Self-test Questions

Topic 7 (SL)

1 Consider the equilibrium

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \quad \Delta H = -92 \text{ kJ mol}^{-1}$

Which of the following would increase the percentage NH_3 present at equilibrium?

A decreasing the pressure
B decreasing the temperature
C removing nitrogen from the reaction mixture
D adding a catalyst

2 Consider these equilibria:

$2SO_3(g) \rightleftharpoons 2SO_2(g) + O_2(g) \quad \Delta H = +197 \text{ kJ mol}^{-1}$

$2NO(g) + O_2(g) \rightleftharpoons 2NO_2(g) \quad \Delta H = -113 \text{ kJ mol}^{-1}$

Which change in conditions would cause the position of equilibrium in **both** reactions to shift in the **same** direction.

A increasing the pressure
B adding $O_2(g)$
C increasing the temperature
D none of the above

3 Consider the equilibrium

$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

At 500 K and 1.0×10^6 kPa the equilibrium mixture contained 82.5% HI. Which of the following could be the percentage of HI in the equilibrium mixture at 500 K and 2.0×10^6 kPa?

A 41.25%
B 82.5%
C 93.2%
D 71.6%

4 Consider the equilibrium

$CH_3OH(g) \rightleftharpoons CO(g) + 2H_2(g) \quad \Delta H^{\ominus} = +90 \text{ kJ mol}^{-1}$

If the percentage CH_3OH in the reaction mixture at 500 K and 1.0×10^6 kPa is 17%, which of the following could be the percentage CH_3OH in the equilibrium mixture at 0.5×10^6 kPa and 1000 K?

A 1%
B 17%
C 34%
D 68%

5 Consider these equilibria:

$N_2(g) + O_2(g) \rightleftharpoons 2NO(g) \quad \Delta H = 180 \text{ kJ mol}^{-1}$

$Br_2(g) + Cl_2(g) \rightleftharpoons 2BrCl(g) \quad \Delta H = 29 \text{ kJ mol}^{-1}$

$XeF_4(g) + F_2(g) \rightleftharpoons XeF_6(g) \quad \Delta H = -120 \text{ kJ mol}^{-1}$

Which of the following is true?

A All three equilibria are affected in the same way by a change in pressure.
B The yield of XeF_6 increases as the temperature is decreased.
C The yield of NO increases as the pressure is increased.
D The yield of BrCl increases as the temperature is decreased.

6 What is the equilibrium constant expression for the reaction
$2NO(g) + O_2(g) \rightleftharpoons 2NO_2(g)$

A $K_C = \dfrac{[NO(g)]^2[O_2(g)]}{[NO_2(g)]^2}$

B $K_C = \dfrac{[NO(g)][O_2(g)]}{[NO_2(g)]}$

C $K_C = \dfrac{[NO_2(g)]^2}{[NO_2(g)]^2[O_2(g)]}$

D $K_C = \dfrac{[NO_2(g)]^2}{[NO(g)]^2 + [O_2(g)]}$

7 Which of the following represents the reaction quotient for the reaction
$SO_3(g) \rightleftharpoons SO_2(g) + \frac{1}{2}O_2(g)$

A $Q = \dfrac{[SO_2(g)]^2[O_2(g)]}{[SO_3(g)]^2}$

B $Q = \dfrac{[SO_3(g)]}{[SO_2(g)][O_2(g)]}$

C $Q = \dfrac{[SO_2(g)][O_2(g)]^{1/2}}{[SO_3(g)]}$

D $Q = \dfrac{[SO_3(g)]^2}{[SO_2(g)]^2[O_2(g)]}$

8 Consider the reaction
$N_2O_4(g) \rightleftharpoons 2NO_2(g) \quad \Delta H = +57 \text{ kJ mol}^{-1}$
Which of the following changes would cause the value of the equilibrium constant for this reaction to increase?

A increasing the temperature
B decreasing the temperature
C decreasing the pressure
D introducing a catalyst

9 The value of the equilibrium constant for the reaction
$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$
at 1000 K is 2.05×10^6. What is the value of the equilibrium constant for the reaction
$CH_3OH(g) \rightleftharpoons CO(g) + 2H_2(g)$
at the same temperature?

A 2.05×10^6
B 4.88×10^{-7}
C -2.05×10^6
D 0.488×10^6

10 Consider the reaction

$2NH_3(g) \rightleftharpoons N_2(g) + 3H_2(g) \quad \Delta H = +92 \text{ kJ mol}^{-1}$

for which $K_c = 3.83$ at 700 K.

1.00 mol of ammonia was placed in a sealed container at 700 K and left for some time. The concentrations of all the gases in the container were then measured. The reaction quotient Q was calculated to be 2.25. What can be concluded from this?

A The temperature must have been higher than 700 K.

B The reaction had not reached equilibrium.

C Not enough ammonia was put in the container.

D The position of the equilibrium had shifted to the left.