

Chemistry 1154 R25 Fall 2023 Test 2

Friday, October 27, 2023

Time: 1 hour 50 minutes

Name: _____

Student #: _____

*This test consists of **seven** pages of questions, the formula sheet, and a periodic table. Please ensure that you have a complete test and, if you do not, obtain one from me **immediately**. There are **42** marks available. Good luck!*

1) **[4 marks]** The following apparatus was assembled:

Flask 1:

Volume: 4 litres

Filled with: C₄H₁₀

At a pressure of: 6000 torr

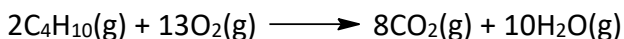
Flask 2:

Volume: 6 litres

Filled with: O₂

At a pressure of: 6500 torr

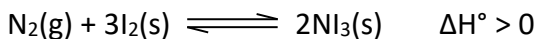
The two flasks were kept at a temperature of 528.6°C. The flasks were connected to one another by a valve (of no significant volume). When the valve was opened, the reaction



occurred. Calculate the mole fractions of all species after reaction. Give your answers in torr.

- 2) **[4 marks]** Helium effuses 5.0512 times faster than a gas of formula S_nF_m , and 5.9167 times faster than a gas of formula S_nF_{m+n} . What are the formulas of the two gases?

3) [4 marks] Given the following equilibrium:



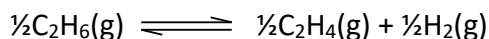
Predict the effect that each of the changes given below would have on the value of K_p and on the moles of I_2 present in a fresh system initially at equilibrium. Your choices are Increase from the starting value, Decrease from the starting value, or **Not Change** from the starting value. You may assume that, unless explicitly stated otherwise, the changes were carried out at constant temperature.

	Effect on:					
	K_p			I_2		
Adding some N_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 some $\text{NI}_3(\text{s})$	I	D	NC	I	D	NC

4) [6 marks total] For the reaction:



a) [2 marks] K_p for the reaction:



at 25°C will be:

- i) 4.94×10^{-18} ii) 1.57×10^{-9} iii) -6.36×10^8 iv) -2.03×10^{17}

b) [2 marks] K_c at 25°C will be:

- i) 1.63×10^{14} ii) 1.63×10^{16} iii) 1.00×10^{19} iv) 1.00×10^{21}

c) [2 marks] K_p at 30°C will be:

- i) 1.56×10^{-22} ii) 1.29×10^{-30} iii) 1.63×10^{17} iv) 4.05×10^{17}

5) **[2 marks]** The normal boiling point of ethanol is 78.35°C, and its enthalpy of vaporization is 42.3 kJ/mol. Its vapour pressure (in torr) at 35°C will be:

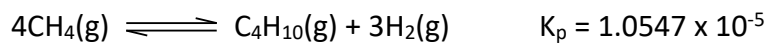
a) 2.8×10^{-86}

b) 9×10^{-33}

c) 99.2

d) 758.5

6) **[4 marks]** A flask was charged with 4 bar of CH₄, 1 bar of C₄H₁₀, and 3 bar of H₂, and the equilibrium:



established. Calculate the equilibrium partial pressures of all species.

7) **[3 marks]** Only 7.761×10^{-4} grams of BiI_3 (bismuth iodide, 589.69 g/mol) will dissolve in 100 mL of water. What is the K_{sp} of BiI_3 ?

8) **[3 marks]** The K_{sp} of $\text{Cd}(\text{CN})_2$ is 9.6×10^{-9} . Calculate the molar solubility of $\text{Cd}(\text{CN})_2$ in a 0.20 M solution of KCN.

9) **[3 marks]** A solution has $[\text{CO}_3^{2-}] = 0.0030 \text{ M}$ and $[\text{PO}_4^{3-}] = 0.0020 \text{ M}$. To separate these two ions, you slowly add solid CaCl_2 into the solution. The K_{sp} s of CaCO_3 and $\text{Ca}_3(\text{PO}_4)_2$ are 2.8×10^{-9} and 2.0×10^{-29} , respectively. At the point of maximum separation, what percent of the first anion to precipitate will remain in solution?

10) **[2 marks]** The pH of a certain aqueous solution is 7.10. The solution is:

- a) Acidic
- b) Neutral
- c) Basic
- d) There is not enough information to answer this question.

11) **[2 marks]** The pH of a $1.00 \times 10^{-9} \text{ M}$ solution of $\text{Mg}(\text{OH})_2$ at 25°C should be:

- a) 5.0
- b) 5.3
- c) 7.0
- d) 8.7
- e) 9.0

12) **[5 marks total]** HN_3 (hydrozoic acid) is a weak acid with a $K_a = 1.9 \times 10^{-5}$. Calculate the pH of the following solutions:

a) **[2 marks]** 0.0526 M hydrazoic acid

b) **[3 marks]** A solution that has $[\text{HN}_3] = 0.10 \text{ M}$ and $[\text{NaN}_3] = 0.19 \text{ M}$