

CHEMISTRY 12 – UNIT II – EQUILIBRIUM

E Learning Goals

1. Consider the following equilibrium: $4 \text{NH}_{3(g)} + 5 \text{O}_{2(g)} \rightleftharpoons 4 \text{NO}_{(g)} + 6 \text{H}_2\text{O}_{(g)} + \text{Energy}$

Which of the following will cause the equilibrium to shift to the left?

- Adding $\text{H}_2\text{O}_{(g)}$
- Removing some $\text{NO}_{(g)}$
- Increasing the volume
- Decreasing the temperature

2. Consider the following equilibrium: $2 \text{NO}_{(g)} + \text{O}_{2(g)} \rightleftharpoons 2 \text{NO}_2(g) + \text{Energy}$

When the volume of the container is increased, the equilibrium shifts to the

- Left and $[\text{NO}]$ increases
- Left and $[\text{NO}]$ remains constant
- Right and $[\text{NO}]$ increases
- Right and $[\text{NO}]$ remains constant

3. Consider the following equilibrium: $2 \text{SO}_{2(g)} + \text{O}_{2(g)} \rightleftharpoons 2 \text{SO}_{3(g)} + \text{Energy}$

Which of the following will cause this equilibrium to shift to the left?

- Adding a catalyst
- Adding some SO_2
- Increasing the volume
- Decreasing the temperature

4. Consider the following equilibrium: $2 \text{NO}_{(g)} + \text{Br}_{2(g)} \rightleftharpoons 2 \text{NOBr}_{(g)}$

The equilibrium will shift to the left as a result of

- Adding a catalyst
- Removing NOBr
- Increasing the volume
- Increasing the temperature

5. Consider the following equilibrium: $\text{N}_{2(g)} + \text{O}_{2(g)} + \text{Energy} \rightleftharpoons 2 \text{NO}_{(g)}$

When the temperature is increased, the equilibrium shifts to the

- Left and $[\text{NO}]$ increases
- Right and $[\text{NO}]$ increases
- Left and $[\text{NO}]$ decreases
- Right and $[\text{NO}]$ decreases

6. Consider the following equilibrium: $2 \text{NO}_{2(g)} \rightleftharpoons \text{N}_2\text{O}_{4(g)} + \text{Energy}$

The equilibrium will shift to left as a result of

- Adding a catalyst
- Removing some N_2O_4
- Increasing the volume
- Decreasing the temperature

7. Consider the following equilibrium: $\text{C}_{(s)} + 2 \text{H}_2(g) \rightleftharpoons \text{CH}_4(g)$

The addition of H_2 will cause the equilibrium to shift to the

- Left and $[\text{CH}_4]$ will increase
- Right and $[\text{CH}_4]$ will increase
- Left and $[\text{CH}_4]$ will decrease
- Right and $[\text{CH}_4]$ will decrease

8. Consider the following equilibrium: $\text{PCl}_{5(g)} \rightleftharpoons \text{PCl}_{3(g)} + \text{Cl}_{2(g)}$

The equilibrium concentration of PCl_5 will increase when

- PCl_3 is added
- A catalyst is added
- Cl_2 is removed
- The volume of the container is increased

9. Consider the following equilibrium: $\text{N}_2\text{O}_{4(g)} \rightleftharpoons 2 \text{NO}_{2(g)}$

If the volume of the container is increased, the

- K_{eq} decreases
- $[\text{N}_2\text{O}_4]$ increases
- Equilibrium does not shift
- Equilibrium will shift to the right

10. Consider the following equilibrium: $\text{NH}_{3(g)} + \text{HCl}_{(g)} \rightleftharpoons \text{NH}_4\text{Cl}_{(s)} + \text{energy}$

Which of the following will result in a decrease in the mass of NH_4Cl ?

- Adding NH_3
- Removing HCl
- Decreasing the volume
- Decreasing the temperature

11. When the temperature of an equilibrium system is increased, the equilibrium always shifts to favour the

- a. Exothermic reaction
- b. Endothermic reaction
- c. Formation of products
- d. Formation of reactants

12. An equilibrium system shifts left when the temperature is increased. The forward reaction is

- a. Exothermic and ΔH is positive
- b. Endothermic and ΔH is positive
- c. Exothermic and ΔH is negative
- d. Endothermic and ΔH is negative

13. An equilibrium system shifts left when the

- a. Rate of the forward reaction is equal to the rate of the reverse reaction
- b. Rate of the forward reaction is less than the rate of the reverse reaction
- c. Rate of the forward reaction is greater than the rate of the reverse reaction
- d. Rate of the forward reaction and the rate of the reverse reaction are constant

14. Addition of a catalyst to an equilibrium system

- a. Increases the value of K_{eq}
- b. Has no effect on the rates of reaction
- c. Increases the yield of products
- d. Increases the rate of formation of both reactants and products

15. Consider the following equilibrium: $H_{2(g)} + I_{2(g)} \rightleftharpoons 2 HI_{(g)}$

The volume of the equilibrium system is increased and a new equilibrium is established. Compared to the rates in the original equilibrium, which of the following describes the rates of the forward and reverse reaction in the new equilibrium?

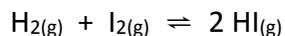
	Forward Rate	Reverse Rate
a.	Decreased	Decreased
b.	Increased	Increased
c.	Decreased	Increased
d.	Remained constant	Remained constant

16. Consider the following equilibrium: $\text{H}_{2(g)} + \text{I}_{2(g)} \rightleftharpoons 2 \text{HI}_{(g)}$

The pressure on the system is increased by reducing the volume. When comparing the new equilibrium with the original equilibrium,

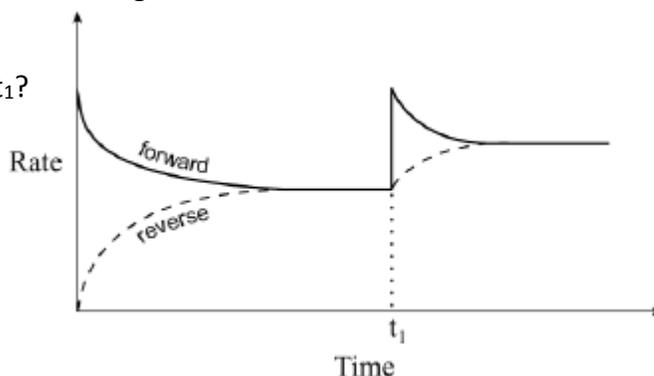
- All concentrations remain constant
- The concentration of all species have increased
- Reactant concentrations have increased while product concentrations have decreased
- Reactant concentrations have decreased while product concentrations have increased

17. Consider the rate diagram below for the following reaction:



Which of the following occurs at time t_1 ?

- Addition of H_2
- Addition of HI
- Addition of a catalyst
- A decrease in volume

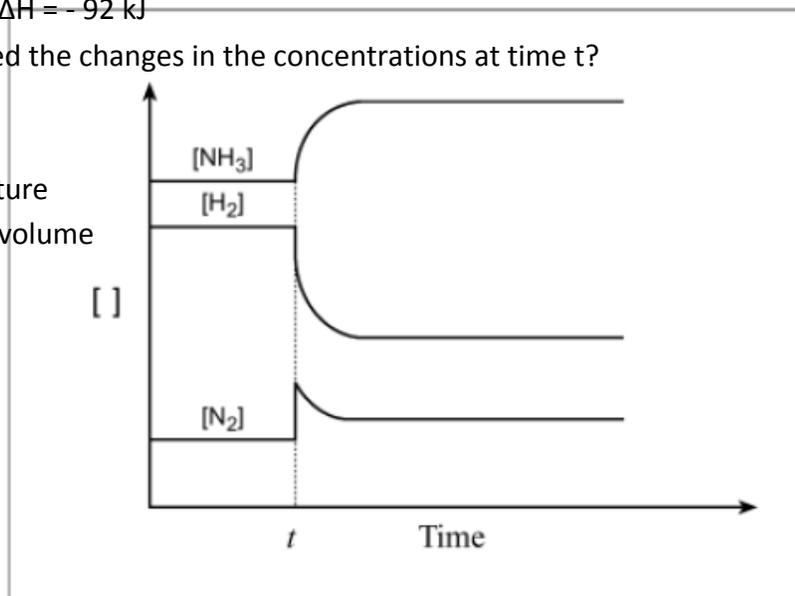


18. Consider the following graph which relates to this equilibrium:



Which of the following caused the changes in the concentrations at time t ?

- Addition of N_2
- Removal of H_2
- Decrease in temperature
- Decrease in reaction volume



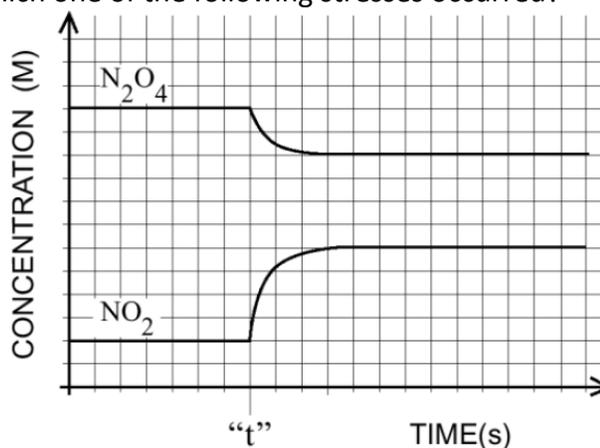
19. Which of the following reactions will shift left when pressure is increased and when temperature is decreased?

- a. $\text{N}_{2(g)} + \text{O}_{2(g)} + \text{Energy} \rightleftharpoons 2 \text{NO}_{(g)}$
- b. $\text{N}_{2(g)} + 3 \text{H}_{2(g)} \rightleftharpoons 2 \text{NH}_{3(g)} + \text{heat}$
- c. $\text{CH}_{4(g)} + \text{H}_2\text{O}_{(g)} + \text{Heat} \rightleftharpoons \text{CO}_{(g)} + 3 \text{H}_{2(g)}$
- d. $\text{CS}_{2(g)} + 4 \text{H}_{2(g)} \rightleftharpoons \text{CH}_{4(g)} + 2 \text{H}_2\text{S}_{(g)} + \text{heat}$

20. Consider the following concentration versus time graph for the equilibrium:

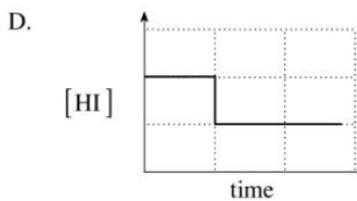
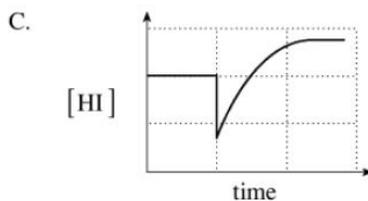
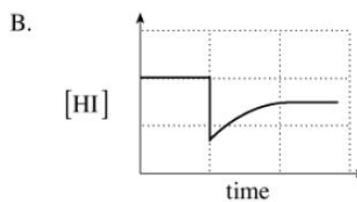
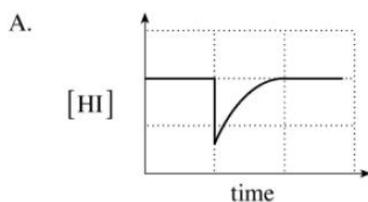
$\text{N}_2\text{O}_{4(g)} + \text{Energy} \rightleftharpoons 2 \text{NO}_{2(g)}$, At time t, which one of the following stresses occurred?

- a. Catalyst was added
- b. Pressure was changed
- c. Temperature was changed
- d. Concentration of NO_2 was changed

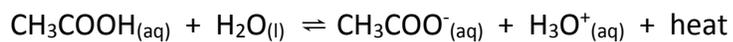


21. Consider the following equilibrium: $\text{H}_{2(g)} + \text{I}_{2(g)} \rightleftharpoons 2 \text{HI}_{(g)}$

Which graph represents what happens when some HI is removed and a new equilibrium is established?



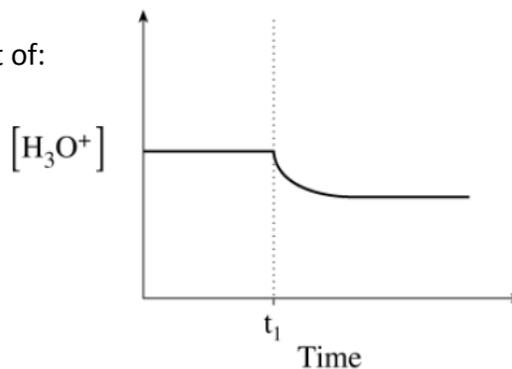
22. Consider the following equilibrium:



A stress was applied at time t_1 and the data was plotted on the graph below.

The stress that was imposed at time t_1 was a result of:

- The addition of HCl
- Decreasing the temperature
- The addition of NaCH_3COO
- Increasing the volume of the container



Answer Key:

1. a	12. c
2. a	13. b
3. c	14. d
4. c	15. a
5. b	16. b
6. c	17. a
7. b	18. a
8. a	19. c
9. d	20. c
10. b	21. b
11. b	22. c