II. (80 points) Please show your work in a logical manner so that partial credit may be given.

1. (20 points) Consider the following exothermic reaction:
   \[ \text{CS}_2(\text{g}) + 4 \text{H}_2(\text{g}) \rightleftharpoons \text{CH}_4(\text{g}) + 2 \text{H}_2\text{S}(\text{g}) \]

   A. Write an expression for \( K_p \) for this reaction in terms of the partial pressures of the gases in an equilibrium mixture.
   \[ K_p = \frac{P_{\text{CH}_4} P_{\text{H}_2\text{S}}^2}{P_{\text{CS}_2} P_{\text{H}_2}^4} \]

   B. If \( K_p = 15 \) at 25 °C, calculate \( K_c \) at 25 °C.
   \[ K_p = \left( \frac{n_{\text{CS}_2} RT}{V} \right) \left( \frac{n_{\text{H}_2\text{S}} RT}{V} \right)^2 \]
   \[ K_c = K_p (RT)^2 = 15 \left( \frac{0.0821 \text{ L atm}}{\text{mol K}} \right) 298 \]
   \[ K_c = 8980 \]

   C. If this reaction is in equilibrium and the volume of the reaction container is decreased, will the equilibrium shift to the left (reactants) or to the right (products)? Please justify your answer.
   
   It will shift to right (towards products) to reduce the pressure.

   D. If this reaction is in equilibrium and the temperature of the reaction is decreased, will the equilibrium shift to the left (reactants) or to the right (products)? Please justify your answer.

   It will shift to the right (towards products) exothermic reaction.