

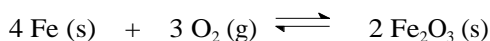
1. If a reaction system is proceeding in the reverse direction, i.e. reactants are being formed and products are being consumed, then

- a) $Q < K$
- b) $Q > K$
- c) $Q = K$
- d) the relationship between Q and K cannot be determined

2. The value of K changes with

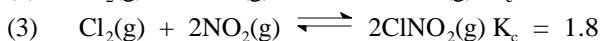
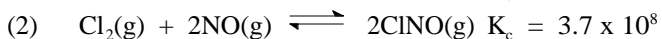
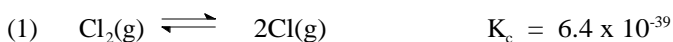
- a) concentrations of reactants and products
- b) pressure
- c) volume
- d) temperature
- e) all of the above

3. What is the equilibrium constant expression for K_c for the following reaction?



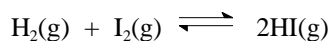
- a) $K_c = \frac{[\text{Fe}]^4[\text{O}_2]^3}{[\text{Fe}_2\text{O}_3]^2}$
- b) $K_c = \frac{[2\text{Fe}_2\text{O}_3]}{[4\text{Fe}][3\text{O}_2]}$
- c) $K_c = \frac{[2\text{Fe}_2\text{O}_3]^2}{[4\text{Fe}]^4[3\text{O}_2]^3}$
- d) $K_c = \frac{[\text{Fe}_2\text{O}_3]^2}{[\text{Fe}]^4[\text{O}_2]^3}$
- e) $K_c = \frac{1}{[\text{O}_2]^3}$

4. For which of the following reactions will the equilibrium mixture contain an appreciable concentration of both reactants and products?



- a) 3
- b) 2 and 3
- c) 1, 2, and 3
- d) 1
- e) none of these

5. A 1.000 L flask is filled with 1.000 mol of H_2 and 2.000 mol of I_2 at 448°C . When the following reaction is allowed to reach equilibrium,



the equilibrium concentration of HI is 1.870 M. What is the equilibrium constant K_c for this reaction?

- a) 111
- b) 0.00904
- c) 50.5
- d) 1.75
- e) 27.0

6. The following reaction is catalyzed by a zinc/chromium catalyst:



Which of the following actions will increase the equilibrium yield of CH_3OH ?

- I. addition of $\text{CO}(\text{g})$
- II. increasing the total pressure by addition of He
- III. increasing the total pressure by decreasing the volume
- IV. increasing the temperature
- V. adding a catalyst

- a) I and III
- b) I, III, and IV
- c) I, III, and V
- d) I, III, IV, and V
- e) I, II, III, IV, and V

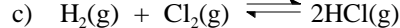
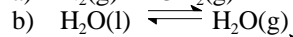
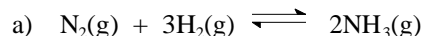
7. At 250°C , the reaction



has an equilibrium constant $K_c = 1.80$. If 0.200 mol of PCl_5 is placed in a 5.00 L container, what will be the equilibrium concentration of Cl_2 ?

- a) 0.182 M
- b) 0.0200 M
- c) 0.0391 M
- d) 0.600 M
- e) 0.268 M

8. Which of the reactions below have $K_c = K_p$?



- d) all of these
- e) none of these

9. Which of the following would have the lowest pH at 25°C ?

- a) 0.10 M $\text{HCl}(\text{aq})$
- b) 0.10 M $\text{HNO}_3(\text{aq})$
- c) 0.10 M $\text{HClO}_4(\text{aq})$
- d) 0.10 M $\text{HI}(\text{aq})$
- e) All of these would have the same pH.

10. A Lewis acid is defined as

- a) a proton donor
- b) an electron-pair donor
- c) a proton acceptor
- d) an electron-pair acceptor
- e) none of the above

11. What is the pH of 0.0010 M HCl (aq)?
- 0.0010
 - 2.00
 - 3.00
 - 1.00
 - 1.30
12. Which of the following is the strongest acid?
- HBrO₄
 - HBrO₃
 - HBrO₂
 - HBrO
 - all of these acids are equally strong
13. If K_b for aniline (C₆H₅NH₂) is 4.3 × 10⁻¹⁰ at 25°C, then what is the value of K_a for C₆H₅NH₃⁺?
- 2.3 × 10⁻⁵
 - 4.3 × 10⁻¹⁰
 - 1.0 × 10⁻¹⁴
 - 4.3 × 10⁻⁴
 - 5.6 × 10⁻²
14. Which of the following is the weakest acid?
- H₂Se
 - H₂S
 - HI
 - HBr
 - H₂Te
15. What is the pH of a 0.50 M solution of HCN (aq) at 25°C? (K_a = 4.9 × 10⁻¹⁰ for HCN at 25°C)
- 4.8
 - 7.0
 - 9.2
 - 1.3
 - 2.7
16. What is the pH of a 0.25 M solution of NH₄Cl (aq) at 25°C? (K_b = 1.8 × 10⁻⁵ for NH₃ at 25°C)
- 9.1
 - 11.3
 - 7.0
 - 2.7
 - 4.9
17. Which of the following 0.10 M salt solutions will be acidic?
- NaCl
 - KClO₄
 - NaCH₃COO
 - NH₄Br
 - KNO₃
18. In a 0.35 M solution of H₂CO₃, what is the concentration of CO₃²⁻(aq)? (K_{a1} = 4.3 × 10⁻⁷, K_{a2} = 5.6 × 10⁻¹¹ for H₂CO₃)
- 3.9 × 10⁻⁴
 - 4.4 × 10⁻⁶
 - 1.0 × 10⁻⁷
 - 5.6 × 10⁻¹¹
 - 4.3 × 10⁻⁷
19. A 0.50 M aqueous solution of HF is diluted to 0.10 M. As a result of this dilution
- the pH and the percent dissociation both decrease
 - the pH and the percent dissociation both increase
 - the pH increases and the percent dissociation decreases
 - the pH decreases and the percent dissociation increases
 - the pH remains constant and the percent dissociation decreases
20. What are the Brønsted-Lowry acids in the following reaction?
- $$\text{CN}^-(\text{aq}) + \text{NH}_4^+(\text{aq}) \rightleftharpoons \text{HCN}(\text{aq}) + \text{NH}_3(\text{aq})$$
- NH₄⁺, HCN
 - CN⁻, NH₄⁺
 - HCN, NH₃
 - CN⁻, HCN
 - CN⁻, NH₄⁺, HCN, NH₃
21. What is the pH of a 0.40 M aqueous solution of NH₂OH at 25°C? (K_b = 9.1 × 10⁻⁹ for NH₂OH at 25°C)
- 4.2
 - 9.8
 - 7.0
 - 10.4
 - 2.0

Answer Key

- | | | |
|-------|-------|-------|
| 1. B | 11. C | 21. B |
| 2. D | 12. A | |
| 3. E | 13. A | |
| 4. A | 14. B | |
| 5. C | 15. A | |
| 6. A | 16. E | |
| 7. C | 17. D | |
| 8. C | 18. D | |
| 9. E | 19. B | |
| 10. D | 20. A | |