所別：化學學系碩士班 不分組 科目：綜合化學

1. For this process: $Br_{2(l)} \rightarrow Br_{2(g)}$, where $\Delta H^\circ = 31.0$ kJ/mol and $\Delta S^\circ = 93.0$ J $K^{-1}mol^{-1}$, what is the boiling point of liquid Br_2 at 1.0 atm? (6 pts)

2. Arrange the following species according to their strength as bases: Cl^-, F^-, NO_2^-, CN^-, $C_2H_3O_2^-$ (5 pts) [HF: $Ka = 7.2 \times 10^{-4}$;HNO_2: $K_a = 4.0 \times 10^{-4}$; HCN: $K_a = 6.2 \times 10^{-10}$; $C_2H_3O_2H$: $K_a = 1.8 \times 10^{-5}$]

3. The rate of effusion of a particular gas was measured to be 24.0 mL/min. Under the same conditions the rate of effusion of pure methane gas, CH_4 is 47.8 mL/min. What is the molar mass of the unknown gas? (6 pts)

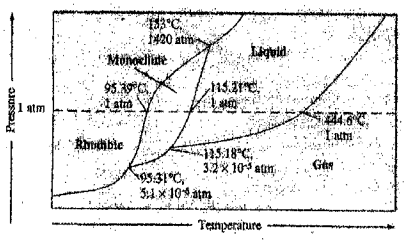
4. Considering the following equilibrium:

   $2SO_{2(g)} + O_{2(g)} \rightarrow 2SO_{3(g)}$

   An equilibrium mixture, at 25°C, contains $O_{2(g)}$ and $SO_{3(g)}$ at partial pressures of 0.50 atm and 2.0 atm, respectively. Determine the equilibrium partial pressure of $SO_{2(g)}$ in the mixture. ($\Delta G^\circ_{f\,(SO2)} = -300$ kJ/mol; $\Delta G^\circ_{f\,(SO3)} = -371$ kJ/mol) (8 pts)

5. ABS Plastic is a tough, hard plastic used in applications requiring shock resistance. The polymer consists of three monomer units: **a**crylonitrile (CH_2=CH-C≡N), **b**utadiene (CH_2=CH-CH=CH2), and **s**tyrene (C_6H_5CH=CH_2).
   (a) Draw **two** repeating units of ABS plastic assuming the three monomer units react in a 1:1:1 mol ratio and react in the same order as the monomers listed above, *i. e.* A-B-S. (5 pt)
   (b) In fact, ABS is not formed in a 1:1:1 mol ratio of the three monomers. Please calculate the percent by mass of acrylonitrile, butadiene, and styrene based on the following information: (i) ABS plastic contains 8.80% N by mass. (ii) A 1.20 g sample of ABS plastic reacts completely with 0.605 g of Br_2 (Br, atomic mass = 79.90). (10 pts)

6. Use the following phase diagram for sulfur to answer the following questions.



   a. How many triple points are in the phase diagram? (2 pts)
   b. What phase is stable at room temperature and 1.0 atm? (2 pts)
   c. What are the normal melting point and boiling point of sulfur? (4 pts)
   d. Which is the denser solid phase? (2 pts)

注意：背面有試題

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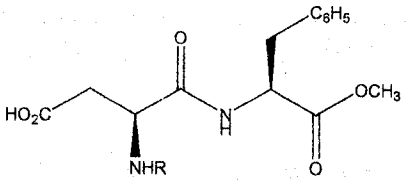
7. The Food and Drug Administration (FDA) of the United States has approved a new sweetener (artificial sugar), neotame, in 2002. It is about 8,000 times sweeter than sugar on a weight basis. The structures of neotame and aspartame are shown below:



Aspartame, R = H
Neotame, R = $CH_2CH_2C(CH_3)_3$

(a) What are the two main amino acids in producing these two sweetner? Please draw them and give their names. (6 pts)

(b) The metabolism of neotame is shown in the figure 1. According to this, what is the potential risk in using these sweeteners? (4 pts)

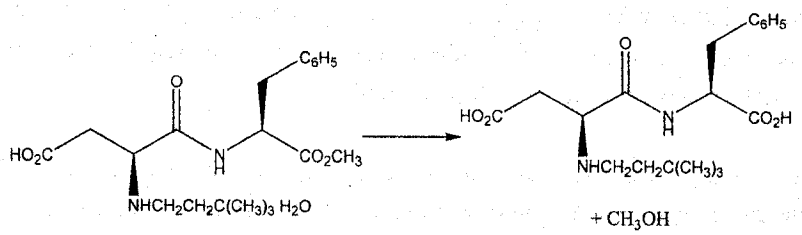


Figure 1.

8. List two commercial electrolytic processes and describe their redox reactions. (10 pts)

9. In defining the sizes of orbitals, why must we use an arbitrary value, such as 90% of the total probability (10 pts)

10. The complex ion $PdCl_4^{2-}$ is diamagnetic. Propose a structure for $PdCl_4^{2-}$ and explain your answer. (10 pts)

11. Consider the following energy changes:

	ΔE(kJ/mol)
$Mg(g) \longrightarrow Mg^+(g) + e^-$	735
$Mg^+(g) \longrightarrow Mg^{2+}(g) + e^-$	1445
$O(g) + e^- \longrightarrow O^-(g)$	-141
$O^-(g) + e^- \longrightarrow O^{2-}(g)$	878

a. Magnesium oxide exists as $Mg^{2+}O^{2-}$ not as Mg^+O^-. Explain it. (5 pts)

b. What experiment could be done to confirm that magnesium oxide does not exist as Mg^+O^-? (5 pts).