Solutions

SOLUTIONS TO PRACTICE FINAL EXAMINATION

_____ *Please circle the name of your instructor:*

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This exam set consists of questions. Please ensure that you have a complete set.

1. Calculators may not be shared. Programmable calculators are not permitted.
2. No books or extra paper are permitted.
3. In order to obtain full credit, you must show the method used to solve all

1. a) Carry out the following calculations. Assume the numbers represent measurements and express your answers to the proper number of significant figures.

i) $(12.688 < 10.0) \times (7.85 + 2.666)$ = 28 (1 mark)

ii) $(12.61 + 0.22 + 0.037) \div 0.04$ = 3×10^2 (1 mark)

b) Express the following numbers in scientific notation.

i) 0.000771 = 7.71×10^{4} (1 mark)

ii) 157 = 1.57×10^2 (1 mark)

c) Convert the following:

i) 205 K = 68°C °C (1 mark)

ii) 25.7 g = 2.57×10^4 mg mg (1 mark)

iii) 102°F = 39°C °C (1 mark)

d) Pumice is a volcanic rock that contains many trapped air bubbles. A 155 g sample of pumice is found to have a volume of 163 mL.

i) What is the density of pumice in g mL^{-1}? = 155 / 163 = 0.951 g/mL (1 mark)

ii) What is the volume occupied by a 4.56 kg sample of pumice? =
4560 / 0.951 = 4.80×10^3 mL (1 mark)

iii) Will pumice float or sink in ethyl alcohol?
(density of ethyl alcohol is 0.790 g/mL at 20°C) = It will sink (1 mark)

2.

b) Write the chemical formulas for the following compounds: (5 marks)

7.

b) The following are some physical and chemical properties of metals and nonmetals. Match the stated properties in column one with the type of element (or) that can exhibit the given property. State your answer in column two (6 marks)

Have high melting point	*Metal*
Have no lustre	Nonmetal
Mostly hard but malleable	Metal
May combine with each other	Nonmetal
Have high electrical conductivity	Metal
Most have high densities	Metal
Will generally not be ductile but rather brittle	Nonmetal

9. Complete the following table by providing the missing information: (9 marks)

Nuclear Symbol	Atomic Number	Mass Number	Number of Neutrons	Number of Electrons	Number of Protons
$^{32}_{16}S$	16	[redacted]	16	16	16
$^{80}_{35}Br$	35	80	45	35	35 3

5

11. If 3.45 g bismuth metal, Bi, is reacted with chlorine gas according to the unbalanced chemical equation:

$$Bi\,(s) + Cl_2\,(g) \quad BiCl_3\,(s)$$

calculate the mass in grams of chlorine needed to completely react with the bismuth metal and the mass in grams of bismuth (III) chloride formed. (4 marks)

Molar Mass: Bi = 208.98 Cl_2 = 2(35.453) = 70.906

$BiCl_3$ = (208.98) + 3(35.453) = 315.34

$$2\,Bi\,(s) + 3\,Cl_2\,(g) \quad 2\,BiCl_3\,(s)$$

$$n_{Bi} = \frac{3.45\text{ g}}{208.98\text{ g mol}^{-1}} = 0.0165\text{ mol Bi}$$

$$n_{Cl_2} = 0.0165\text{ mol Bi}\left(\frac{3\text{ mol } Cl_2}{2\text{ mol Bi}}\right) = 0.0248\text{ mol}$$

$$n_{BiCl_3} = 0.0165\text{ mol Bi}\left(\frac{2\text{ mol } BiCl_3}{2\text{ mol Bi}}\right) = 0.0165\text{ mol}$$

$$m_{Cl_2} = 0.0248\text{ mol}\left(\frac{70.906\text{ g } Cl_2}{1\text{ mol}}\right) = 1.76\text{ g } Cl_2$$

$$m_{BiCl_3} = 0.0165\text{ mol}\left(\frac{315.34\text{ g } BiCl_3}{1\text{ mol}}\right) = 5.20\text{ g } BiCl_3$$

12. When 2.50 g potassium superoxide, KO_2 , reacts with 4.50 g carbon dioxide according to the <u>unbalanced</u> chemical equation:

$$KO_2\,(s) \;+\; CO_2\,(g) \qquad K_2CO_3\,(s) + \; O_2\,(g)$$

0.799 g oxygen gas are produced. Calculate:

a) The theoretical yield of oxygen.

b) The percent yield of oxygen in this reaction. (5 marks)

Molar Mass: KO_2 = 71.10 CO_2 = 44.01 O_2 = 32.00 K_2CO_3 = 138.21

$$4\,KO_2\,(s) \;+\; 2\,CO_2\,(g) \qquad 2\,K_2CO_3\,(s) + \; 3\,O_2\,(g)$$

$$n_{KO_2} = \frac{2.50\text{ g}}{71.10\text{ g mol}^{1}} = 0.0352\text{ mol}\,KO_2$$

$$n_{CO_2} = \frac{4.50\text{ g}}{44.01\text{ g mol}^{1}} = 0.102\text{ mol}\,CO_2$$

Assume KO_2 is the Limiting Reactant

Number of moles CO_2 needed $n_{CO_2} = 0.0352\text{ mol}\,KO_2 \;\; \frac{2\text{ mol }CO_2\text{l}}{4\text{ mol}\,KO_2} = 0.0176\text{ mol}\,CO_2$

Number of moles CO_2 needed (0.0176 mol) < Number of moles present (0.102 mol)

There is sufficient CO_2 so the assumption is correct.

a) Theoretical yield of oxygen;

= 136oTc09.73526(ed7(1E1 47.57)13( )62(0 [3 mol O_2

= =

13. a) Perform the following molar concentration calculations:

i) Calculate the molar concentration of 5.55 g $CaCl_2$ in 125 mL of solution. (2 marks)

Molar Mass: $CaCl_2 = (40.08) + 2(35.453) = 110.99$

$$n_{CaCl_2} = \frac{5.55\ g}{110.99\ g\ mol^{-1}} = 0.0500\ mol$$

$$V = 125 mL\left(\frac{10^{-3} L}{mL}\right) = 0.125\ L$$

$$[CaCl_2] = \frac{0.0500\ mol}{0.125\ L} = 0.400\ M$$

ii) Calculate the molar concentration of ammonium ion in a 0.333 M solution of ammonium phosphate. (2 marks)

Formula of ammonium phosphate $(NH_4)_3PO_4$

$[NH_4^+]$ _____ _____

14. a) Given that 24.0 mL of 0.170 M sodium iodide reacts with 0.209 M mercury (II) nitrate according to the unbalanced equation:

$Hg(NO_3)_2$

15. a) A 5.00 L sample of krypton gas contains 1.51×10^{24} atoms at 25°C. What is the pressure of the krypton gas in units of atm? (2 marks)

$$n_{Kr} = 1.51 \times 10^{24} \text{ atoms Kr} \left(\frac{\text{mol}}{6.022 \times 10^{22} \text{ atoms}} \right) = 2.51 \text{ mol}$$

$$V = 289 K$$

$$T = 25 + 273 = 289 K$$

$$P = \frac{nRT}{V} = \frac{(2.51 \text{ mol})(0.08206 \text{ L atm K}^{-1} \text{ mol}^{-1})(298 \text{ K})}{5.00 \text{ L}} = 12.3 \text{ atm}$$

b) A sample of unknown gas weighs 1.95 g and occupies 3.00 L at 1.25 atm and 20°C. What is the molar mass of the unknown gas? (2 marks)

T=20+273=293 K

$$MM = \frac{mRT}{PV} = \frac{(1.95 \text{ g})(0.08206 \text{ L atm K}^{-1} \text{ mol}^{-1})(293 \text{ K})}{(1.25 \text{ atm}))(3.00 \text{ L})} = 12.5 \text{ g mol}^{-1}$$