109 學年度第二學期　材料熱力學二　第二次期中考試（在家考試）

$$1\ atm = 760\ \ mmHg = 101325\ \ Pa = 1.01325\ \ bar; 1\ \ cal = 4.188\ \ J;\ \ R = 8.314\ \ J\ \ K^{-1}\ \ mol^{-1} = 0.082\ \ L\ \ atm\ \ K^{-1} mol^{-1}$$

1 The total molar volume of A-B liquid solution is followed by the below equation:

$$V\ \ (mol\ \ cm^{-3}) = 100 - 5X_A - 10X_A^2$$

1.1 **(15%)** Find $\bar{V}_A$, $\bar{V}_B$ and ΔV^M.

1.2 **(10%)** We would like to have the 500 cm^3 of A-B liquid solution with a 0.20 molar fraction of A ($X_A = 0.20$). How many volumes of pure A and pure B do we need to mix?

2 The gold-silver alloy is often used in the jewelry accessory. The phase diagram of gold-silver is obtained in the below figure. Some thermodynamic properties are given by the below table. Assume that both of liquid and solid solutions are ideal.

	Enthalpy of fusion (kJ mol^{-1})	Heat capacity at constant pressure (J K^{-1} mol^{-1})
Gold	12.5	25.4
Silver	11.3	25.4

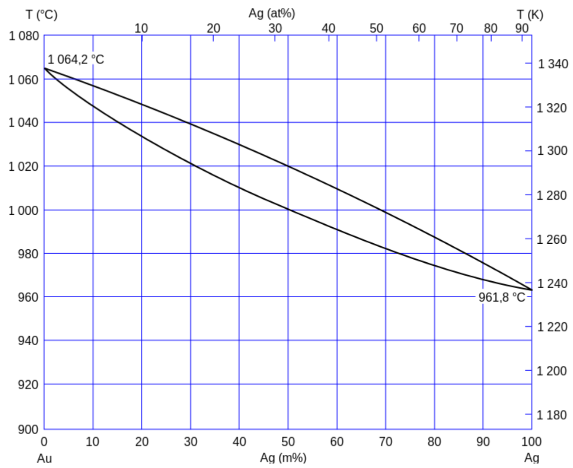
2.1 **(20%)** One mole of gold is at 1040°C, and then it is dissolved in the melting silver at 1040°C, forming the molar fraction of gold at 0.50 ($X_{Au} = 0.5$) in the solution. Calculate (1) the total changes in enthalpy and entropy of <u>the solution</u>. (2) the total changes in enthalpy and entropy of <u>the gold</u>.

2.2 **(20%)** One mole of gold is at 25°C, and then it is dissolved in the melting silver at 1040°C, forming the molar fraction of gold at 0.50 ($X_{Au} = 0.5$) in the solution. Calculate (1) the total changes in enthalpy and entropy of <u>the solution</u>. (2) the total changes in enthalpy and entropy of <u>the gold</u>.

3 **(20%)** Now the gold-silver solution is the regular solution, and the molar heat of mixing is given by:

$$\Delta H^M (J\ \ mol^{-1}) = -20000 X_{Ag} X_{Au}$$

One mole of gold is at 25°C, and then it is dissolved in the melting silver at 1040°C, forming the molar fraction of gold at 0.50 ($X_{Au} = 0.5$) in the solution. Calculate the total changes in enthalpy and entropy of <u>the solution</u>.



4 The activity coefficient of A-B solution at 500 K is followed by:

$$\ln \gamma_A = X_B^2 - 0.2X_B^3$$

4.1 **(5%)** Derive $\ln \gamma_B\ \ vs. X_A$.

4.2 **(10%)** Plot curves of $a_A\ \ vs. X_B$ and $a_B\ \ vs. X_B$ in one figure.