

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) Calculate the pOH of a 0.0827 M aqueous sodium cyanide solution at 25.0 °C. K_b for CN^- is 4.9×10^{-10} .

- A) 1.17 $CN^- \rightarrow HCN + OH^-$
 B) 9.33 I - 0.0827 0 0
 C) 10.00 C - X + X + X
 D) 5.20 E - 0.0827 - X X X
 E) 8.89

$$4.9 \times 10^{-10} = \frac{X^2}{0.0827}$$

$$X = 6.37 \times 10^{-6}$$

$$pOH = -\log(6.37 \times 10^{-6}) = 5.20$$

2) Which of the following ions will act as a weak base in water?

- A) NO_3^- - No effect
 B) ClO^- - conj base of weak acid
 C) Cl^- - No effect
 D) OH^- - strong base
 E) None of the above will act as a weak base in water.

3) Which of the following ions will act as a weak base in water?

- A) NO_2^-
 B) F^-
 C) HS^-
 D) ClO^-
 E) All of the above will act as a weak base in water.
- } all are weak (conj) bases

4) Which of the following aqueous solutions has the highest $[OH^-]$?

- A) pure water $= 1 \times 10^{-7}$
 B) a 1×10^{-3} M solution of NH_4Cl NH_4 is weak acid of NH_3
 C) a solution with a pH of 3.0 1×10^{-11}
 D) a 1×10^{-4} M solution of HNO_3
 E) a solution with a pOH of 12.0 $[H^+] = 1 \times 10^{-2}$
- $1 \times 10^{-7} \rightarrow$
 $< 1 \times 10^{-7} \rightarrow$
 $1 \times 10^{-11} \rightarrow$
 $1 \times 10^{-10} \rightarrow$
 $1 \times 10^{-12} \rightarrow$

5) Which of the following aqueous solutions has the lowest $[OH^-]$?

- A) a solution with a pH of 3.0 $[OH^-] = 1 \times 10^{-11}$
 B) pure water $[OH^-] = 1 \times 10^{-7}$
 C) a solution with a pOH of 12.0 $[1 \times 10^{-12}]$
 D) a 1×10^{-3} M solution of NH_4Cl NH_4 is weak acid of NH_3
 E) a 1×10^{-4} M solution of HNO_3 pH = 4
- $1 \times 10^{-11} \rightarrow$
 $1 \times 10^{-7} \rightarrow$
 $1 \times 10^{-12} \rightarrow$
 $< 1 \times 10^{-7} \rightarrow$
 $1 \times 10^{-10} \rightarrow$

6) A 0.0035 M aqueous solution of a particular compound has pH = 2.46. The compound is _____.

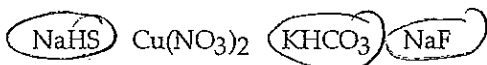
- A) a weak acid
 B) a strong acid
 C) a salt
 D) a strong base
 E) a weak base

$$[H^+] = 10^{-2.46}$$

$$= 0.0035$$

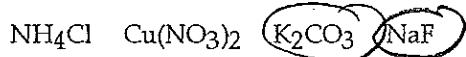
means the compound ionized 100% so its a strong acid

7) Of the following substances, an aqueous solution of _____ will form basic solutions.



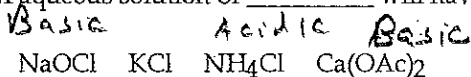
- A) NaF only
- B) NaF, KHCO₃
- C) KHCO₃, NaHS
- D) NaHS, Cu(NO₃)₂
- E) NaHS, KHCO₃ and NaF

8) Of the following substances, an aqueous solution of _____ will form basic solutions.



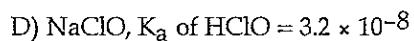
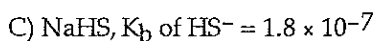
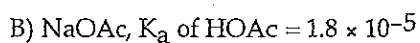
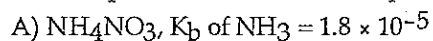
- A) K₂CO₃, NH₄Cl
- B) NH₄Cl only
- C) NH₄Cl, Cu(NO₃)₂
- D) NaF only
- E) NaF, K₂CO₃

9) A 0.1 M aqueous solution of _____ will have a pH of 7.0 at 25.0 °C.



- A) NaOCl
- B) KCl
- C) NH₄Cl
- D) Ca(OAc)₂
- E) KCl and NH₄Cl

10) Of the compounds below, a 0.1 M aqueous solution of _____ will have the highest pH.

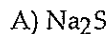


$$K_b = \frac{K_w}{K_a}$$

$$K_b = \frac{1.0 \times 10^{-14}}{4.0 \times 10^{-10}}$$

Largest K_b Value

11) A 0.1 M solution of _____ has a pH of 7.0.



11) A 0.1 M solution of _____ has a pH of 7.0.

- A) Na₂S
- B) NH₄Cl
- C) NaNO₃ - Both the cation (Na⁺) and the anion (NO₃⁻) are from a strong base and a strong acid respectively
- D) KF
- E) NaF

12) An aqueous solution of _____ will produce a basic solution.

- A) KBr - neutral
- B) Na₂SO₃ - SO₃ is a weak conj base
- C) NaHSO₄ - acidic
- D) NaCl - neutral
- E) NH₄ClO₄ - weak acid - very weak base ≈ neutral

$$K_w = K_a \cdot K_b$$

$$K_b = \frac{1.0 \times 10^{-14}}{7.0 \times 10^{-4}}$$

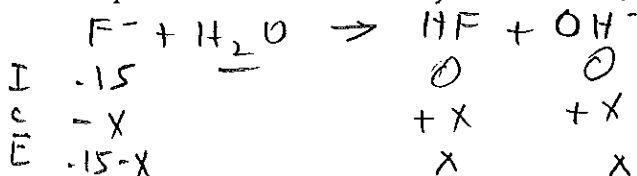
$$K_b = 1.43 \times 10^{-11}$$

13) Determine the pH of a 0.15 M aqueous solution of KF. For hydrofluoric acid, K_a = 7.0 × 10⁻⁴.

- A) 5.85
- B) 2.32
- C) 12.01
- D) 6.68
- E) 8.17

$$pH = 14 - 5.8$$

$$= 8.2$$



$$1.43 \times 10^{-11} = \frac{X^2}{.15 - X}$$

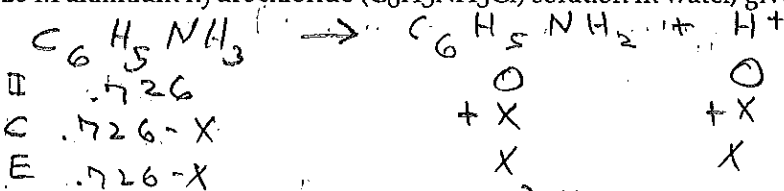
$$pOH = -\log [OH^-] = -\log [1.46 \times 10^{-6}] = 5.8$$

14) Calculate the pH of 0.726 M anilinium hydrochloride (C₆H₅NH₃Cl) solution in water, given that K_b for aniline is 3.83 × 10⁻⁴.

- A) 5.36
- B) 8.64
- C) 12.2
- D) 1.77
- E) 12.4

$$pH = -\log [H^+]$$

$$pH = -\log (4.35 \times 10^{-6}) = 5.36$$



$$K_a = \frac{K_w}{K_b} = \frac{1 \times 10^{-14}}{3.83 \times 10^{-4}} = 2.61 \times 10^{-11}$$

$$2.61 \times 10^{-11} = \frac{X^2}{.726}$$

$$X = 4.35 \times 10^{-6} = [H^+]$$

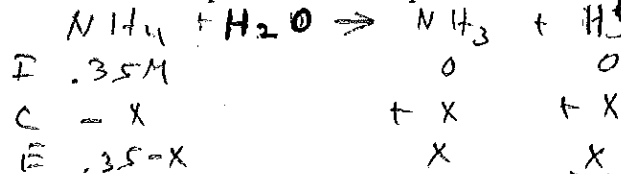
15) K_b for NH₃ is 1.8 × 10⁻⁵. What is the pH of a 0.35 M aqueous solution of NH₄Cl at 25.0°C?

- A) 4.86
- B) 9.76
- C) 11.23
- D) 4.35
- E) 9.11

$$pH = -\log [H^+]$$

$$pH = 4.86$$

$$X = 1.34 \times 10^{-5} = [H^+]$$

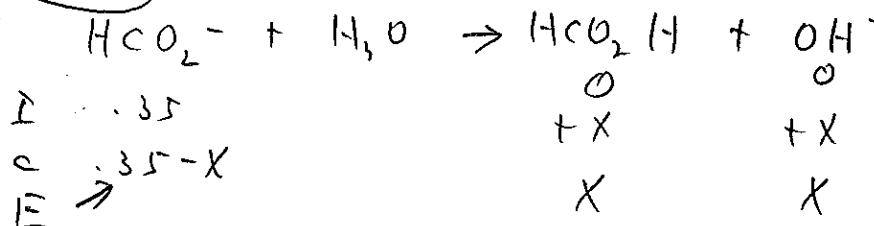


$$K_a = \frac{1 \times 10^{-14}}{1.8 \times 10^{-5}} = 5.6 \times 10^{-5}$$

$$K_a = \frac{[NH_3][H^+]}{[NH_4^+]} = \frac{X^2}{.35} = 5.6 \times 10^{-5}$$

16) The K_a for formic acid (HCO₂H) is 1.8 × 10⁻⁴. What is the pH of a 0.35 M aqueous solution of sodium formate (NaHCO₂)?

- A) 5.42
- B) 4.26
- C) 8.64
- D) 3.39
- E) 11.64



$$K_b = \frac{1.0 \times 10^{-14}}{1.8 \times 10^{-4}} = 5.6 \times 10^{-11}$$

$$K_b = 5.6 \times 10^{-11}$$

$$pOH = -\log [4.41 \times 10^{-6}]$$

$$5.56 \times 10^{-11} = \frac{X^2}{.35}$$

$$pOH = 5.36$$

$$pH = 14 - 5.36 = 8.64$$

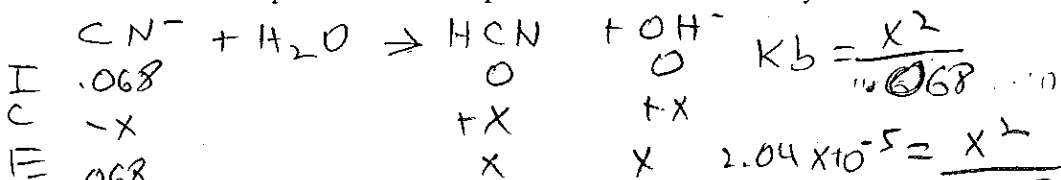
$$X = 4.41 \times 10^{-6} = [OH^-]$$

$$K_b = \frac{K_w}{K_a} = \frac{1.0 \times 10^{-14}}{4.9 \times 10^{-10}}$$

$$K_b = 2.04 \times 10^{-5}$$

17) K_a for HCN is 4.9×10^{-10} . What is the pH of a 0.068 M aqueous solution of sodium cyanide?

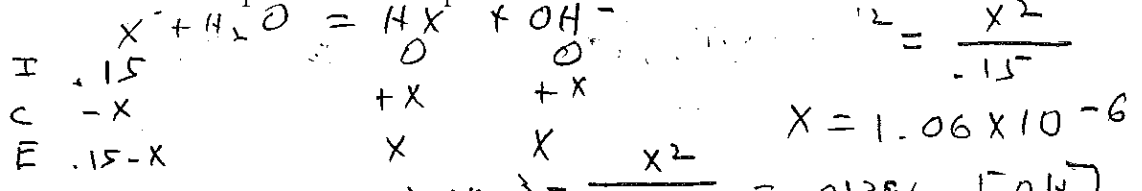
- A) 2.96
- B) 11.07**
- C) 0.74
- D) 13.24
- E) 7.00



$$\text{pH} = 14 - 2.93 = 11.07 \quad \text{pOH} = -\log [1.2 \times 10^{-3}] = 2.93 \quad X = 1.2 \times 10^{-3} = [\text{OH}^-]$$

18) K_a for HX is 7.5×10^{-12} . What is the pH of a 0.15 M aqueous solution of NaX?

- A) 8.04
- B) 7.97
- C) 1.96
- D) 6.00
- E) 12.10**



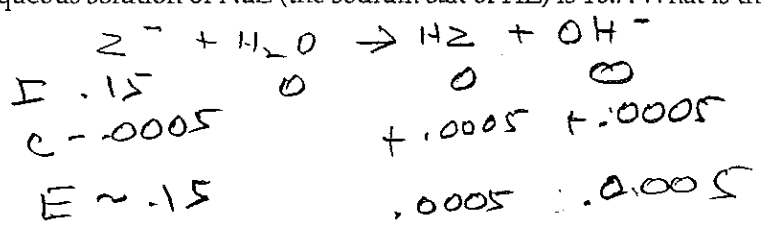
$$K_b = \frac{1.0 \times 10^{-14}}{7.5 \times 10^{-12}} = 1.33 \times 10^{-3}$$

$$\text{pH} = 14 - 1.85 = 12.15$$

$$1.3 \times 10^{-3} = \frac{X^2}{.15 - X} = .01396 = [\text{OH}^-]$$

19) The pH of a 0.15 M aqueous solution of NaZ (the sodium salt of HZ) is 10.7. What is the K_a for HZ?

- A) 3.3×10^{-8}
- B) 6.0×10^{-9}**
- C) 8.9×10^{-4}
- D) 1.3×10^{-12}
- E) 1.6×10^{-6}



$$\text{pOH} = 14 - 10.7 = 3.3$$

$$[\text{OH}^-] = 10^{-3.3} = 5 \times 10^{-4} = (.0005)$$

$$K_b = \frac{(.0005)^2}{.15} = 1.67 \times 10^{-6}$$

$$K_a = \frac{1.0 \times 10^{-14}}{1.67 \times 10^{-6}}$$

$$K_a = 6.0 \times 10^{-9}$$

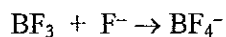
AP Chemistry 16.10 - 16.11

True/False

Indicate whether the statement is true or false. Mark A for True and B for False.

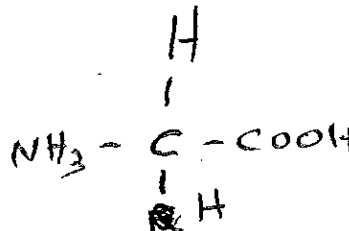
20. An acid containing the COOH group is called a carbo-oxy acid. **F**

21. In the reaction



BF_3 acts as a Brønsted-Lowry acid. **F**

22. The simplest amino acid is glycine. **T**



23. When the proton in the COOH group in an amino acid is transferred to the NH_2 group of that same amino acid molecule, a zwitterion is formed. **T**

24. A Lewis acid is an electron-pair acceptor, and a Lewis base is an electron-pair donor. **T**

Multiple Choice

Identify the choice that best completes the statement or answers the question.

25. Of the following, which is the strongest acid?

- a. HIO
- b. HIO₄**
- c. HIO₂
- d. HIO₃
- e. The acid strength of all of the above is the same.

26. Of the following, which is the weakest acid?

- a. HIO**
- b. HIO₄
- c. HIO₂
- d. HIO₃
- e. The acid strength of all of the above is the same.

27. Which of the following acids will be the strongest?

- a. H₂SO₄**
- b. HSO₄⁻
- c. H₂SO₃
- d. H₂SeO₄
- e. HSO₃⁻

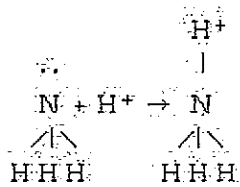
28. Of the following, which is the strongest acid?

- a. HClO
- b. HClO₃
- c. HClO₂
- d. HClO₄**
- e. HIO

Name: _____

ID: A

29. In the gas phase reaction below, NH_3 is acting as a(n) _____ base but not as a(n) _____ base.



- a. Arrhenius, Brønsted-Lowry
- b. Brønsted-Lowry, Lewis
- c. Lewis, Arrhenius
- d. Lewis, Brønsted-Lowry
- e. Arrhenius, Lewis