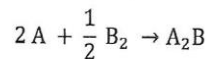
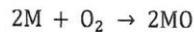


1. Calculate the standard enthalpy ( $\Delta H^0$ ) and entropy changes ( $\Delta S^0$ ) at room temperature (298 K) for the reaction. (15 %)

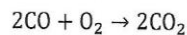


$$\Delta G^0 = -40500 - 3.92T \log T + 29.5T \text{ cal}$$

2. Please calculate the maximum  $\text{CO}_2$  partial pressure to avoid the oxidation of metal M at 1500 K, if the Ni is in the 1 atm CO- $\text{CO}_2$  mixed gas chamber. (15 %)

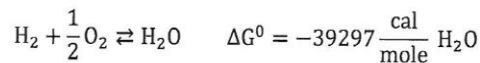


$$\Delta G^0 = -489100 + 197T$$



$$\Delta G^0 = -564800 + 173.62T$$

3. Assuming the standard free energy changes ( $\Delta G^0$ ) of two chemical reactions are listed as follow,



- (a) Calculate the equilibrium constant of  $CO + H_2O \rightleftharpoons CO_2 + H_2$  at 1500 K. (10 %)
- (b) Calculate the compositions of the gases in the chamber after adding 0.4 mole CO and 1 mole  $H_2O$  into the chamber. The chamber keeps at 1500 K and 1 atm. (10 %)
4. What are the meaning of the First, Second and Third Law of thermodynamics? (20%)
5. Calculate the entropy change of (a) a sample of perfect gas when it expands isothermally from 1 L to 10 L, and (b) when He at 25 °C and 2 bar in a container of volume 1  $\text{dm}^3$  is allowed to expand to 10  $\text{dm}^3$  and is simultaneously heated to 200 °C. (each 15%)