Le Chatelier's Principle

Mr. Dvorsky

SCH 4U1

Lundi 16 mai

Le Chatelier's Principle

When a chemical system at equilibrium is disturbed by a change in a property, the system adjusts itself in a way that opposes the change.

Le Chatelier's Principal and Concentration changes

- If more reactant is added to a system at equilibrium, then that system will undergo an equilibrium shift.
- After more reactant is added we notice that the reactant concentrations decrease as some of the added reactant changes to products.
- Eventually a new equilibrium state is established, but the concentrations are different than original values.

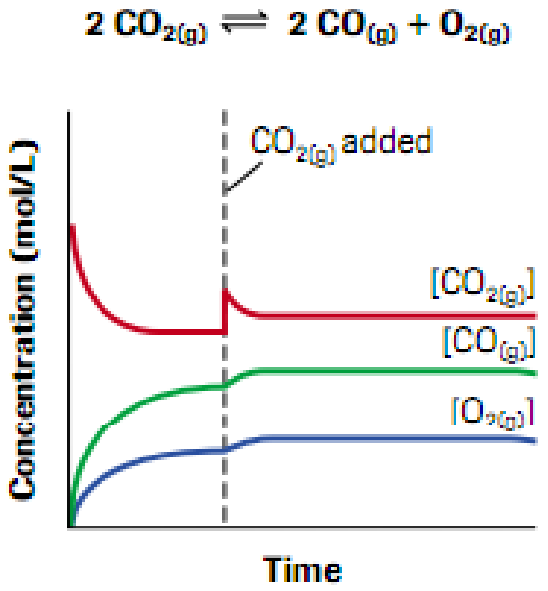

Figure 2
The reaction establishes an equilibrium that is then disturbed (at the time indicated by the vertical dotted line) by the addition of $CO_{2(g)}$. Some of the added $CO_{2(g)}$ reacts, decreasing its concentration, while the concentration of both products increases until a new equilibrium is established. The concentrations eventually become constant again, at a new level. However, the initial *K* value and the final *K* value are the same.

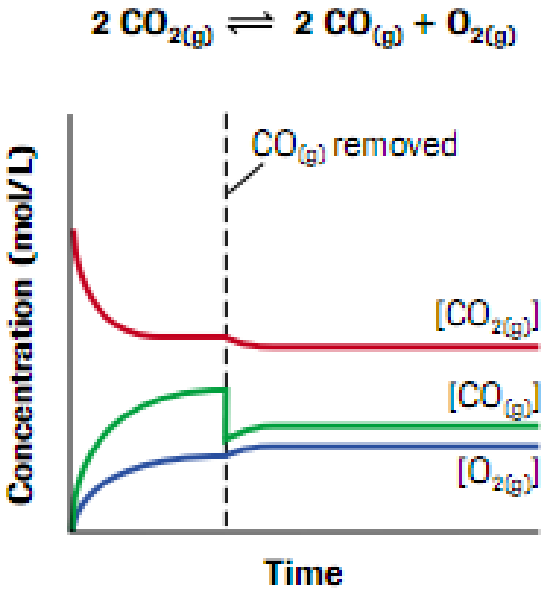

Figure 3
The reaction establishes an equilibrium that is disturbed (at the time indicated by the vertical dotted line) by the removal of $CO_{(g)}$. The equilibrium shifts forward; the concentration of $O_{2(g)}$ increases while the concentration of $CO_{2(g)}$ decreases, until a new equilibrium is established. The initial *K* value and the final *K* value are the same.

Le Chatelier's Principal and Temperature Changes

- Energy in chemical equilibrium can be treated as though it were a reactant or product.

Endothermic reaction: reactants + energy ⇌ products

Exothermic reaction: reactants ⇌ products + energy

- If heat is added, shifts in the direction to absorb the heat. If reaction is cooled, the reaction "tries to warm itself" and shifts in the direction that produces heat.

$$2\,SO_{2(g)} + O_{2(g)} \rightleftharpoons 2\,SO_{3(g)} + \text{energy}$$

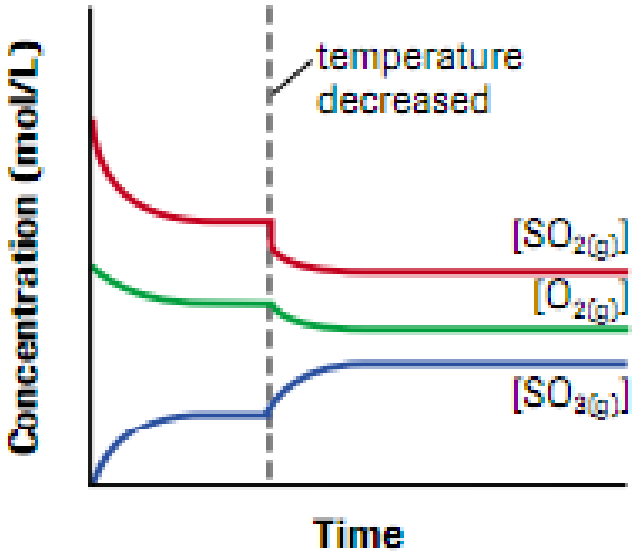

Figure 7
The reaction establishes an equilibrium that is disturbed (at the time indicated by the vertical dotted line) by a decrease in temperature. The equilibrium shifts forward, increasing the concentration of $SO_{3(g)}$ product while decreasing the concentration of both reactants, until a new equilibrium is established.

Le Chatelier's Principal and Volume/Pressure Changes

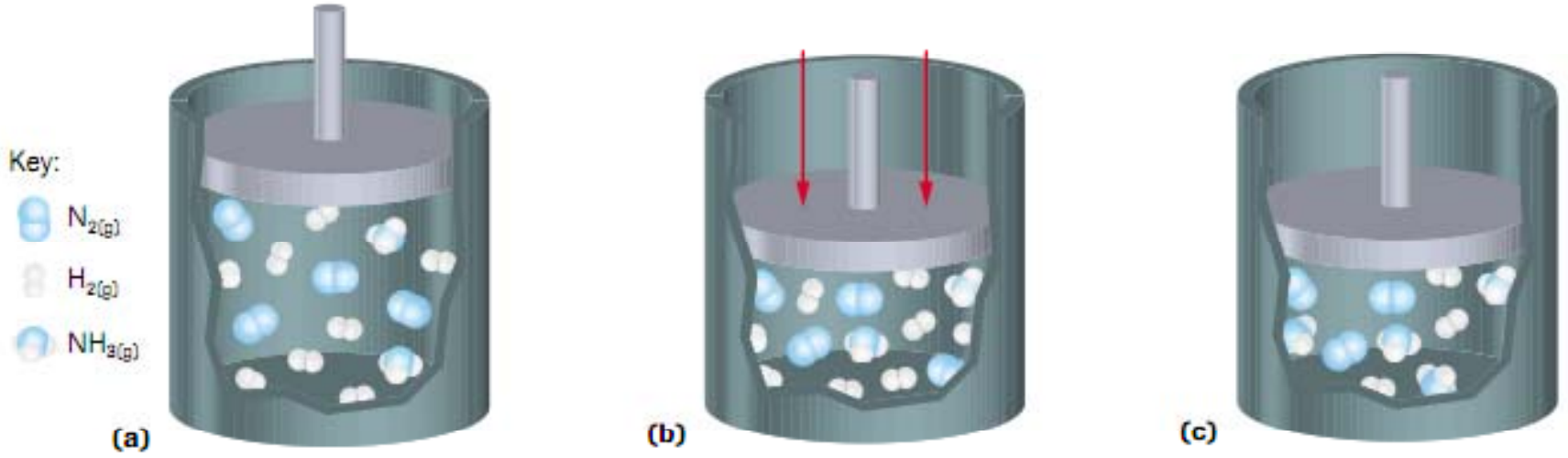

Figure 9

(a) An equilibrium mixture containing $N_{2(g)}$, $H_{2(g)}$, and $NH_{3(g)}$

(b) The volume is decreased, increasing the pressure.

(c) The reaction shifts to the right, toward the side with fewer molecules, to relieve pressure.

If the volume of the vessel is increased, the pressure is decreased, and the shift is in the opposite direction, to the left, which counteracts the change by producing more gas molecules.

Le Chatelier's Principal and Catalysts

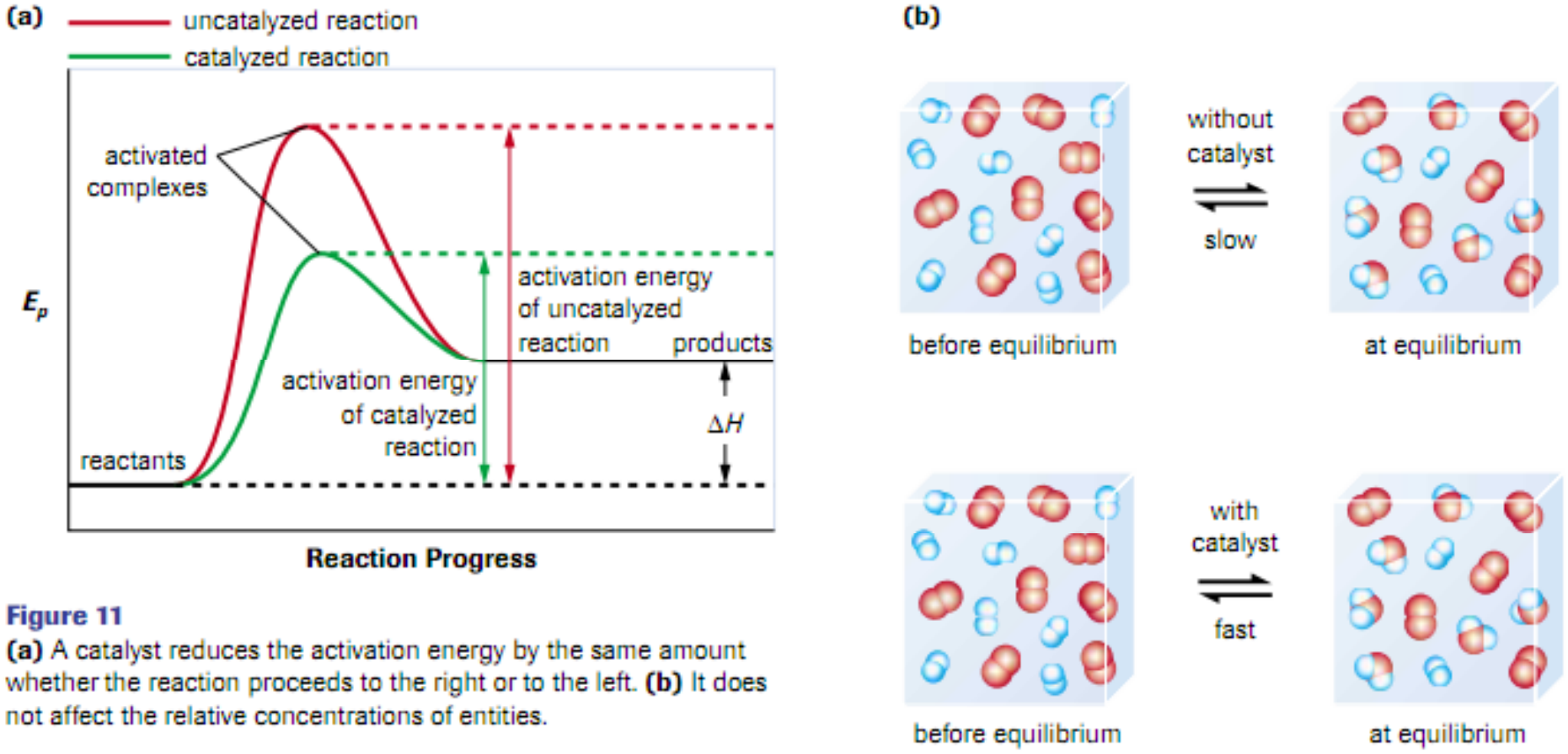

Figure 11
(a) A catalyst reduces the activation energy by the same amount whether the reaction proceeds to the right or to the left. **(b)** It does not affect the relative concentrations of entities.