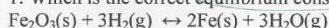


Test bank chapter (14)

Choose the most correct answer

1. Which is the correct equilibrium constant expression for the following reaction?



- $K_c = [\text{Fe}_2\text{O}_3] [\text{H}_2]^3 / [\text{Fe}]^2 [\text{H}_2\text{O}]^3$
- $K_c = [\text{H}_2] / [\text{H}_2\text{O}]$
- $K_c = [\text{H}_2\text{O}]^3 / [\text{H}_2]^3$
- $K_c = [\text{Fe}]^2 [\text{H}_2\text{O}]^3 / [\text{Fe}_2\text{O}_3] [\text{H}_2]^3$

$$K_c = \frac{[\text{H}_2\text{O}]^3}{[\text{H}_2]^3}$$

ملاحظة:
الموارد الأولية والسائل
لا يكتب في ثابت التوازن
" فقط g و l "

2. The following reactions occur at 500 K. Arrange them in order of increasing tendency to proceed to completion (least → greatest tendency).

- $2\text{NOCl} \rightleftharpoons 2\text{NO} + \text{Cl}_2$
- $2\text{SO}_3 \rightleftharpoons 2\text{SO}_2 + \text{O}_2$
- $2\text{NO}_2 \rightleftharpoons 2\text{NO} + \text{O}_2$

$$K_p = 1.7 \times 10^{-2}$$

$$K_p = 1.3 \times 10^{-3}$$

$$K_p = 5.9 \times 10^{-3}$$

كلما كانت قيمة K أكبر
كان ميل التفاعل اكتمالاً
النواتج كبير

- $2 < 1 < 3$
- $1 < 2 < 3$
- $2 < 3 < 1$
- $3 < 2 < 1$

$$1 > 3 > 2$$

3. Calculate K_p for the reaction $2\text{NOCl}(\text{g}) \leftrightarrow 2\text{NO}(\text{g}) + \text{Cl}_2(\text{g})$ at 400°C if K_c at 400°C for this reaction is 2.1×10^{-2} .

- 2.1×10^{-2}
- 1.7×10^{-3}
- 0.70
- 1.2

$$K_p = \frac{[\text{Cl}_2][\text{NO}]^2}{[\text{NOCl}]^2}$$

$$K_p = K_c (RT)^{\Delta n}$$

$$\Delta n = (2+1) - 2 = 3 - 2 = 1$$

$$K_p = 2.1 \times 10^{-2} (0.082 \times 673.15)^1 = 1.16 \approx 1.2$$

4. For the reaction $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \leftrightarrow 2\text{HI}(\text{g})$, $K_c = 50.2$ at 445°C. If $[\text{H}_2] = [\text{I}_2] = [\text{HI}] = 1.75 \times 10^{-3} \text{ M}$ at 445°C, which one of these statements is true?

- The system is at equilibrium, thus no concentration changes will occur.
- The concentrations of HI and I₂ will increase as the system approaches equilibrium.
- The concentration of HI will increase as the system approaches equilibrium.
- The concentrations of H₂ and HI will fall as the system moves toward equilibrium.

$$Q_c = \frac{[\text{HI}]^2}{[\text{H}_2][\text{I}_2]}$$

$$= \frac{(1.75 \times 10^{-3})^2}{(1.75 \times 10^{-3})(1.75 \times 10^{-3})}$$

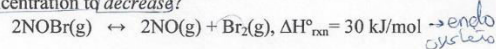
$$= 1$$

5. For the following reaction at equilibrium, which choice gives a change that will shift the position of equilibrium to favor formation of more products?



- Increase the total pressure by decreasing the volume. → $\Delta P \uparrow$ \rightarrow تنضغط الغازات \rightarrow يتحول التوازن نحو اليسار X
- Add more NO. → \rightarrow تزداد النواتج \rightarrow يتحول التوازن نحو اليمين ✓
- Remove Br₂. → \rightarrow تقل النواتج \rightarrow يتحول التوازن نحو اليسار X
- Lower the temperature. → \rightarrow تنخفض الحرارة \rightarrow يتحول التوازن نحو اليسار X

6 - For the following reaction at equilibrium in a reaction vessel, which one of these changes would cause the Br_2 concentration to decrease?



- a) Increase the temperature. → يزداد التسخين X
- b) Remove some NO. → يزيل X
- c) Add more NOBr. → يضيف X
- d) Compress the gas mixture into a smaller volume. (ضغط الجسيمات في حيز أصغر) ←

7. For the reaction at equilibrium $2\text{SO}_3 \leftrightarrow 2\text{SO}_2 + \text{O}_2$ ($\Delta H^\circ_{\text{rxn}} = 198 \text{ kJ/mol}$), if we increase the reaction temperature, the equilibrium will

endo متفاعلات
لوزاد حيز الجسيمات

- a) shift to the right.
- b) shift to the left.
- c) not shift.
- d) The question cannot be answered because the equilibrium constant is not given.

8. For the equilibrium reaction $2\text{SO}_2\text{(g)} + \text{O}_2\text{(g)} \leftrightarrow 2\text{SO}_3\text{(g)}$, $\Delta H^\circ_{\text{rxn}} = -198 \text{ kJ/mol}$. Which one of these factors would cause the equilibrium constant to increase?

- a) Decrease the temperature.
- b) Add SO_2 gas.
- c) Remove O_2 gas.
- d) Add a catalyst.

	exo	endo
T increase	de K	in K
T decrease	in K	de K

exo في النواتج

ماي متفاعل يحتاج
بتأثير التنازل بـ K_c
أو الحرارة!

9. The reaction $2\text{SO}_3\text{(g)} \leftrightarrow 2\text{SO}_2\text{(g)} + \text{O}_2\text{(g)}$ is endothermic. If the temperature is increased

- a) more SO_3 will be produced.
- b) K_c will decrease.
- c) no change will occur in K_c .
- d) K_c will increase.

أو ك يزداد

10. If a catalyst is added to a chemical reaction, the equilibrium yield of a product will be ... , and the time taken to come to equilibrium will be than before.

- a) higher; less
- b) lower; the same
- c) higher; the same
- d) the same; less

المحفزات لا تؤثر على الإتزان
بسبب تزييد سرعة التفاعل فقط
وأنها خذت وقت أقل

11- For the reaction, $\text{N}_2\text{(g)} + 3 \text{H}_2\text{(g)} \rightleftharpoons 2 \text{NH}_3\text{(g)}$

$K_c = 0.0600$ at a certain temperature. In an equilibrium mixture of the three gases, $[\text{NH}_3] = 0.242 \text{ M}$ and $[\text{H}_2] = 1.03 \text{ M}$. What is the concentration of N_2 in this system?

- a) 3.9 M
- b) $3.2 \times 10^{-3} \text{ M}$
- c) 0.89 M
- d) $1.4 \times 10^{-2} \text{ M}$

$$K_c = \frac{[\text{NH}_3]^2}{[\text{N}_2][\text{H}_2]^3}$$

$$0.0600 = \frac{(0.242)^2}{\text{N}_2(1.03)^3} \Rightarrow \text{N}_2 = \frac{(0.242)^2}{0.0600(1.03)^3}$$

$$\text{N}_2 = 0.893 \text{ M}$$

11. Consider the reaction $\text{NH}_4\text{Cl(s)} \rightleftharpoons \text{NH}_3\text{(g)} + \text{HCl(g)}$.

If an equilibrium mixture of these three substances is compressed, equilibrium will _____, because _____.

- a) shift to the right; higher pressure favors fewer moles of gas
- b) shift to the right; higher pressure favors more moles of gas
- c) **shift to the left; higher pressure favors fewer moles of gas**
- d) shift to the left; higher pressure favors more moles of gas

الضغط يزداد يقل الحجم
يزداد عدد المولات الأقل
يعني لليسار

12- Consider the equilibrium system; $\text{C(s)} + \text{CO}_2\text{(g)} \rightleftharpoons 2\text{CO(g)}$.

If more C(s) is added, the equilibrium will _____; if CO is removed the equilibrium will _____.

- a) shift to the left; shift to the left
- b) shift to the right; shift to the right $\rightarrow \text{CO}$
- c) **shift to the right; shift to the left $\rightarrow \text{CO}_2$**
- d) be unchanged; shift to the left

- زدنا المتفاعلات
- زاد اليمين
- قلنا CO (نواتج)
- زاد اليمين

8. Consider the exothermic reaction at equilibrium: $2\text{SO}_2\text{(g)} + \text{O}_2\text{(g)} \rightleftharpoons 2\text{SO}_3\text{(g)}$, If the system is cooled, the equilibrium will _____, because _____.

- a) shift to the left; decreased temperature favors an exothermic reaction
- b) **shift to the right; decreased temperature favors an exothermic reaction**
- c) shift to the right; decreased temperature favors an endothermic reaction
- d) shift to the left; decreased temperature favors an endothermic reaction

exothermic \rightarrow نواتج
لو زدنا الحرارة حيرج اليسار
لو خفضنا الحرارة حيرج اليمين

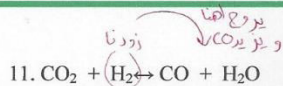
9. A large value of the equilibrium constant indicates that when the reaction reaches equilibrium, mostly _____ will be present.

- a) reactants
- b) **products**
- c) catalysts
- d) shrapnel

$K > 1 \rightarrow \text{product}$
 $K < 1 \rightarrow \text{reactant}$

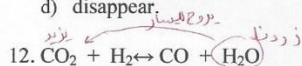
10. When equilibrium is achieved

- a) $Q > K$
- b) $Q < K$
- c) **$Q = K$**
- d) $Q_2 = K$



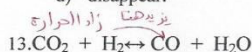
If all species are gases and H_2 is added, the amount of CO present at equilibrium will:

- a) increase.
- b) decrease.
- c) remain unchanged.
- d) disappear.



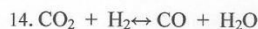
If all species are gases and H_2O is added, the amount of CO present at equilibrium will:

- a) increase.
- b) decrease.
- c) remain unchanged.
- d) disappear.



If the reaction is endothermic and the temperature is raised, the amount of CO present will:

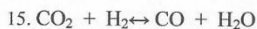
- a) increase.
- b) decrease.
- c) remain unchanged.
- d) disappear.



If all species are gases and the container is compressed, the amount of CO present will:

- a) increase.
- b) decrease.
- c) remain unchanged.
- d) disappear.

Handwritten notes: $n = 2 - 2 = 0$, $\Delta n = 0$ (no change in moles).



If all species are gases and the container is compressed, the amount of CO present will:

- a) increase.
- b) decrease.
- c) remain unchanged.
- d) disappear.

Handwritten notes: $\Delta n = 0$ (no change in moles).

16. What is K_p in terms of K_c for the following reaction? $2\text{NO(g)} + \text{O}_2\text{(g)} \leftrightarrow 2\text{NO}_2\text{(g)}$

Handwritten notes: $\Delta n = 2 - (1 + 2) = 2 - 3 = -1$

- a) $K_p = K_c RT$
- b) $K_p = K_c / RT$
- c) $K_p = K_c R / T$
- d) $K_p = K_c / (RT)^2$

Handwritten notes: $K_p = K_c (RT)^{\Delta n}$, $K_p = K_c (RT)^{-1}$, $K_p = \frac{K_c}{RT}$

Handwritten note: $K_p = \frac{K_c}{RT}$

17. What is the correct equilibrium constant expression for the reaction: **ANS. 3**



1. $\frac{[\text{PCl}_3]^4}{[\text{P}_4][\text{Cl}_2]^6}$
2. $\frac{[\text{PCl}_3]^4}{[\text{Cl}_2]^6}$
3. $\frac{1}{[\text{Cl}_2]^6}$
4. $\frac{[\text{Cl}_2]^6}{[\text{PCl}_3]^4}$
5. $\frac{[4 \text{ PCl}_3]^4}{[\text{P}_4][6 \text{ Cl}_2]^6}$

18. The equation relating K_p and K_c is

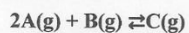
- a) $K_p = K_c (RT)^{\Delta n}$
- b) $K_p = K_c RT^{\Delta n}$
- c) $K_c = K_p RT^{\Delta n}$
- d) $K_c = K_p (RT)^{\Delta n}$

(الاقواس تعرف في الحد)
(القانون ثابت)

19. K_p will be equal to K_c if

- a) $\Delta n = 1$
- b) $\Delta n = 0$
- c) $RT = 0$
- d) $\Delta n = -1$

20. Consider the reversible reaction at equilibrium at 392 °C:



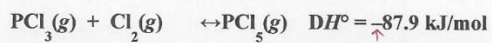
The partial pressures are found to be: A: 6.70 atm, B: 10.1 atm, C: 3.60 atm. Evaluate K_p for this reaction.

- a) 7.94×10^{-3}
- b) 0.146
- c) 0.0532
- d) 54.5

$$K_p = \frac{P_C}{P_A^2 P_B}$$

$$= \frac{3.60}{(6.70)^2 (10.1)} = 7.94 \times 10^{-3}$$

20. Which of the following will result in an equilibrium shift to the right?

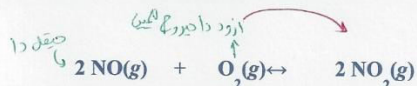


- a) Increase temperature/increase volume
 b) Increase temperature/decrease volume
 c) Decrease temperature/increase volume
 d) Decrease temperature/decrease volume

الحرارة
بالنواحي

تزداد لعدد الجزيئات
اليمين

21. Which accurately reflects the changes in concentration that will occur if O_2 is added to disturb the equilibrium?



	[NO]	[O ₂]	[NO ₂]
a)	Increase	Increase	Increase
b)	Increase	Increase	Decrease
c)	Decrease	Decrease	Decrease
d)	Decrease	Increase	Increase