

## Reaction Thermodynamics

### Given Statement to be Completed:

"As  $(T)$  increases,  $(K_c)$  \_\_\_\_\_, and  $(K_p)$  \_\_\_\_\_, so the reaction is \_\_\_\_\_."

### Explanation:

To determine whether a reaction is exothermic or endothermic, the temperature dependence of the equilibrium constants  $(K_c)$  (equilibrium constant with concentration) and  $(K_p)$  (equilibrium constant with pressure) needs to be considered:

- According to Le Chatelier's principle:
  - For an **exothermic reaction**, increasing the temperature shifts the equilibrium to the left, decreasing the value of  $(K)$ . Therefore, both  $(K_c)$  and  $(K_p)$  decrease.
  - For an **endothermic reaction**, increasing the temperature shifts the equilibrium to the right, increasing the value of  $(K)$ . Therefore, both  $(K_c)$  and  $(K_p)$  increase.

### Step-by-Step Solution:

1. Determine the behavior of  $(K_c)$  and  $(K_p)$  as the temperature increases:
  - If  $(K_c)$  and  $(K_p)$  decrease as the temperature increases, the reaction is exothermic.
  - If  $(K_c)$  and  $(K_p)$  increase as the temperature increases, the reaction is endothermic.

### Final Solution:

"As  $(T)$  increases,  $(K_c)$  decreases, and  $(K_p)$  decreases, so the reaction is exothermic."

This shows that when the temperature is increased, the equilibrium constants  $(K_c)$  and  $(K_p)$  both decrease indicating an exothermic reaction.