

CONCEPT: LE CHATELIER'S PRINCIPLE

Le Chatelier's Principle states if a reaction's equilibrium is disrupted it will shift in order to re-establish equilibrium.

Reactants & Products

- Adding Reactants or Removing Products

Reaction will shift to the _____.



- Removing Reactants or Adding Products

Reaction will shift to the _____.



Pressure & Volume

- Decreasing Pressure or Increasing Volume

Reaction will shift to side with _____ moles of gas.



- Increasing Pressure or Decreasing Volume

Reaction will shift to side with _____ moles of gas.



Temperature

−ΔH (exothermic) heat as a product

+ΔH (endothermic) heat as a reactant

- Increasing Temperature

Reaction will shift _____ heat.



- Decreasing Temperature

Reaction will shift _____ heat.



Inert Gas (Noble Gas)

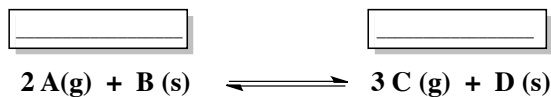
- Adding under constant volume

There will be _____ in the equilibrium position



- Adding under constant pressure

Reaction will shift to side with _____ moles of gas.



Liquids, Solids & Catalysts

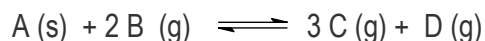
- Addition

There will be _____ in the equilibrium position



PRACTICE: LE CHATELIER'S PRINCIPLE

EXAMPLE 1: The following data was collected for the following reaction at equilibrium.



At 55°C, K is 4.7×10^{-7} and at 100°C K is 1.9×10^{-2} . Which of the following statements is true?

- a) The reaction is exothermic.
- b) The reaction is endothermic.
- c) The enthalpy change, ΔH , is equal to zero.
- d) Not enough information is given.

EXAMPLE 2: In which of these gas-phase equilibria is the yield of products increased by increasing the total pressure on the reaction mixture?

- a) $\text{CO (g)} + \text{H}_2\text{O (g)} \rightleftharpoons \text{CO}_2\text{ (g)} + \text{H}_2\text{ (g)}$
- b) $2 \text{NO (g)} + \text{Cl}_2\text{ (g)} \rightleftharpoons 2 \text{NOCl (g)}$
- c) $2 \text{SO}_3\text{ (g)} \rightleftharpoons 2 \text{SO}_2\text{ (g)} + \text{O}_2\text{ (g)}$
- d) $\text{PCl}_5\text{ (g)} \rightleftharpoons \text{PCl}_3\text{ (g)} + \text{Cl}_2\text{ (g)}$
- e) $2 \text{H}_2\text{O}_2\text{ (g)} \rightleftharpoons 2 \text{H}_2\text{O (g)} + \text{O}_2\text{ (g)}$

PRACTICE: The reaction $2 \text{NaHCO}_3\text{ (s)} \rightleftharpoons \text{Na}_2\text{CO}_3\text{ (s)} + \text{H}_2\text{O (g)} + \text{CO}_2\text{ (g)}$ is endothermic. What would you do in order to maximize the yield of $\text{Na}_2\text{CO}_3\text{ (s)}$?

- a) Lower the temperature and increase the volume of the container.
- b) Raise the temperature and add $\text{CO}_2\text{(g)}$ and $\text{H}_2\text{O(g)}$.
- c) Lower the temperature and decrease the volume of the container.
- d) Add $\text{CO}_2\text{(g)}$ and $\text{H}_2\text{O(g)}$ and increase the volume of the container.
- e) Increase the volume of the container and raise the temperature.