of H_2O are produced? (a) 0.50 mol (b) 2.0 mol (c) 4.0 mol (d) 8.0 mol

13. Given the reaction $2NO(g) + O_2(g) \rightarrow 2NO_2(g)$, if 13 L of O_2 react at STP, how many liters of NO_2 are produced? (a) 6.5 L (b) 3.2 L (c) 26 L (d) 13 L

14. Given the reaction $Zn + 2HCl \rightarrow ZnCl_2 + H_2$, if 2.0 mol Zn and 5.0 mol HCl are allowed to react: (a) Zn is the limiting reagent. (b) HCl is the limiting reagent. (c) 1.0 mol of $ZnCl_2$ is produced. (d) 1.0 mol of H_2 is produced.

15. The quantity of heat that raises the temperature of 1 gram of pure water 1^oC is: (a) the heat capacity. (b) 1 joule. (c) 1 calorie. (d) the heat of combustion.

16. As perspiration (the system) evaporates from your skin, cooling your body, this process is said to be: (a) endothermic. (b) exothermic. (c) isothermic. (d) none of these.

17. When the container of a chemical reaction feels hot to the touch the reaction is called (a) endothermic. (b) exothermic. (c) isothermic. (d) none of these.

18. Given the equation $I_2(s) + 62.4\ kJ \rightarrow I_2(g)$, which of the following is true: (a) The reaction is exothermic. (b) $\Delta H = +62.4$ kJ (c) $\Delta H = -62.4$ kJ (d) The reaction releases heat.

19. If a thermochemical equation has $\Delta H < 0$, this equation is said to be: (a) exothermic (b) endothermic (c) absorbing heat from the surroundings. (d) isothermic.

20. The symbol ΔH_f^o is called: (a) the molar heat of fusion. (b) the heat of a reaction. (c) the enthalpy change of fusion. (d) the standard heat of formation.

Part 2: Problems – Solve the following problems in the space provided. Remember to develop a system of showing your work, especially if you choose not to follow the problem solving method presented in class, your partial credit depends on this.

1. Find the mass of each of the following:
   a. 3.65×10^{-2} mol K_2SO_4
   b. 2.61×10^{24} molec. H_2O_2
   c. 0.060 L of CH_4 gas at STP
   d. 3.70×10^{22} atoms of Kr
2. Make the necessary conversion in the following:
   a. How many molecules are in 25.0 g of H_2O?
   b. How many **milliliters** do 2.56×10^{21} atoms of He occupy at STP?
   c. How many formula units are present in a 1.34 nanogram sample of $MgCl_2$?
3. What is the density of N_2O, a gas at STP?

4. What is the percent composition of each of the elements in the following compounds?

   a. Cr_2O_3

   b. Experimental evidence of a compound indicates that a 18.35 g of the compound contains 5.74 g of tin and the rest is chlorine.

5. Determine the empirical formula of the compound with the percent composition of: 29.1% Na, 40.5% S, and 30.4% O.

6. A compound is 85.7% C and 14.3% H. If the gram molecular mass of the compound is 42.0 g, find the molecular formula of the compound.

7. $2C_4H_{10}(g) + 13O_2(g) \rightarrow 8CO_2 + 10H_2O(g)$ Answer the following questions based on this reaction.

   a. How many liters of oxygen (at STP) are required to burn 4.84 grams of butane (C_4H_{10}) completely?

   b. How many grams of CO_2 are produced when 88.6g of O_2 are reacted with an excess of butane?

8. How many molecules of chlorine are produced when 40.0g of salt are split by electrolysis according to this equation?

$$2NaCl(s) \rightarrow 2Na(s) + Cl_2(g)$$

9.

$$2Al(s) + 2H_3PO_4(aq) \rightarrow 2AlPO_4(s) + 3H_2(g)$$

10. Referring to problem 9, what is the limiting reagent

11. If a what is the limiting reagent?

12. In problem #11 give the maximum

13. Fill in the missing pieces of information in the following blanks and state whether the reaction is endothermic or exothermic.

(a) $2K(s) + Br_2(g) \rightarrow 2KBr(s) + 784kJ$

$\Delta H =$ _____

(b) $H_2O(l) +$ _____ $\rightarrow H_2(g) + \frac{1}{2} O_2(g)$

$\Delta H = 286$ kJ _____

14. How much heat is absorbed when 55.3 grams of NH_4NO_3 solid are dissolved in a beaker full of water? ($\Delta H_{soln} = 25.7$ kJ/mol)

15. Calculate the amount of heat produced when 125 g of methane, CH_4, burns in excess air according to the following equation.

$$CH_4 + 3O_2 \rightarrow CO_2 + 2H_2O + 890.2 \text{ kJ}$$