Chemistry 1105 Spring 2024 Test 3

Thursday, March 28, 2024 Time: 1 hour 50 minutes

Name: _____ Student #: _____

*This test consists of **eight** pages of questions, a page of useful constants and conversions, and a periodic table. Please ensure that you have a complete test and, if you do not, obtain one from me **immediately**. There are **35** marks available. Good luck!*

1) **[3 marks]** At 100 torr pressure and 90.46°C, the density of a gas of formula H_2O_n is 0.150 g/L. What is the number, n?

2) **[4 marks]** A mixture of two gases (A and B) had a total pressure of 60 atm. There were three moles of gas A, and the mole fraction of gas B was found to be 0.75.

   a) How many moles of gas B were in the mixture?

   b) What were the partial pressures of each gas?

3) **[3 marks]** According to Apple, the iPhone 15 Pro Max can be submerged in 6 metres of water for up to half an hour. If the density of water is 0.9984 g/cm^3, how many bars of pressure is exerted by water at this depth?

4) **[4 marks]** The following apparatus was assembled:

Flask 1:	**Flask 2:**
Volume: 8 L	Volume: 12 L
Filled with: HCN	Filled with: H_2
At a pressure of: 5 atm	At a pressure of 7 atm

Both flasks were kept at a temperature of 336.18°C before, during, and after reaction.

When the valve was opened, the following reaction occurred:

$$HCN(g) + 3H_2(g) \longrightarrow CH_4(g) + NH_3(g)$$

Calculate the partial pressures of all species **after** reaction.

5) **[4 marks]** A 3-mole piece of iron ($\bar{C} = 25.07 \frac{J}{mol \cdot °C}$) at 89.35°C was placed into 200 g of water ($S = 4.184 \frac{J}{(g \cdot °C)}$ at 15°C. The water was contained in a cup with $C = 20 \frac{J}{°C}$. What was the final temperature of the water?

6) **[4 marks]** A 760.9-mg piece of $Ca(OH)_2$ (74.09 g/mol) was put into 100.0 mL of 0.300 M HCl (1.00 g/mL, $4.184\,\frac{J}{(g\cdot°C)}$) at 22.85°C:

$2HCl(aq) + Ca(OH)_2(s) \longrightarrow CaCl_2(aq) + 2H_2O(l)$

The temperature of the solution increased to 26.65°C. Calculate the molar enthalpy of the reaction.

7) **[3 marks]** Given the following reactions:

$SrO(s) + CO_2(g) \longrightarrow SrCO_3(s)$ $\Delta H = -234$ kJ
$2SrO(s) \longrightarrow 2Sr(s) + O_2(g)$ $\Delta H = +1184$ kJ
$2SrCO_3(s) \longrightarrow 2Sr(s) + 2C(s, gr) + 3O_2(g)$ $\Delta H = +2440$ kJ

Find ΔH for the following reaction:

$C(s, gr) + O_2(g) \longrightarrow CO_2(g)$

8) **[1 mark]** What is the molar enthalpy of formation of SrO(s)?

9) **[4 marks]** Given the reaction:

$2Sr(s) + 2C(s, gr) + 3O_2(g) \longrightarrow 2SrCO_3(s)$ $\Delta H = -2440$ kJ

How many kJ of heat would be released by the reaction of 87.62 grams of Sr with 31.998 grams of oxygen and 12.011 grams of C(s, gr)?

10) **[4 marks]** Given the following equilibrium:

$H_2(g) + Cl_2(g) \rightleftharpoons 2HCl(g)$ $\quad \Delta H° < 0$ (exothermic)

Predict the effect that each of the changes given below would have on the value of K and on the moles of Cl_2 present in a fresh system initially at equilibrium. Your choices are **I**ncrease from the starting value, **D**ecrease from the starting value, or **N**ot **C**hange from the starting value. You may assume that, unless explicitly stated otherwise, the changes were carried out at constant temperature.

	Effect on:					
	K			Cl_2		
Adding some H_2	I	D	NC	I	D	NC
Cooling the reaction mixture	I	D	NC	I	D	NC
compressing the reaction mixture	I	D	NC	I	D	NC
Adding a non-reactive gas	I	D	NC	I	D	NC

11) **[1 mark]** Write a reaction for which the equilibrium expression is $K = [O_2]$.