

Brett Robbins Academic Consulting

Chemistry 30 Practice Test

Unit D: Equilibrium, Acids & Bases

25 Questions

Original practice questions written to the Alberta curriculum, in the style of past diploma examinations. Work through each question, then check your answers with the key at the end.

This practice test was made by AI and there may be mistakes. If a question or answer looks wrong, contact Brett for clarification.

Question 1

The equilibrium law expression for the reaction $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$ is

A) $\frac{[SO_2]^2[O_2]}{[SO_3]^2}$

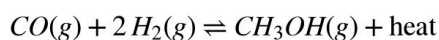
B) $\frac{[SO_3]^2}{[SO_2]^2[O_2]}$

C) $\frac{[SO_3]}{[SO_2][O_2]}$

D) $\frac{[2SO_3]}{[2SO_2][O_2]}$

Question 2

The synthesis of methanol is represented by the equation



Which of the following changes will increase the amount of $CH_3OH(g)$ at equilibrium?

A) Increasing the temperature

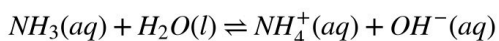
B) Adding a catalyst

C) Increasing the pressure

D) Increasing the volume of the container

Question 3

Use the following equation to answer this question.



In this equation, the species that acts as a Brønsted – Lowry base is

A) $NH_3(aq)$

B) $H_2O(l)$

C) $NH_4^+(aq)$

D) $OH^-(aq)$

Question 4

Which of the following pairs of species is a conjugate acid – base pair?

A) $HNO_3(aq)$ and $NO_2^-(aq)$

B) $H_2SO_4(aq)$ and $SO_4^{2-}(aq)$

C) $NH_4^+(aq)$ and $NH_2^-(aq)$

D) $HF(aq)$ and $F^-(aq)$

Question 5

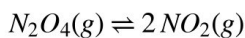
A solution has a hydronium ion concentration of 1.0×10^{-4} mol/L.

The pH of the solution is

- A) -4.0
- B) 4.0
- C) 10.0
- D) 1.0×10^{-10}

Question 6

At a certain temperature, the following system is at equilibrium.



The equilibrium concentrations are $[N_2O_4] = 0.20$ mol/L and $[NO_2] = 0.40$ mol/L.

The value of K_c , to two decimal places, is

Question 7

A system is at equilibrium. Which of the following changes will change the value of the equilibrium constant, K_c , for the system?

- A) Adding a catalyst
- B) Increasing the concentration of a reactant
- C) Increasing the temperature
- D) Decreasing the volume of the container

Question 8

Which of the following species is amphoteric?

- A) $HCO_3^-(aq)$
- B) $CO_3^{2-}(aq)$
- C) $NH_4^+(aq)$
- D) $CH_3COOH(aq)$

Question 9

The pH of a 0.020 mol/L $\text{NaOH}(\text{aq})$ solution, to the nearest hundredth, is

Question 10

Which of the following pairs of solutions, when mixed together, will form a buffer solution?

A) $\text{HCl}(\text{aq})$ and $\text{NaCl}(\text{aq})$

B) $\text{HNO}_3(\text{aq})$ and $\text{KNO}_3(\text{aq})$

C) $\text{NaOH}(\text{aq})$ and $\text{NaCl}(\text{aq})$

D) $\text{CH}_3\text{COOH}(\text{aq})$ and $\text{NaCH}_3\text{COO}(\text{aq})$

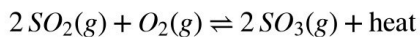
Question 11

Ethanoic acid, $\text{CH}_3\text{COOH}(\text{aq})$, has a K_a value of 1.8×10^{-5} .

The pH of a 0.10 mol/L $\text{CH}_3\text{COOH}(\text{aq})$ solution, to the nearest hundredth, is

Question 12

Consider the following equilibrium system.



If the temperature of the system is increased, then the equilibrium position *i* and the value of K_c *ii*.

A) i: shifts toward the products

ii: increases

B) i: shifts toward the reactants

ii: decreases

C) i: shifts toward the reactants

ii: increases

D) i: shifts toward the products

ii: decreases

Question 13

Two weak acids, $\text{HX}(\text{aq})$ and $\text{HY}(\text{aq})$, have K_a values of 2.0×10^{-4} and 5.0×10^{-6} , respectively.

Which of the following statements is correct?

A) $\text{HY}(\text{aq})$ is a stronger acid than $\text{HX}(\text{aq})$

B) A 0.10 mol/L solution of $\text{HX}(\text{aq})$ has a higher pH than a 0.10 mol/L solution of $\text{HY}(\text{aq})$

C) $\text{X}^-(\text{aq})$ is a stronger base than $\text{Y}^-(\text{aq})$

D) $\text{X}^-(\text{aq})$ is a weaker base than $\text{Y}^-(\text{aq})$

Question 14

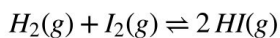
A 25.0 mL sample of 0.10 mol/L $NH_3(aq)$ is titrated with 0.10 mol/L $HCl(aq)$.

The pH at the equivalence point will be

- A) less than 7
- B) equal to 7
- C) greater than 7
- D) equal to the initial pH of the $NH_3(aq)$

Question 15

Consider the following equilibrium system.



A mixture initially contains 0.50 mol/L $H_2(g)$ and 0.50 mol/L $I_2(g)$.

At equilibrium, $[HI] = 0.80$ mol/L. The value of K_c is

Question 16

Indicator data : methyl orange changes colour over the pH range 3.1 to 4.4;

methyl red, 4.4 to 6.2; bromothymol blue, 6.0 to 7.6; phenolphthalein, 8.2 to 10.0.

A strong acid is titrated with a strong base, and the pH at the equivalence point is 7.0.

The most suitable indicator for this titration is

- A) methyl orange
- B) phenolphthalein
- C) bromothymol blue
- D) methyl red

Question 17

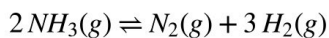
The K_a value of $NH_4^+(aq)$ is 5.6×10^{-10} , and $K_w = 1.0 \times 10^{-14}$.

The K_b value of $NH_3(aq)$ is

- A) 5.6×10^{-10} B) 1.8×10^{-5}
C) 1.8×10^{-9} D) 5.6×10^{-4}

Question 18

Consider the following equilibrium system.



A sample initially contains only $NH_3(g)$, at a concentration of 1.00 mol/L.

At equilibrium, $[NH_3] = 0.60$ mol/L. The value of K_c , to two decimal places, is

Question 19

A 25.0 mL sample of 0.10 mol/L $CH_3COOH(aq)$ is titrated with 0.10 mol/L $NaOH(aq)$.

Which of the following statements correctly describes this titration?

- A) The pH starts at 7 and rises slowly to the equivalence point
- B) The pH at the equivalence point is exactly 7
- C) The initial pH is the same as the pH of 0.10 mol/L $HCl(aq)$
- D) The pH rises gradually, then sharply near the equivalence point, where the pH is greater than 7

Question 20

When the pH of a solution increases from 3.0 to 6.0, the hydronium ion concentration decreases by a factor of

- A) 1000
- B) 3
- C) 100
- D) 2

Question 21

Acid ionization constants : K_a of $HF(aq) = 3.5 \times 10^{-4}$; K_a of $CH_3COOH(aq) = 1.8 \times 10^{-5}$;

K_a of $HCN(aq) = 6.2 \times 10^{-10}$. $HCl(aq)$ ionizes completely.

Which of the following 0.10 mol/L solutions has the lowest pH?

- A) $HCN(aq)$
- B) $CH_3COOH(aq)$
- C) $HCl(aq)$
- D) $HF(aq)$

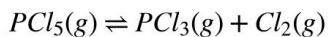
Question 22

Ammonia, $NH_3(aq)$, has a K_b value of 1.8×10^{-5} .

The pH of a 0.050 mol/L $NH_3(aq)$ solution, to the nearest hundredth, is

Question 23

Consider the following equilibrium system.



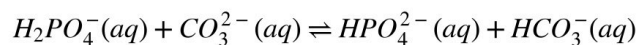
At equilibrium, $[PCl_5] = 0.20$ mol/L, $[PCl_3] = 0.50$ mol/L, and $[Cl_2] = 0.50$ mol/L.

The value of K_c is

- A) 0.80
- B) 1.25
- C) 0.50
- D) 2.5

Question 24

Consider the following equation.



In this equation, $H_2PO_4^-(aq)$ acts as an *i*, and $HPO_4^{2-}(aq)$ is the conjugate *ii* of $H_2PO_4^-(aq)$.

A) i: acid

ii: acid

B) i: base

ii: base

C) i: base

ii: acid

D) i: acid

ii: base

Question 25

A student dissolves 0.0020 mol of HNO_3 in water to make 500 mL of solution.

The pH of the solution, to the nearest hundredth, is

Answer Key

- | | | |
|----------|----------|-----------|
| 1. B | 10. D | 19. D |
| 2. C | 11. 2.87 | 20. A |
| 3. A | 12. B | 21. C |
| 4. D | 13. D | 22. 10.98 |
| 5. B | 14. A | 23. B |
| 6. 0.80 | 15. 64 | 24. D |
| 7. C | 16. C | 25. 2.40 |
| 8. A | 17. B | |
| 9. 12.30 | 18. 0.12 | |

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