

CALVIN

Name:

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AP Chem Ch.14 Review

1) For the equilibrium that exists in an aqueous solution of nitrous acid (HNO_2 , a weak acid), the equilibrium constant expression is:

A) $K = \frac{[\text{H}^+][\text{NO}_2^-]}{[\text{HNO}_2]}$

B) $K = \frac{[\text{H}^+][\text{N}^{3+}][\text{O}^{2-}]^2}{[\text{HNO}_2]}$

C) $K = [\text{H}^+][\text{NO}_2^-]$

D) $K = \frac{[\text{H}^+]^2[\text{NO}_2^-]}{[\text{HNO}_2]}$

E) none of these

2) Which of the following is a conjugate acid/base pair?

A) HCl/OCl^-

B) $\text{H}_2\text{SO}_4/\text{SO}_4^{2-}$

C) $\text{NH}_4^+/\text{NH}_3$

D) $\text{H}_3\text{O}^+/\text{OH}^-$

E) more than one of these

3) The equilibrium constant for the reaction $\text{A}^- + \text{H}^+ \rightleftharpoons \text{HA}$ is called:

A) K_a

B) K_b

C) $\frac{1}{K_a}$

D) $\frac{K_w}{K_b}$

E) $K_w K_a$

4) What is the equilibrium constant for the following reaction? $\text{N}_3^- + \text{H}_3\text{O}^+ \rightleftharpoons \text{HN}_3 + \text{H}_2\text{O}$

The K_a value for $\text{HN}_3 = 1.9 \times 10^{-5}$.

A) 5.3×10^{-10}

B) 1.9×10^{-9}

C) 1.9×10^{-5}

D) 5.3×10^4

E) 1.9×10^9

$$\frac{1}{1.9 \times 10^{-5}} = 5.3 \times 10^4$$

5) The hydrogen sulfate or bisulfate ion HSO_4^- can act as either an acid or a base in water solution. In which of the following equations does HSO_4^- act as an acid?

- A) $\text{HSO}_4^- + \text{H}_2\text{O} \rightarrow \text{H}_2\text{SO}_4 + \text{OH}^-$
- B) $\text{HSO}_4^- + \text{H}_3\text{O}^+ \rightarrow \text{SO}_3 + 2\text{H}_2\text{O}$
- C) $\text{HSO}_4^- + \text{OH}^- \rightarrow \text{H}_2\text{SO}_4 + \text{O}^{2-}$
- D) $\text{HSO}_4^- + \text{H}_2\text{O} \rightarrow \text{SO}_4^{2-} + \text{H}_3\text{O}^+$
- E) none of these

6) Consider the reaction $\text{HNO}_2(aq) + \text{H}_2\text{O}(l) \rightleftharpoons \text{H}_3\text{O}^+(aq) + \text{NO}_2^-(aq)$. Which species is a conjugate base?

- A) $\text{HNO}_2(aq)$
- B) $\text{H}_2\text{O}(l)$
- C) $\text{H}_3\text{O}^+(aq)$
- D) $\text{NO}_2^-(aq)$
- E) two of these

(For #7) Consider the following reactions:

- a) $\text{Al}^{3+} + 6\text{H}_2\text{O} \rightleftharpoons \text{Al}(\text{OH}_2)_6^{3+}$
- b) $\text{Al}(\text{OH}_2)_6^{3+} \rightleftharpoons \text{Al}(\text{OH})(\text{OH}_2)_5^{2+} + \text{H}^+$
- c) $\text{OCl}^- + \text{H}_2\text{O} \rightleftharpoons \text{HOCl} + \text{OH}^-$
- d) $\text{CN}^- + \text{H}^+ \rightleftharpoons \text{HCN}$
- e) none of these

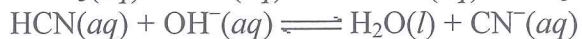
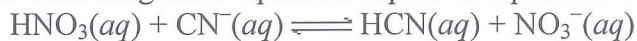
7) Which is associated with the definition of K_a ?

- A) a
- B) b
- C) c
- D) d
- E) e

8) Which of the following is *not* true for a solution at 25°C that has a hydroxide concentration of $2.5 \times 10^{-6} \text{ M}$?

- A) $K_w = 1 \times 10^{-14}$
- B) The solution is acidic.
- C) The solution is basic.
- D) The $[\text{H}^+]$ is $4.0 \times 10^{-9} \text{ M}$.
- E) The K_w is independent of what the solution contains.

The following three equations represent equilibria that lie far to the right.



9) Identify the strongest acid.

- A) HCN
- B) HNO₃
- C) H₂O
- D) OH⁻
- E) CH₃OH

10) A solution in which the pOH is 12.1 would be described as

- A) very acidic
- B) slightly acidic
- C) neutral
- D) very basic
- E) slightly basic

11) Calculate the [H⁺] in a solution that has a pH of 9.88.

- A) 4.1 M
- B) 9.9 M
- C) $7.6 \times 10^{-5} M$
- D) $1.3 \times 10^{-10} M$
- E) none of these

12) The pH of a solution at 25°C in which [OH⁻] = $3.9 \times 10^{-5} M$ is:

- A) 4.41
- B) 3.90
- C) 9.59
- D) 4.80
- E) none of these

13) Solid calcium hydroxide is dissolved in water until the pH of the solution is 11.44. The hydroxide ion concentration [OH⁻] of the solution is:

- A) $3.6 \times 10^{-12} M$
- B) $5.5 \times 10^{-3} M$
- C) $2.8 \times 10^{-3} M$
- D) $1.4 \times 10^{-3} M$
- E) none of these

14) At 65°C, the ion-product constant of water, K_w , is 1.20×10^{-13} . The pH of pure water at 65°C is:

- A) 7.000
- B) 6.560
- C) 5.880
- D) 6.460
- E) none of these

15) Which of the following indicates the most basic solution?

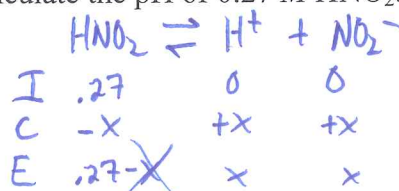
- A) $[H^+] = 1 \times 10^{-10} M$
- B) $pOH = 6.7$
- C) $[OH^-] = 7 \times 10^{-5} M$
- D) $pH = 4.2$
- E) At least two of the solutions are equally basic.

16) You have 100.0 mL of a solution of hydrochloric acid that has a pH of 3.00. You add 100.0 mL of water to this solution. What is the resulting pH of the solution?

- A) The pH = 5.00 (the average of 3.00 and 7.00).
- B) The pH = 10.00 ($3.00 + 7.00 = 10.00$).
- C) The pH = 3.00 (water is neutral and does not affect the pH).
- D) None of the above is correct, but the pH must be greater than 3.00.
- E) None of the above is correct, but the pH must be less than 3.00.

17) For nitrous acid, HNO_2 , $K_a = 4.0 \times 10^{-4}$. Calculate the pH of 0.27 M HNO_2 .

- A) 1.98
- B) 0.57
- C) 3.97
- D) 12.02
- E) none of these



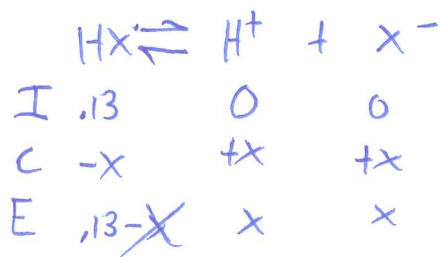
$$4.00 \times 10^{-4} = \frac{x^2}{.27}$$

$$x = 0.6104$$

$$pH = \boxed{1.98}$$

18) For weak acid, HX , $K_a = 6.9 \times 10^{-6}$. Calculate the pH of a 0.13 M solution of HX .

- A) 0.89
- B) 3.02
- C) 6.05
- D) 10.98
- E) none of these



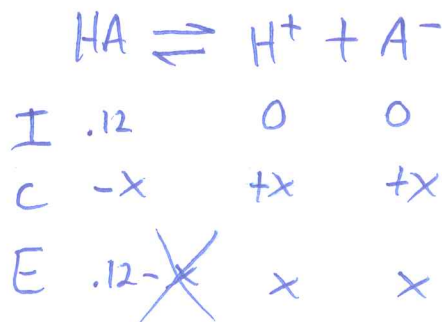
$$\frac{x^2}{.13} = 6.9 \times 10^{-6}$$

$$x = 9.47 \times 10^{-4}$$

$$pH = \boxed{3.02}$$

19) Calculate the pOH of a 0.12 M solution of acetic acid ($K_a = 1.8 \times 10^{-5}$).

- A) 2.83
- B) 8.33
- C) 5.67
- D) 11.17
- E) 1.91



$$\frac{x^2}{.12} = 1.8 \times 10^{-5}$$

$$x = 1.47 \times 10^{-3}$$

$$pOH = \boxed{11.17}$$

20) Which of the following solutions contains the strongest acid?

- A) 5.00 M HCN ($K_a = 6.2 \times 10^{-10}$)
- B) 3.50 M $\text{H}_2\text{C}_6\text{H}_6\text{O}_6$ ($K_{a1} = 7.9 \times 10^{-5}$, $K_{a2} = 1.6 \times 10^{-12}$).
- C) 2.50 M $\text{HC}_2\text{H}_3\text{O}_2$ ($K_a = 1.8 \times 10^{-5}$)
- D) 4.00 M HOCl ($K_a = 3.5 \times 10^{-8}$)
- E) 1.00 M HF ($K_a = 7.2 \times 10^{-4}$)

21) Calculate the pH of a 0.02 M solution of KOH.

- A) 1.7
- B) 15.7
- C) 14.0
- D) 12.3
- E) cannot calculate answer unless a volume is given

22) Calculate the pH of a 0.059 M solution of $\text{Ca}(\text{OH})_2$.

- A) 13.07
- B) 12.77
- C) 0.93
- D) 1.23
- E) none of these

23) Calculate the pOH of a 0.32 M solution of $\text{Ba}(\text{OH})_2$.

- A) 0.49
- B) 0.19
- C) 13.81
- D) 13.51
- E) none of these

24) A 0.372-g sample of NaOH(s) is added to enough water to make 250.0 mL of solution. The pH of this solution is:

- A) 1.429
- B) 0.429
- C) 11.968
- D) 12.571
- E) none of these

$$\frac{0.372 \text{ g NaOH}}{40.00 \text{ g NaOH}} \times \frac{1 \text{ mol NaOH}}{1} = \frac{0.00930 \text{ mol}}{0.250 \text{ L}} = 0.0372 \text{ M}$$

pH = 12.57

25) Calculate the pH of a 2.28 M solution of NaOH.

- A) 0.358
- B) 13.642
- C) 14.358
- D) 2.28
- E) none of these

26) For the stepwise dissociation of aqueous H_3PO_4 , which of the following is not a conjugate acid–base pair?

- A) HPO_4^{2-} and PO_4^{3-}
- B) H_3PO_4 and H_2PO_4^-
- C) H_2PO_4^- and HPO_4^{2-}
- D) H_2PO_4^- and PO_4^{3-}
- E) H_3O^+ and H_2O

27) The conjugate acid and conjugate base of bicarbonate ion, HCO_3^- , are, respectively:

- A) H_3O^+ and OH^-
- B) H_3O^+ and CO_3^{2-}
- C) H_2CO_3 and OH^-
- D) H_2CO_3 and CO_3^{2-}
- E) CO_3^{2-} and OH^-

Go VIKINGS!!