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?

$$A\,(g) + B\,(g) \rightleftarrows C(g) + D(g)$$

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, Kc , for the reaction shown below?

$$N_2\,(g) + 3\,H_2\,(g) \rightleftarrows 2\,NH_3\,(g)$$

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, Kc , for the reaction shown below?

$2\ ICl\ (s) \rightleftarrows I_2\ (s) + Cl_2\ (g)$

a) $K_c = \frac{[ICl]^2}{[I_2][Cl_2]}$

b) $K_c = \frac{[I_2][Cl_2]}{[ICl]^2}$

c) $K_c = [I_2][Cl_2]$

d) $K_c = [Cl_2]$

Question 05

The reaction below has a Kc value of 50. Determine the Kp value for the reaction at the same temperature.

$H_2\ (g) + I_2\ (g) \rightleftarrows 2\ HI\ (g)$ Kc = 50. at 600^0C

a) 0.020
b) 50.
c) 2,500
d) 3,600

Question 06

The reaction below has a Kc value of 0.040 at 450^0C. Determine the Kp value for the same reaction at 450^0C.

$PCl_5\ (g) \rightleftarrows PCl_3\ (g) + Cl_2\ (g)$ Kc = 0.040 at 450^0C

a) 0.040
b) 1.5
c) 2.4
d) 150
e) 3,600

Question 07

The reaction below has a Kc value of 15 at 210^0C . Determine the Kp value for the same reaction at 210^0C.

$CO\ (g) + 2\ H_2\ (g) \rightleftarrows CH_3OH\ (g)$ $Kc = 15$ at 210^0C

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

Question 08

$AB\ (g) \rightleftarrows \frac{1}{2}A_2\ (g) + \frac{1}{2}B_2$ $\qquad K_{eq} = 0.1$

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

$A_2\ (g) + B_2\ (g) \rightleftarrows 2\ AB\ (g)$ $\qquad$ Keq = ?

a) Keq = 0.01
b) Keq = 0.2
c) Keq = 10
d) Keq = 20
e) Keq = 100

Question 09

$2A + 3\ B \rightleftarrows 4\ C$ Keq = 4.0

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

$2\ C \rightleftarrows A + (3/2)\ B$ $\qquad$ Keq = ?

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 445^0C. Which of the following is true as the system approaches equilibrium?

$2\ HI\ (g) \rightleftarrows\ H_2\ (g) +\ I_2\ (g)\ Kc = 0.020\ \text{ at } 445^0C$

a) More H_2 and I_2 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_2 and I_2 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 450^0C, $Kc = 0.040$ 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?

$PCl_5\ (g) \rightleftarrows PCl_3\ (g) + Cl_2\ (g)$

a) $Q = K$. The system is at equilibrium and no changes will occur.
b) More PCl_5 will be generated since $Q < K$
c) More PCl_5 will be generated since $Q > K$
d) More PCl_3 and Cl_2 will be generated since $Q < K$
e) More PCl_3 and Cl_2 will be generated since $Q > K$

Question 12

$COCl_2$ (g) decomposes according to the equation below. When a sample of $COCl_2$ (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 Kp for the reaction at this temperature?

$COCl_2\ (g) \rightleftarrows\ CO\ (g) + Cl_2\ (g)$

a) 0.040
b) 0.20
c) 0.27
d) 0.40
e) 047

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 (Kc) for this reaction at 298 K.

$2A\ (g) + B\ (g) \rightleftarrows 2C\ (g)$

a) Kc = 8.00
b) Kc = 32.0
c) Kc = 64.0
d) Kc= 128

Question 14

A 1.0 mole sample of each of the gases is injected into an evacuated, rigid 1.0 L container at 450^0C. Which of the following will have the greatest concentration once equilibrium is achieved?

$2A\ (g) + B\ (g) \rightleftarrows 2C\ (g)$ Kc = 4.8×10^{-4} at 450^0C

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 H_2S (g) and 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?

$2\ H_2S\ (g) + CH_4\ (g) \rightleftarrows CS_2\ (g) + 4\ H_2\ (g)$

I.[H_2S] must be less than [CS_2]
II.[CH_4] must be greater than [H_2S]
III.[H_2] must be greater than [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_2 (g) + B_2 (g) ⇄ 2 AB (g) Kc = 100

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^{0}C it is found that 60.0% of the NOCl dissociates. What is the value of the equilibrium constant at this temperature?

NOCl (g) ⇄ NO (g) + 1/2 Cl_2 (g)

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^{0}C.

H_2 (g) + I_2 (g) ⇄ 2 HI (g) Kc = 55 at 425^{0}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 N_2 and O_2 in a sealed, rigid container, determine the equilibrium concentration of NO.

$N2\ (g) + O2\ (g) \rightleftarrows 2\ NO\ (g)\ Kc = 0.10$ at 2000^0C

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?

$A\ (g) + B\ (g) \rightleftarrows C\ (g) + D\ (g)$

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.

$A\ (g) + 2\ B\ (g) \rightleftarrows C\ (g)\ Kc = 20.0$

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 450^0C?

$AB\ (g) \rightleftarrows A\ (g) + B\ (g) \quad Kc = 5.0 \times 10^{-5} \quad$ at 450^0C

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_2 and 0.025 M O_2 to a rigid container . After equilibrium is reached, the concentration of SO_3 is 0.020 M. What is the equilibrium concentration of O_2?

$2\ SO_2\ (g) + O_2\ (g) \rightleftarrows 2\ SO_3\ (g)$

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_2O (g) at equilibrium?

$2\ H_2O\ (g) \rightleftarrows 2\ H_2\ (g) + O_2\ (g) \quad H > 0$

a) Adding a catalyst to the system
b) Increasing the concentration of O_2 (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?

$2\ A\ (g) + B\ (g) \rightleftarrows 2\ C\ (g)\ \Delta H < 0$

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_2 that can be produced from the reaction?

$2\ ICl\ (s) \rightleftarrows I_2\ (s) + Cl_2\ (g)$

a) Remove Cl_2 as it is generated in the reaction.
b) Remove some I_2 (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_2 (g) is added to the flask at constant temperature.

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

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, NH_3 , can be synthesized at 200^0C according to the reaction below. What will happen to the equilibrium constant, Kc , if the temperature of the reaction is raised?

$N_2\ (g) + 3\ H_2\ (g) \rightleftarrows 2\ NH_3\ (g) \quad \Delta H < 0$

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

Question 29

Which of the following reaction conditions will increase the yield of CH_3OH from the equilibrium reaction shown below?

$CO\ (g) + 2\ H_2\ (g) \rightleftarrows\ CH_3OH\ (g) \quad \Delta H < 0$

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, Kc , be increased for the reaction below?

$2\ BaO_2\ (s) \rightleftarrows 2\ BaO\ (s) + O_2\ (g)\ \Delta H^0 = +\ 162\ kJ/mol$

a) Kc can increase if more O_2 is added to the system.
b) Kc can increase if the temperature is raised.
c) Kc can increase if the volume of the system is increased.
d) Kc can increase if a catalyst is added to the reaction.
e) Kc 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?

$2\ NO\ (g) + O_2\ (g) \rightleftarrows\ 2\ NO_2\ (g)$

a) Increasing the volume of the reaction container.
b) Decreasing the volume of the reaction container.
c) Adding a catalyst to the system.
d) Adding Ne at constant volume.

Question 32

$HF\ (aq) + H_2O\ (l) \rightleftarrows\ H_3O^+\ (aq) + F^-\ (aq)$ $\quad K_{eq} = 6.8 \times 10^{-4}$ where $K_{eq} = \dfrac{[H_3O^+][F^-]}{[HF]}$

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?

a. $Q = K_{eq}$ and no shift in the equilibrium occurs because H_2O is not involved in the equilibrium expression.
b. $Q = ½\ K_{eq}$ and the reverse rate of reaction will be greater than the forward rate of reaction.
c. $Q = ½\ K_{eq}$ and the forward rate of reaction will be greater than the reverse rate of reaction.
d. $Q = 2\ K_{eq}$ and the reverse rate of reaction will be greater than the forward rate of reaction.
e. $Q = 2\ K_{eq}$ and the forward rate of reaction will be greater than the reverse rate of reaction.

Question 33

N_2O_4 (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?

$N_2O_4\ (g) \rightleftarrows\ 2\ NO_2\ (g)$

a) The partial pressures of both gases increase and the reaction shifts to the left.
b) The partial pressures of both gases increase and the reaction shifts to the right.
c) The partial pressure of NO_2 increases and the partial pressure of N_2O_4 decreases causing a shift to the left.
d) The partial pressures of both gases remain the same and no shift in equilibrium occurs.