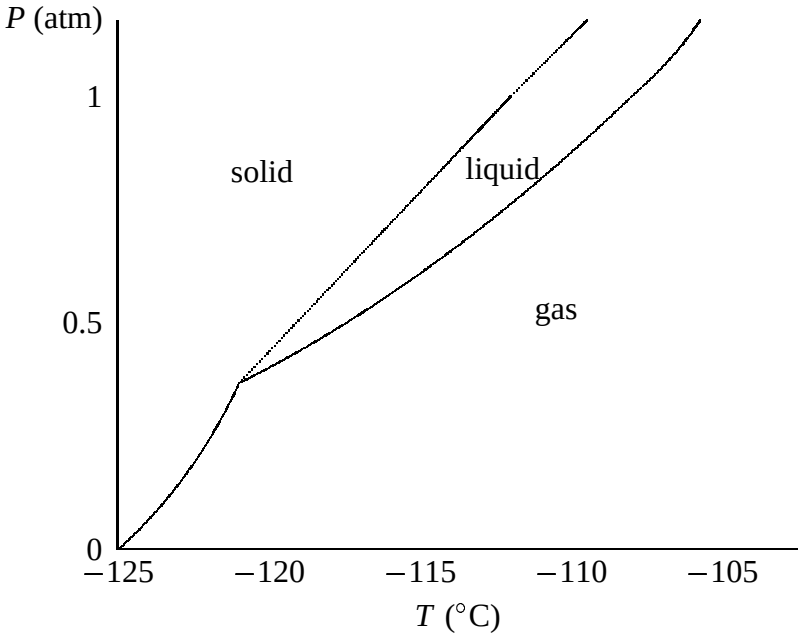
Chemistry 2000 Spring 2001 Section B Test 2

Aids allowed: Calculator. In particular, periodic tables and other written or printed materials are excluded.

Useful data is given at the end of this paper.

Answer all questions in the booklet provided.

1. Here is a sketch of the phase diagram of xenon:



   (a) What is the (approximate) minimum pressure at which solid xenon will melt rather than sublime as the temperature is increased? [2 marks]

   (b) What is the normal boiling point of xenon? [2 marks]

   (c) Which is denser, solid or liquid xenon? [2 marks]

2. The equilibrium constant for the water gas reaction

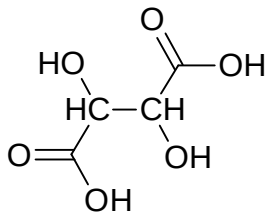
$$C_{(s)} + H_2O_{(g)} \rightleftharpoons CO_{(g)} + H_{2(g)}$$

   is 2.6 at 1000 K. Suppose that you want to make carbon monoxide and hydrogen, i.e. you want the reaction to proceed from left to right. Give a set of initial pressures of reactants and products such that this will actually happen. [4 marks]

3. Suppose that each of the following compounds is dissolved in water at room temperature. Which would be volatile (to an appreciable extent) under these conditions? Explain your reasoning in a few words. [2 marks each]

   (a) potassium iodide

   (b) tartaric acid:



   (c) bromine

4. A 0.0032 mol/L aqueous solution of potassium hydroxide is prepared. What is the pH of this solution at 30°C? [4 marks]

5. Hypochlorous acid (HClO) has a pK_a of 7.46 at 25°C. What is the pH of a 0.05 mol/L solution of HClO in water? [10 marks]

6. What is the vapor pressure of a solution made by mixing 50 g of ammonium sulfate into 300 g of water at 40°C? The vapor pressure of pure water at this temperature is 7373 Pa. [10 marks]

7. 2.75 atm of hydrogen gas is mixed with 1.50 atm of iodine vapor at 425°C. The two react, forming $HI_{(g)}$. At equilibrium, the partial pressure of HI is 2.79 atm. What is the equilibrium constant for the reaction? [10 marks]

Useful data

Molar masses of selected elements (g/mol)					
H	1.0079	O	15.999	S	32.06
N	14.007				

At 30°C, $K_w = 1.47 \times 10^{-14}$.

Thermodynamic standard states

$P^\circ = 1\,\text{atm}$

$c^\circ = 1\,\text{mol/L}$