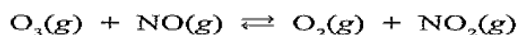


# CHEM 3AB EQUILIBRIUM Assignment (Foundations of Chemistry)

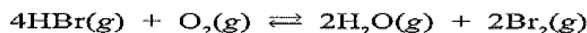
1. CO and Cl<sub>2</sub> are mixed in a flask so their concentrations are 0.400 mol l<sup>-1</sup>
- 12 Consider the following reaction at equilibrium.



How would the concentrations of each of these substances change if:

- The concentration of O<sub>3</sub> was increased.
- The partial pressure of NO<sub>2</sub> was increased.
- The concentration of NO was decreased.
- The partial pressure of O<sub>2</sub> was decreased.

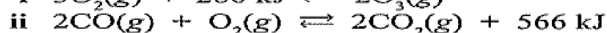
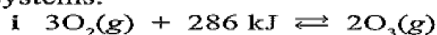
- 13 For the equilibrium



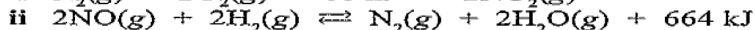
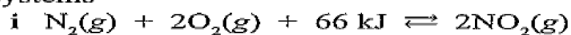
predict the effect of the following changes on the concentrations of each of the substances.

- Decreasing the volume of the system.
- Decreasing the external pressure on the system.
- Adding some of the noble gas helium to the system but keeping the volume constant.

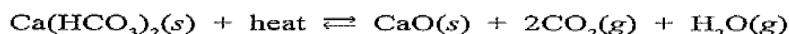
- 14 a Predict the effect of increasing the temperature of the following equilibrium systems.



- b Predict the effect of decreasing the temperature of the following equilibrium systems



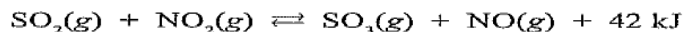
- 15 If the reaction



is at equilibrium, predict the effects of the following changes on the concentration and mass of each substance present.

- Increasing the concentration of CO<sub>2</sub>.
- Decreasing the partial pressure of H<sub>2</sub>O.
- Decreasing the external pressure.
- Increasing the mass of CaO.
- Decreasing the temperature.

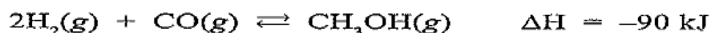
- 16 Consider the following reaction at equilibrium.



If the following changes are made to the system

- The SO<sub>2</sub> concentration is increased.
- The pressure is increased.
- The volume is increased.
- The temperature is increased.
- A catalyst is added.
  - Predict the effect on the concentrations of each substance and explain your prediction.
  - Describe what happens to the rates of the forward and reverse reactions.

- 17 Methanol, a useful fuel and solvent, can be manufactured from hydrogen and carbon monoxide



- a What conditions would favour a fast reaction rate for this reaction?

System A:  $[\text{CO}] = 0.025 \text{ mol l}^{-1}$   $[\text{H}_2] = 0.040 \text{ mol l}^{-1}$   $[\text{CH}_3\text{OH}] = 0.010 \text{ mol l}^{-1}$

- What conditions would favour a high equilibrium yield of methanol?
- Is it likely that compromise conditions would be needed in an industrial process based on this reaction?

- 18 a Write an equation for the equilibrium between solid NaCl and its saturated aqueous solution.

- b If HCl gas is bubbled through saturated NaCl solution the gas dissolves to form H<sup>+</sup> and Cl<sup>-</sup> ions but some NaCl crystallises from the solution. Use Le Chatelier's principle to explain the reduced solubility of NaCl in HCl solution.

- 19 When the equilibrium system



is heated, the equilibrium constant increases. Predict whether the forward reaction is exothermic or endothermic and explain your prediction.

- 20 The following system is at equilibrium.



When iodide ions are added silver iodide precipitates. Predict the effect this will have on the ammonia concentration.