**Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**AP Chemistry**

**Chapter 3 Practice Problems 2020**

**Multiple Choice**

*Identify the letter of the choice that best completes the statement or answers the question. Use of a calculator is NOT permitted for these questions!*

\_\_\_\_ 1. A compound contains 1.10 mol of K, 0.55 mol of Te, and 1.65 mol of O. What is the simplest formula of this compound?

|  |  |  |  |
| --- | --- | --- | --- |
| a. | KTeO | c. | K2TeO3 |
| b. | KTe2O | d. | K2TeO6  |

\_\_\_\_ 2. Which of the following alkali metal chlorides has the lowest percent chloride by mass?

|  |  |  |  |
| --- | --- | --- | --- |
| a. | sodium chloride | c. | rubidium chloride |
| b. | potassium chloride | d. | cesium chloride |

\_\_\_\_ 3. Which oxides of chromium, Cr, have percent by mass of chromium that is greater than 50%?

I. CrO

II. Cr2O3

III. CrO3

|  |  |  |  |
| --- | --- | --- | --- |
| a. | I only | d. | I and II only |
| b. | II only | e. | I, II and III |
| c. | II and III only |

\_\_\_\_ 4. Which expression gives the percent by mass of carbon in citric acid, C6H8O7•H2O?

|  |  |  |  |
| --- | --- | --- | --- |
| a. |  | c. |  |
| b. |  | d. |  |

\_\_\_\_ 5. Liquid pentane, C5H10, burns in excess oxygen gas. When the equation for this reaction is correctly balanced and all coefficients are reduced to their lowest whole-number terms, the coefficient for O2 is

|  |  |  |  |
| --- | --- | --- | --- |
| a. | 15 | c. | 8 |
| b. | 6 | d. | 9 |

\_\_\_\_ 6.

2 N2H4*(g)* + N2O4*(g)*  3 N2*(g)* + 4 H2O*(g)*

When 8.0 g of N2H4 (32 g mol-1) and 92 g of N2O4 (92 g mol-1) are mixed together and react according to the equation above, what is the maximum mass of H2O that can be produced?

|  |  |  |  |
| --- | --- | --- | --- |
| a. | 9.0  | c. | 36 g |
| b. | 18 g | d. | 72 g |

\_\_\_\_ 7. If 0.40 mol of H2 and 0.15 mol of O2 were to react as completely as possible to produce H2O, what mass of reactant would remain?

|  |  |  |  |
| --- | --- | --- | --- |
| a. | 0.20 g of H2 | c. | 3.2 g of O2 |
| b. | 0.40 g of H2 | d. | 4.0 g of O2 |

**Free Response Questions**

4Fe*(s)* + 3 O2*(g)*  2 Fe2O3*(s)* *Hf*° = -824 kJ mol–1

Iron reacts with oxygen to produce iron(III) oxide as represented above. A 75.0 g sample of Fe*(s)* is mixed with 11.5 L of O2*(g)* at 2.66 atm and 298 K. (**2004 B)**

 8. a) Calculate the number of moles of each of the following before the reaction occurs. (2 pts)

 (i) Fe*(s)*

(ii) O2*(g)*

b)Identify the limiting reactant when the mixture is heated to produce Fe2O3. Support your answer with calculations. (1 pt)

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 9. A sample of a pure, gaseous hydrocarbon is introduced into a previously evacuated rigid 1.00 L vessel. The pressure of the gas is 0.200 atm at a temperature of 127o C. (2012A)

(a) Calculate the number of moles of the hydrocarbon in the vessel. (2 pts)

(b) O2(*g*) is introduced into the same vessel containing the hydrocarbon. After the addition of the O2(*g*), the total pressure of the gas mixture in the vessel is 1.40 atm at 127oC. Calculate the partial pressure of O2(*g*) in the vessel. (1 pt)

The mixture of the hydrocarbon and oxygen is sparked so that a complete combustion reaction occurs, producing CO2(*g*) and H2O(*g*). The partial pressures of these gases at 127oC are 0.600 atm for CO2(*g*) and 0.800 atm for H2O(*g*). There is O2(*g*) remaining in the container after the reaction is complete.

(c) Use the partial pressures of CO2(*g*) and H2O(*g*) to calculate the partial pressure of the O2(*g*) consumed in the combustion. (2 pts)

(d) On the basis of your answers above, write the balanced chemical equation for the combustion reaction and determine the formula of the hydrocarbon. (2 pts)

(e) Calculate the mass of the hydrocarbon that was combusted. (2 pts)

 10. Ethene, C2H4(g) (molar mass 28.1 g/mol) may be prepared by the dehydration of ethanol, C2H5OH(g) (molar mass 46.1 g/mol), using a solid catalyst. A setup for the lab synthesis is shown in the diagram below. (2015)



The equation for the dehydration reaction is given below.

 C2H5OH(g)  C2H4(g) + H2O(g)  = 45.5 kJ/mol  = 126 J/mol K

A student added a 0.200 g sample of C2H5OH(l) to a test tube using the setup shown above. The student heated the test tube gently with a Bunsen burner until all of the C2H5OH(l) evaporated gas generation stopped. When the reaction stopped, the volume of collected gas was 0.0854 L at 0.822 atm and 305 K. (The vapor pressure of water at 305 K is 35.7 torr.)

a) Calculate the number of moles of C2H4(g)

 i) that are actually produced in the experiment and measured in the gas collection tube (2 pts)

 ii) and that would be produced if the dehydration reaction went to completion. (1 pt)

b) Calculate the percent yield of C2H4(g) in the experiment. (1 pt)

**Chapter 3 Practice Problems 2020**

**Answer Section**

**MULTIPLE CHOICE**

 1. ANS: C PTS: 1

 2. ANS: D PTS: 1 REF: adapted from AP MCQ

 3. ANS: E PTS: 1 REF: adapted from AP MCQ

 4. ANS: D PTS: 1 REF: adapted from AP MCQ

 5. ANS: A PTS: 1 REF: after AP MCQ 2011

 6. ANS: A PTS: 1

 7. ANS: A PTS: 1

**PROBLEM**

 8. ANS:

a) (i) 75.0 g Fe  = 1.34 mol Fe

 (ii) PV = nRT, n =

 = 1.25 mol O2

b) Fe; 1.34 mol Fe  = 1.01 mol O2

 excess O2, limiting reagent is Fe

PTS: 1 KEY: mole; ideal gas law

 9. ANS:

*a) n PV RT* { { � �

*n =* 6.09 x 10-3 moles 1 pt for setup, 1 pt for correct answer

b) *P*O2 = 1.40 atm – 0.200 atm = 1.20 atm 1 pt for correct answer

c) PO2 = 1.000 atm, based on stoichiometry OR ideal gas law 1 pt for stoichiometry/work, 1 pt for correct answer

d) C3H8 + 5O2 --> 3CO2 + 4H2O 1 pt for correct hydrocarbon (can be found from relative partial presssure ratios OR from calculating empirical formula) 1 pt for correct equation

e) .269 g 1 pt for using moles from part a, 1 pt for correctly finding mass with gfm

PTS: 1

 10. ANS:

a) i) Pethene = 0.775 atm, 0.00264 moles of gas

 ii) 0.00434 mol

b) 60.8%

PTS: 1