

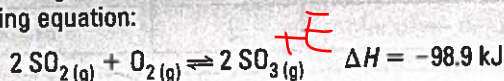
# Textbook p298 1-6

1. Observe each of the reactions in a state of equilibrium below and answer the questions that follow:

- A  $\text{CO}_{2(g)} + \text{H}_{2(g)} \rightleftharpoons \text{CO}_{(g)} + \text{H}_2\text{O}_{(g)} + \text{energy}$   
 B  $2 \text{CO}_{(g)} + \text{O}_{2(g)} \rightleftharpoons 2 \text{CO}_{2(g)} + \text{energy}$   
 C  $\text{NO}_{(g)} + \text{CO}_{2(g)} \rightleftharpoons \text{NO}_{2(g)} + \text{CO}_{(g)} + \text{energy}$   
 D  $\text{CaCO}_{3(s)} + \text{energy} \rightleftharpoons \text{CaO}_{(s)} + \text{CO}_{2(g)}$

- a) For each of the equations, what reaction will be favoured by adding carbon dioxide ( $\text{CO}_2$ ) in the system?  
 b) For each of the equations, what reaction will be favoured by an increase in the pressure of the system?  
 c) For each of the equations, what reaction will be favoured by a decrease in the temperature of the system?

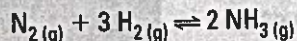
2. Sulphur trioxide ( $\text{SO}_3$ ) is synthesized from sulphur dioxide ( $\text{SO}_2$ ) and oxygen ( $\text{O}_2$ ) according to the following equation:



What reaction will be favoured if:

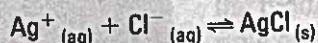
- a) the temperature of the system is increased?  
 b) the pressure of the system is decreased by decreasing its volume?  
 c) oxygen ( $\text{O}_2$ ) is added?  
 d) a catalyst is added?

3. The industrial production of ammonia ( $\text{NH}_3$ ) from atmospheric nitrogen ( $\text{N}_2$ ) and hydrogen ( $\text{H}_2$ ) is expressed by the following balanced equation:



Explain how the production of ammonia in this system can be favoured without adding nitrogen or hydrogen and without changing the temperature or pressure.

4. The state of equilibrium between the precipitation and dissolution of silver chloride ( $\text{AgCl}$ ) is represented by the following equation:



Will the addition of aqueous hydrogen chloride ( $\text{HCl}$ ) favour the formation of silver chloride if the temperature and pressure of the system remain constant? Explain your answer.

1. a) A forward B reverse C forward D reverse  
 b) A ~~forward~~ <sup>neither</sup> B forward C neither D reverse.

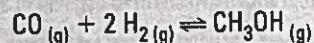
- c) A } Forward  
 B }  
 C }  
 D } reverse.

2. a) reverse  
 b) reverse  
 c) forward  
 d) both

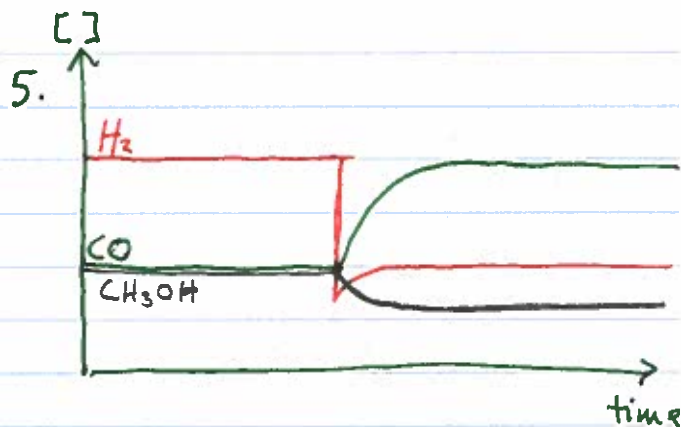
3. removing  $\text{NH}_3$

4. Favour the forward.  
 as the  $[\text{Cl}^-]$  will go up.

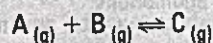
5. Methanol ( $\text{CH}_3\text{OH}$ ) is synthesized from carbon monoxide ( $\text{CO}$ ) and hydrogen ( $\text{H}_2$ ). The state of equilibrium of this reaction is represented by the following equation:



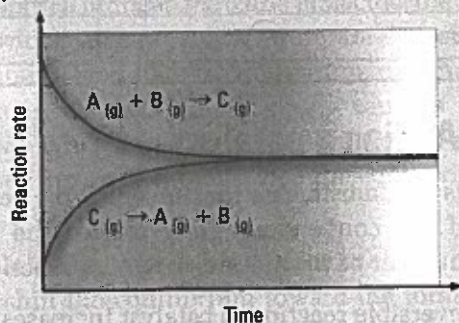
Illustrate the effect of a decrease in the quantity of hydrogen by drawing a graph showing the changes in concentrations of carbon monoxide, hydrogen and methanol as a function of time. Indicate the areas on the graph that correspond to the initial equilibrium, the change in concentration of the components of the system and the new state of equilibrium.



6. The following is a balanced reaction:



The graph below represents the change in reaction rate as a function of time of the conversion of compounds A and B into compound C.



What would this graph look like if the reaction were catalyzed? Illustrate your answer by copying this graph and adding the curves corresponding to the catalyzed direct and reverse reactions.

