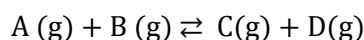




## Equilibrium Practice Test Questions

### Question 01

Reactants A and B are placed in a sealed flask and allowed to reach equilibrium according to the reversible reaction shown below. Which of the following statements **must** be true once equilibrium is reached?



- a) At equilibrium, there are equal concentrations of products and reactants.
- b) At equilibrium, both the forward and reverse reactions have stopped.
- c) At equilibrium, the concentration of products increases at a steady rate.
- d) At equilibrium, neither the forward nor the reverse reaction have stopped.

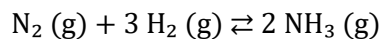
### Question 02

Which of the following statements about the equilibrium constant (K) for a specific reaction is correct?

- a) It remains constant under all reaction conditions.
- b) It can be increased with the addition of a catalyst.
- c) It is affected by changes in temperature.
- d) It increases if the concentration of one of the products is increased.
- e) It increases if the concentration of one of the reactants is increased.

### Question 03

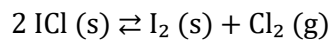
What is the equilibrium constant expression,  $K_c$ , for the reaction shown below?



- a)  $K_c = \frac{[N_2][H_2]}{[NH_3]}$
- b)  $K_c = \frac{[N_2][H_2]^3}{[NH_3]^2}$
- c)  $K_c = \frac{[NH_3]^2}{[N_2][H_2]^3}$
- d)  $K_c = \frac{[2NH_3]^2}{[N_2][3H_2]^3}$

**Question 04**

What is the equilibrium constant expression,  $K_c$ , for the reaction shown below?



a)  $K_c = \frac{[\text{ICl}]^2}{[\text{I}_2][\text{Cl}_2]}$

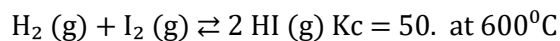
b)  $K_c = \frac{[\text{I}_2][\text{Cl}_2]}{[\text{ICl}]^2}$

c)  $K_c = [\text{I}_2][\text{Cl}_2]$

d)  $K_c = [\text{Cl}_2]$

**Question 05**

The reaction below has a  $K_c$  value of 50. Determine the  $K_p$  value for the reaction at the same temperature.



a) 0.020

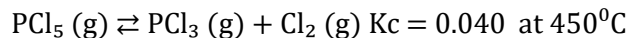
b) 50.

c) 2,500

d) 3,600

**Question 06**

The reaction below has a  $K_c$  value of 0.040 at  $450^\circ\text{C}$ . Determine the  $K_p$  value for the same reaction at  $450^\circ\text{C}$ .



a) 0.040

b) 1.5

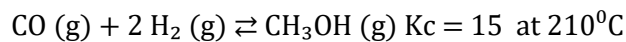
c) 2.4

d) 150

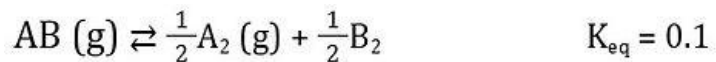
e) 3,600

**Question 07**

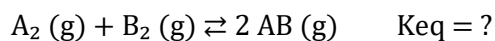
The reaction below has a  $K_c$  value of 15 at  $210^\circ\text{C}$ . Determine the  $K_p$  value for the same reaction at  $210^\circ\text{C}$ .



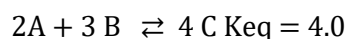
- a)  $9.5 \times 10^{-3}$
- b)  $1.5 \times 10^{-6}$
- c)  $4.5 \times 10^3$
- d)  $2.4 \times 10^4$

**Question 08**

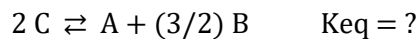
Examine the reaction above and determine the equilibrium constant for the new reaction written below.



- a)  $K_{\text{eq}} = 0.01$
- b)  $K_{\text{eq}} = 0.2$
- c)  $K_{\text{eq}} = 10$
- d)  $K_{\text{eq}} = 20$
- e)  $K_{\text{eq}} = 100$

**Question 09**

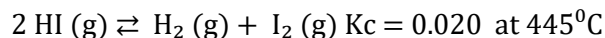
Using the information given in the reaction above, determine the equilibrium constant for the reaction below at the same temperature.



- a) 0.25
- b) 0.50
- c) -8.0
- d) 8.0
- e) 16

**Question 10**

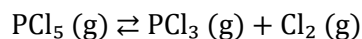
HI (g) decomposes according to the equation below. Equimolar samples of each of the gases are placed inside an evacuated 2.0 L rigid flask at 445°C. Which of the following is true as the system approaches equilibrium?



- a) More H<sub>2</sub> and I<sub>2</sub> will be produced and the overall pressure inside the flask will decrease.
- b) More HI will be produced and the overall pressure inside the flask will increase.
- c) More HI will be produced and the overall pressure inside the flask will stay the same.
- d) More H<sub>2</sub> and I<sub>2</sub> will be produced and the overall pressure inside the flask will increase.
- e) More HI will be produced and the overall pressure inside the flask will decrease.

**Question 11**

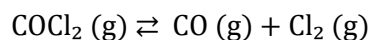
At 450°C,  $K_c = 0.040$  for the reaction shown below. If 1.0 mole of each of the gases is placed into a rigid 2.0 L container, which of the following will occur as the system moves to react equilibrium?



- a)  $Q = K$ . The system is at equilibrium and no changes will occur.
- b) More PCl<sub>5</sub> will be generated since  $Q < K$
- c) More PCl<sub>5</sub> will be generated since  $Q > K$
- d) More PCl<sub>3</sub> and Cl<sub>2</sub> will be generated since  $Q < K$
- e) More PCl<sub>3</sub> and Cl<sub>2</sub> will be generated since  $Q > K$

**Question 12**

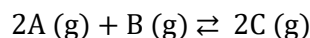
COCl<sub>2</sub> (g) decomposes according to the equation below. When a sample of COCl<sub>2</sub> (g) is placed in a rigid container, the initial pressure within the container was 1.0 atm. After the flask reaches equilibrium, the total pressure in the flask was 1.4 atm. What is the value of  $K_p$  for the reaction at this temperature?



- a) 0.040
- b) 0.20
- c) 0.27
- d) 0.40
- e) 0.47

**Question 13**

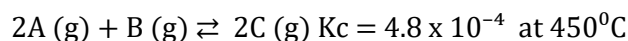
The reversible reaction below is allowed to reach equilibrium in a rigid 2.00 L container at 298 K. At equilibrium, the chemical species were determined to be 1.00 mole A, 0.500 mole B and 4.00 mole C. Determine the equilibrium constant ( $K_c$ ) for this reaction at 298 K.



- a)  $K_c = 8.00$
- b)  $K_c = 32.0$
- c)  $K_c = 64.0$
- d)  $K_c = 128$

**Question 14**

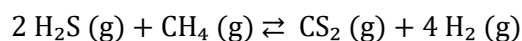
A 1.0 mole sample of each of the gases is injected into an evacuated, rigid 1.0 L container at 450°C. Which of the following will have the greatest concentration once equilibrium is achieved?



- a) A (g) will have the highest concentration.
- b) B (g) will have the highest concentration.
- c) C (g) will have the highest concentration.
- d) Both A and C will have the highest concentration.
- e) All three gases will have the same concentration at equilibrium.

**Question 15**

Equal moles of  $\text{H}_2\text{S}$  (g) and  $\text{CH}_4$  (g) are placed in an evacuated sealed container and are allowed to establish equilibrium. Which of the following statements must be true once equilibrium is achieved?

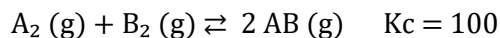


- I.  $[\text{H}_2\text{S}]$  must be less than  $[\text{CS}_2]$
- II.  $[\text{CH}_4]$  must be greater than  $[\text{H}_2\text{S}]$
- III.  $[\text{H}_2]$  must be greater than  $[\text{CS}_2]$

- a) Only I
- b) Only II
- c) I and III only
- d) II and III only

**Question 16**

Equimolar amounts of  $A_2(g)$  and  $B_2(g)$  were added to an evacuated, rigid 1.00 L flask. At equilibrium 0.400 moles of AB were present. How many moles of  $A_2(g)$  were originally added to the flask?

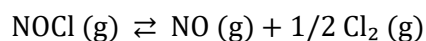


- a) 0.040 mol
- b) 0.240 mol
- c) 0.400 mol
- d) 0.440 mol

Your Answer

**Question 17**

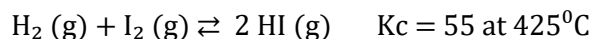
NOCl dissociates according to the reaction below. A 0.020 mol sample of NOCl is placed into an evacuated 1.0 L flask and allowed to dissociate. At a  $375^\circ\text{C}$  it is found that 60.0% of the NOCl dissociates. What is the value of the equilibrium constant at this temperature?



- a) 0.0090
- b) 0.018
- c) 0.12
- d) 0.16

**Question 18**

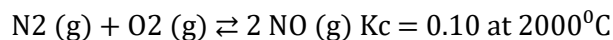
A sample of HI (g) was injected into a rigid evacuated flask and allowed to react equilibrium. At equilibrium the concentration of the HI gas was measured to be 0.080 M. Calculate the concentration of  $H_2$  in the flask at equilibrium at  $425^\circ\text{C}$ .



- a) 0.00012 M
- b) 0.0015 M
- c) 0.011 M
- d) 0.13 M

**Question 19**

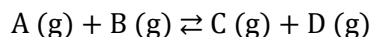
Beginning with 0.020 M samples of both  $\text{N}_2$  and  $\text{O}_2$  in a sealed, rigid container, determine the equilibrium concentration of NO.



- a) 0.0027 M
- b) 0.0048 M
- c) 0.0055 M
- d) 0.0096 M

**Question 20**

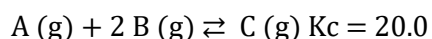
The reversible system below was found to contain 2.0 moles of A, 2.0 moles of B, 4.0 moles of C and 4.0 moles of D in a 1.0 L flask once equilibrium was achieved. If an additional 3.0 moles of C and 3.0 moles of D are suddenly added to this flask, what is the new concentration of A once equilibrium is re-established?



- a) 1.0 M
- b) 2.0 M
- c) 3.0 M
- d) 4.0 M

**Question 21**

A mixture of A and B are placed into a 4.0 L flask. Once equilibrium is achieved, the total pressure of the system is 1.4 atm. If the volume of the system is suddenly compressed to 2.0 L without changing the temperature, what will the new total pressure of the system be once equilibrium is reestablished.



- a) The total pressure will be less than 1.4 atm
- b) The total pressure will be greater than 1.4 atm but less than 2.8 atm
- c) The total pressure will be 2.8 atm
- d) The total pressure will be greater than 2.8 atm

**Question 22**

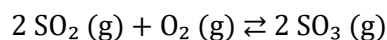
The equilibrium reaction below is started with 0.80 moles of AB in a rigid 2.0 L flask. What will the equilibrium concentration of B be once equilibrium is established at 450°C?



- a) 0.000020 M
- b) 0.000040 M
- c) 0.0045 M
- d) 0.0063 M

**Question 23**

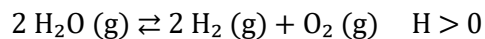
The reaction below is started by adding 0.030 M SO<sub>2</sub> and 0.025 M O<sub>2</sub> to a rigid container. After equilibrium is reached, the concentration of SO<sub>3</sub> is 0.020 M. What is the equilibrium concentration of O<sub>2</sub>?



- a) 0.0050 M
- b) 0.010 M
- c) 0.015 M
- d) 0.020 M

**Question 24**

An equilibrium is established for the reversible reaction shown below. Which of the following changes will decrease the amount of H<sub>2</sub>O (g) at equilibrium?

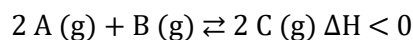


- a) Adding a catalyst to the system
- b) Increasing the concentration of O<sub>2</sub> (g)
- c) Decreasing the volume of the container
- d) Increasing the temperature of the reaction
- e) Adding He at constant volume.



**Question 25**

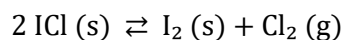
Which of the following changes will increase the concentration of C (g) for the equilibrium system shown below?



- a) Adding a catalyst to the system
- b) Decreasing the concentration of B (g)
- c) Decreasing the volume of the container
- d) Increasing the temperature of the reaction
- e) Adding Ne at constant volume.

**Question 26**

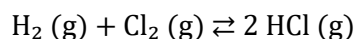
For the equilibrium system shown below, what change will increase the overall amount of Cl<sub>2</sub> that can be produced from the reaction?



- a) Remove Cl<sub>2</sub> as it is generated in the reaction.
- b) Remove some I<sub>2</sub> (s) from the equilibrium mixture
- c) Add more ICl (s) to the equilibrium mixture
- d) Decrease the volume of the container at constant temperature.

**Question 27**

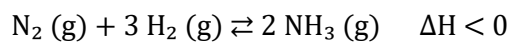
According to the reaction below, an equilibrium can be established when hydrogen gas reacts with chlorine gas in a rigid flask. Which statement below correctly describes what happens to the system at equilibrium immediately after more H<sub>2</sub> (g) is added to the flask at constant temperature.



- a) The rates of both the forward and reverse reactions increase.
- b) The rates of both the forward and reverse reactions decrease.
- c) The rate of the forward reaction becomes greater than the rate of the reverse reaction.
- d) The rate of the reverse reaction becomes greater than the rate of the forward reaction.

**Question 28**

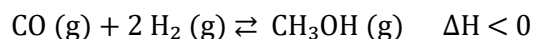
Ammonia,  $\text{NH}_3$ , can be synthesized at  $200^\circ\text{C}$  according to the reaction below. What will happen to the equilibrium constant,  $K_c$ , if the temperature of the reaction is raised?



- a)  $K_c$  is constant and will remain unchanged.
- b)  $K_c$  will increase because reactions go faster at higher temperatures.
- c)  $K_c$  will decrease because the reaction is exothermic.
- d)  $K_c$  will increase because the activation energy of the reaction is lowered.

**Question 29**

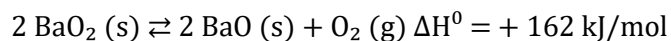
Which of the following reaction conditions will increase the yield of  $\text{CH}_3\text{OH}$  from the equilibrium reaction shown below?



- a) High temperatures and low pressures
- b) High temperatures and high pressures
- c) Low temperatures and low pressures
- d) Low temperatures and high pressures

**Question 30**

How can the equilibrium constant,  $K_c$ , be increased for the reaction below?

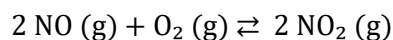


- a)  $K_c$  can increase if more  $\text{O}_2$  is added to the system.
- b)  $K_c$  can increase if the temperature is raised.
- c)  $K_c$  can increase if the volume of the system is increased.
- d)  $K_c$  can increase if a catalyst is added to the reaction.
- e)  $K_c$  is a constant and will not change.



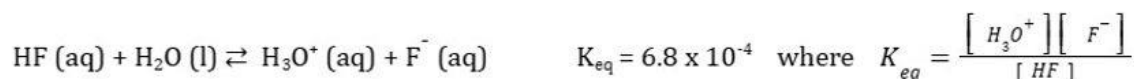
### Question 31

Which of the following would cause a shift to the right for the reaction at equilibrium as represented below?



- Increasing the volume of the reaction container.
- Decreasing the volume of the reaction container.
- Adding a catalyst to the system.
- Adding Ne at constant volume.

### Question 32

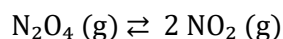


Examine the equilibrium reaction above. If a solution of HF at equilibrium is suddenly diluted with water to twice its original volume, how will the system respond based on changes to the reaction quotient  $Q$ ?

- $Q = K_{\text{eq}}$  and no shift in the equilibrium occurs because  $\text{H}_2\text{O}$  is not involved in the equilibrium expression.
- $Q = \frac{1}{2} K_{\text{eq}}$  and the reverse rate of reaction will be greater than the forward rate of reaction.
- $Q = \frac{1}{2} K_{\text{eq}}$  and the forward rate of reaction will be greater than the reverse rate of reaction.
- $Q = 2 K_{\text{eq}}$  and the reverse rate of reaction will be greater than the forward rate of reaction.
- $Q = 2 K_{\text{eq}}$  and the forward rate of reaction will be greater than the reverse rate of reaction.

### Question 33

$\text{N}_2\text{O}_4 (\text{g})$  is placed in a previously evacuated, rigid flask and allowed to reach equilibrium. What happens to the partial pressures of the gases and the overall equilibrium if Ne (g) is suddenly added at constant volume?



- The partial pressures of both gases increase and the reaction shifts to the left.
- The partial pressures of both gases increase and the reaction shifts to the right.
- The partial pressure of  $\text{NO}_2$  increases and the partial pressure of  $\text{N}_2\text{O}_4$  decreases causing a shift to the left.
- The partial pressures of both gases remain the same and no shift in equilibrium occurs.