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Unit 6 MC Practice

1.

$$2A(g) \rightleftharpoons 2\,B(g) + C(g) \qquad K = 1.6 \times 10^4$$

Two moles of Gas A are placed into a closed system where the temperature is held constant at 270 K and allowed to reach equilibrium as represented by the chemical reaction shown above. After 15 minutes at equilibrium, additional Gas B is injected into the reaction vessel. Which of the following best describes the behavior of the equilibrium mixture in response to the addition of Gas B?

(A) The concentration of Gas A increases.

B The concentration of Gas C increases.

C The value of the equilibrium constant increases.

D There is no observable effect since the equilibrium was already established.

2. In which of the following systems would the number of moles of the substances present at equilibrium NOT be shifted by a change in the volume of the system at constant temperature?

A $CO(g) + NO(g) \rightleftharpoons CO_2(g) + \frac{1}{2} N_2(g)$ $\Delta n = -0.5$

B $N_2(g) + 3\,H_2(g) \rightleftharpoons 2\,NH_3(g)$ $\Delta n = -2$

C $N_2(g) + 2\,O_2(g) \rightleftharpoons 2\,NO_2(g)$ $\Delta n = -1$

(D) $NO(g) + O_3(g) \rightleftharpoons NO_2(g) + O_2(g)$ $\Delta n = \emptyset$

3.

$$H_2(g) + Cl_2(g) \rightleftharpoons 2HCl(g)$$

The chemical equation for the formation of hydrogen chloride gas from its elements is shown above. Given that the equilibrium constant for the reaction above is K_p, Which of the following best represents the equilibrium constant for the reaction

$$HCl(g) \rightleftharpoons \frac{1}{2}H_2(g) + \frac{1}{2}Cl_2(g)\,?$$ reverse AND $\times \frac{1}{2}$

A $\frac{1}{K_p^2}$

(C) $\frac{1}{\sqrt{K_p}}$

B K_p^2

D $\sqrt{K_p}$

~~51~~ 49

4.

$$CaCl_2(s) + 2H_2O(g) \rightleftharpoons CaCl_2 \cdot 2H_2O(s)$$

Solid calcium chloride reacts with water as shown above. Which of the following is the correct equilibrium expression for this reaction?

A $K = \dfrac{[CaCl_2 \cdot 2H_2O]}{[CaCl_2][H_2O]}$

C $K = \dfrac{1}{2[H_2O]}$

(B) $K = \dfrac{1}{[H_2O]^2}$

D $K = [H_2O]^2$

5. A gaseous reaction occurs and comes to equilibrium, as shown below. Which of the following changes to the system will serve to increase the number of moles of I_2 present at equilibrium?

3 mol (g) ⇌ 3 mol (g)

$$2\ HI(g) + Cl_2(g) \leftrightarrow 2\ HCl(g) + I_2(g) + \text{energy}$$

a. Increasing the volume at constant temperature

b. Decreasing the volume at constant temperature

c. Increasing the temperature at constant volume

(d.) Decreasing the temperature at constant volume

reverse, ×2

$CO_2(g) + H_2(g) \rightleftharpoons CO(g) + H_2O(g)$ $K_c = 1.4$ K_1 ⇒ $K' = \frac{1}{K^2} = \frac{1}{1.4^2}$

$CO(g) + 2\,H_2(g) \rightleftharpoons CH_3OH(g)$ $K_c = 14.5$ K_2

6. Given the above information, what would be the equilibrium constant for the reaction below?

$$3\,CO(g) + 2\,H_2O(g) \rightleftharpoons 2\,CO_2(g) + CH_3OH(g)$$

$K_{new} = K' \times K_2$

(A) (2)(1.4)(14.5)

(C) $\dfrac{14.5}{(1.4)^2}$

$= \dfrac{14.5}{1.4^2}$

(B) $\dfrac{(1.4)(14.5)}{2}$

(D) $14.5 - 1.4^2$

7. In which of the following ways could the reaction below be manipulated to create more product?

$$PCl_3(g) + Cl_2(g) \leftrightarrow PCl_5(g) + \text{heat} \quad \Delta H = -92.5\ kJ/mol_{rxn}$$

a. Decreasing the concentration of PCl_3

(b.) Increasing the pressure

c. Increasing the temperature

d. None of the above

$\frac{1}{2} \times 50$

8. A sample of H_2S gas is placed in an evacuated, sealed container and heated until the following decomposition reaction occurs at 1000 K: $2\ H_2S(g) \rightarrow 2\ H_2(g) + S_2(g)$ $K_c = 1.0 \times 10^{-6}$

Which option best describes what will immediately occur to the reaction rates if the pressure on the system is increased after it has reached equilibrium? ↑ P ⇒ shift left

a. The rate of both the forward and the reverse reactions will increase.

b. The rate of the forward reaction will increase will the rate of the reverse reaction will decrease.

(c.) The rate of the forward reaction will decrease will the rate of the reverse reaction will increase.

d. Neither the rate of the forward nor reverse reactions will change.

$$Br_2(g) + I_2(g) \leftrightarrow 2\ IBr(g)$$

9. At 150°C, the equilibrium constant, K_c, for the reaction shown above has a value of 300. The reaction was allowed to reach equilibrium in a sealed container and the partial pressure due to IBr(g) was found to be 3 atm. Which of the following could be the partial pressures due to $Br_2(g)$ and $I_2(g)$ in the container?

	$Br_2(g)$	$I_2(g)$
a.	0.1 atm	0.3 atm
b.	0.3 atm	1 atm
c.	1 atm	1 atm
d.	1 atm	3 atm

$$K_c = \frac{[IBr]^2}{[Br_2][I_2]} = 1$$

10. Consider the following equilibrium: $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$ $K_{eq} = 50.0$

What is the value K_{eq} for the reaction rewritten as: $2HI(g) \rightleftharpoons H_2(g) + I_2(g)$ $K_{eq} = ?$ reversed!

a. −50.0 **(b.)** 0.0200 c. 25.0 d. 50.0

$$K_{new} = \frac{1}{K} = \frac{1}{50} = \frac{1}{5} \times 10^{-1} = 0.2E-1 = 0.02$$

11. Consider the following equilibrium: $N_2O_4(g) \rightleftharpoons 2NO_2(g)$

An equilibrium mixture contains 4.0×10^{-2} mol N_2O_4 and 1.5×10^{-2} mol NO_2 in a 1.0 L flask. What is the value of K_{eq}?

(a.) 5.6×10^{-3} b. 3.8×10^{-1} c. 7.5×10^{-1} d. 1.8×10^{2}

$$K = \frac{[NO_2]^2}{[N_2O_4]} = \frac{(1.5E-2)^2}{4.0E-2} \approx \frac{2E-4}{4E-2} = 0.5E-2 = 5E-3$$

12. Consider the following equilibrium: $Cl_2(g) + 2\ NO(g) \rightleftharpoons 2\ NOCl(g)$ $K_{eq} = 5.0$

At equilibrium, $[Cl_2] = 1.0$ M and $[NO] = 2.0$ M. What is the [NOCl] at equilibrium?

a. 0.12 M b. 0.89 M **(c.)** 4.5 M d. 10. M

$$K = \frac{[NOCl]^2}{[Cl_2][NO]^2} = \frac{x^2}{(1)(2)^2} = 5 = \frac{x^2}{4} \Rightarrow x = \sqrt{20}$$