

Chemistry 1105 R10 Spring 2011 Test 3

Friday, March 25, 2011

Time: 1 hour 50 minutes

Name: _____

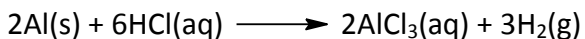
Student Number: _____

*This test consists of **eight** pages of questions, a page of useful constants, and a periodic table. Please ensure that you have a complete paper and, if you do not, obtain one from me **immediately**. There are **33** marks available. Good luck!*

- 1) **[4 marks]** The following data were collected for the molar mass of Aluminum, carried out in the same way as the molar mass of magnesium experiment:

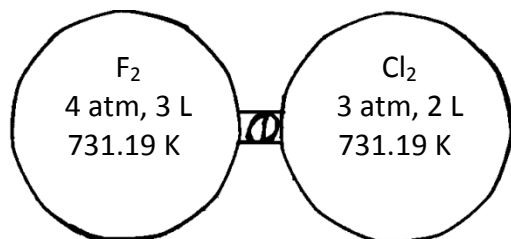
Mass of Aluminum (g)	
Atmospheric pressure (mmHg)	756.3
Volume of H ₂ evolved (mL)	76.0
Temperature of solution (°C)	22.0
Vapour pressure of solution (mmHg)	19.8
Height of column of water (mm)	136.0
Density of water (kg/m ³)	1000.

Aluminum reacts with HCl according to the equation:

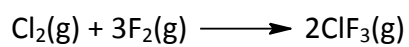


How many grams of aluminum were used in the experiment?

2) [4 marks] The following apparatus was assembled:



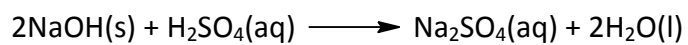
When the valve was opened, the following reaction occurred:



Calculate the partial pressures of all species present after reaction.

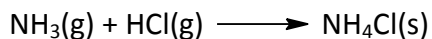
- 3) **[3 marks]** A 60-gram piece of copper ($S = 0.385 \text{ J/g}\cdot^\circ\text{C}$) at 10.00°C was placed in 20.0 grams of water ($S = 4.184 \text{ J/g}\cdot^\circ\text{C}$) at 75.00°C . The water was contained in a cup with heat capacity $20.0 \text{ J/}^\circ\text{C}$. What was the final temperature of the water?

- 4) **[4 marks]** A 1.00-gram sample of NaOH (40.0 g/mol) was added to 200. mL of 0.100 M H_2SO_4 ($S = 4.184 \text{ J/g}^\circ\text{C}$, $D = 1.00 \text{ g/mL}$) at 21.000°C .

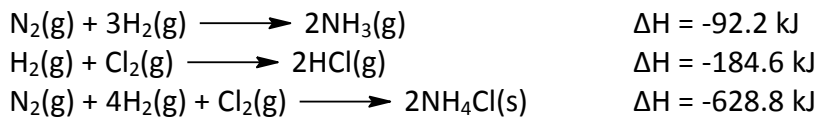


After the reaction, the temperature of the solution had increased to 23.378°C . Calculate ΔH for the reaction.

5) [2 marks] Calculate ΔH for the reaction:



Given the following data:

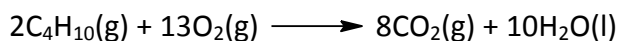


6) [1 mark] What is the enthalpy of formation of $\text{NH}_3(\text{g})$? Give your answer in kJ/mol.

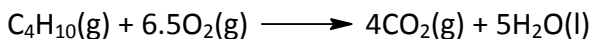
7) [2 marks] Given the following data:

Compound	$\Delta H^\circ_{f,298}$ (kJ/mol)
$\text{C}_4\text{H}_{10}(\text{g})$	-125.6
$\text{CO}_2(\text{g})$	-393.5
$\text{H}_2\text{O}(\text{l})$	-285.8

Calculate ΔH° for the reaction:

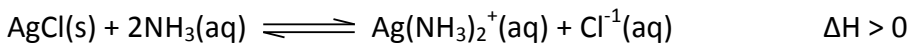


8) [3 marks] Given that ΔH° for the reaction



is -2877.4 kJ , how many kJ of heat would be released by the reaction of 5.80 grams of C_4H_{10} (58.0 g/mol) with 10.4 grams of O_2 (32.0 g/mol)?

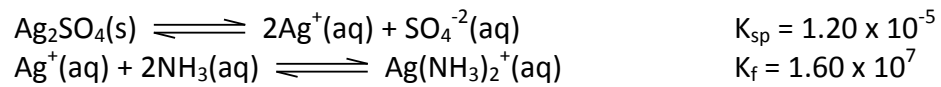
9) [4 marks] Given the following equilibrium:



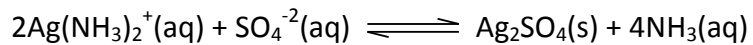
Predict the effect of the following changes on the value of K_c and of the concentration of Cl^- . Your choices are **Increase** from the current value, **Decrease** from the current value, or **Not Change** from the current value. Each change is carried out on a fresh system at equilibrium, and is carried out at constant temperature unless explicitly stated otherwise.

	Effect on:					
	K_c			Cl^-		
	I	D	NC	I	D	NC
Heating the reaction mixture	I	D	NC	I	D	NC
Adding NH_3	I	D	NC	I	D	NC
Adding AgCl	I	D	NC	I	D	NC
Adding water	I	D	NC	I	D	NC

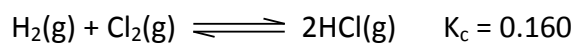
10) [2 marks] Given the following equilibria:



Calculate the equilibrium constant for:



11) **[4 marks total]** A 2.00-litre flask was charged with 2.00 moles of H_2 , 2.00 moles of Cl_2 , and 4.00 moles of HCl , and the equilibrium



established.

a) **[1 mark]** In which direction will the reaction shift in order to establish equilibrium? How do you know?

b) **[3 marks]** What were the equilibrium concentrations of all species once equilibrium had been attained?

Useful Constants

Constant	Value
R	$0.0820575 \frac{L \cdot atm}{mol \cdot K}$
	$62.3637 \frac{L \cdot torr}{mol \cdot K}$
	$8.314472 \frac{J}{mol \cdot K}$
1 atm	760 mmHg
	101325 Pa
g	$9.80665 \frac{m}{s^2}$