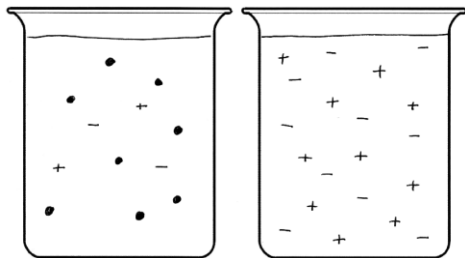


Acid Base Solutions**UNIT TEST – PRACTICE****Part 1 – Multiple Choice**

You should allocate 30 minutes to finish this portion of the test. No calculator should be used. A periodic table and data table will be provided. Select the answer that best responds to each question.

- Consider the equilibrium,
$$\text{HF(aq)} + \text{H}_2\text{O(l)} \rightleftharpoons \text{H}_3\text{O}^+(\text{aq}) + \text{F}^-(\text{aq}).$$
Which pair of substances makes up a conjugate acid-base pair?
(A) H_2O and F^-
(B) H_2O and H_3O^+
(C) H_3O^+ and F^-
(D) HF and H_2O
- A solution of $\text{NH}_3(\text{aq})$ and $\text{H}_2\text{O(l)}$ turns universal indicator blue (basic). In this situation, which of the following statements is true?
(A) H_2O is a base because it accepts a proton from NH_3 .
(B) H_2O is amphoteric because it both accepts and donates a proton.
(C) H_2O is an acid because it donates a proton to NH_3 .
(D) NH_3 is a base because it donates a proton to H_2O .
- Methylamine, CH_3NH_2 , is a weak base. When it reacts with water, the products include:
(A) CH_3NH
(B) CH_3NH_3^+
(C) H_3O^+
(D) NH_4^+
- A 10.0 mL sample of a 0.010 M HCl solution was obtained. What is the pH of the solution if 90.0 mL of water was added to the solution?
(A) 1.0
(B) 2.0
(C) 3.0
(D) 4.0
- At 0°C , $K_w = 0.1 \times 10^{-14}$. What is the pH of a glass of pure ice water at 0°C ?
(A) 8.0
(B) 7.5
(C) 7.0
(D) 6.5
- Milk of Magnesia, magnesium hydroxide, has low solubility in water and is used to neutralize excess stomach acid, hydrochloric acid. Which equation correctly represents the net reaction when milk of magnesia reaches the stomach?
(A) $\text{H}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{H}_2\text{O(l)}$
(B) $\text{Mg(OH)}_2(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow 2\text{H}_2\text{O(l)} + \text{MgCl}_2(\text{s})$
(C) $\text{Mg}^{2+}(\text{aq}) + 2\text{Cl}^-(\text{aq}) \rightarrow \text{MgCl}_2(\text{s})$
(D) $\text{Mg(OH)}_2(\text{s}) + 2\text{H}^+(\text{aq}) \rightarrow 2\text{H}_2\text{O(l)} + \text{Mg}^{2+}(\text{aq})$
- Which one of the following substances is *not* amphoteric/amphiprotic?
(A) H_2PO_3^-
(B) H_2O
(C) HCO_3^-
(D) NH_4^+

8. 0.200 M solutions with two different substances were prepared, and are represented by these particulate drawings:



The representation on the right best illustrates which of the following substances?

- (A) HF(aq)
 (B) NaOH(aq)
 (C) H₂S(aq)
 (D) NH₃(aq)
9. A 0.10 M sample of a weak base was placed in water. The pH of the solution was 11.0, when tested. What is the value of the K_b for the base?
 (A) 1.0×10^{-1}
 (B) 1.0×10^{-3}
 (C) 1.0×10^{-5}
 (D) 1.0×10^{-7}
10. How do the amounts of these species compare when solid NaNO₂ is added to water? K_a of HNO₂ = 4.0×10^{-4} .
 (A) $H^+ < HNO_2 < OH^- < NO_2^- < Na^+$
 (B) $H^+ < HNO_2 = OH^- < NO_2^- < Na^+$
 (C) $HNO_2 < H^+ < OH^- < NO_2^- = Na^+$
 (D) $HNO_2 < H^+ = OH^- < NO_2^- = Na^+$
11. Suppose we have a 0.10 M HF solution. Which of the following, when added, would result in the lowest [F⁻]?
 (A) Nothing else added
 (B) 0.0010 mol HCl
 (C) 0.0010 mol KF
 (D) 0.0010 mol KOH

12. 0.100 M of which of the following would have the lowest pH?

- (A) Chloroacetic acid, K_a = 1.4×10^{-3}
 (B) 3-chlorobenzoic acid, K_a = 1.5×10^{-4}
 (C) Benzoic acid, K_a = 6.5×10^{-5}
 (D) Ascorbic acid, K_a = 8.0×10^{-5}

13. Of the following salts, which one forms a 0.1 M solution with the lowest pH?

- (A) KBr
 (B) KC₂H₃O₂
 (C) NaNO₂
 (D) NH₄Cl

14. Carbonic acid, H₂CO₃, is a diprotic acid. Which equation correctly shows the dissociation of carbonic acid's second proton?

- (A) $H_2CO_3(aq) \rightleftharpoons 2H^+(aq) + CO_3^{2-}(aq)$
 (B) $H_2CO_3(aq) \rightleftharpoons H_2O(g) + CO_2(g)$
 (C) $HCO_3^-(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + CO_3^{2-}(aq)$
 (D) $HCO_3^-(aq) + H_2O(l) \rightleftharpoons H_2CO_3(aq) + OH^-(aq)$

15. Consider the following acids:



When listed from weakest to strongest, the order would be:

- (A) $HClO_3 < HClO_4 < HIO_2 < HIO_3$
 (B) $HClO_4 < HClO_3 < HIO_3 < HIO_2$
 (C) $HIO_2 < HClO_3 < HIO_3 < HClO_4$
 (D) $HIO_2 < HIO_3 < HClO_3 < HClO_4$

Part 2 – Free Response

You should allocate 30 minutes to finish this portion of the test. You may use a scientific calculator. A periodic table and data table will be provided. Respond to each part of the questions completely. Be sure to show your work clearly for questions that involve calculations.

16. Methylamine, CH_3NH_2 , is a weak base, and has a base ionization constant, K_b , of 4.17×10^{-4} at 25°C
- Consider the ionization of methylamine when dissolved in water.
 - Write the chemical equation for this process.
 - Identify a Brønsted-Lowry conjugate acid-base pair in this reaction.
 - A sample of methylamine has a pH of 12.26. What is the molar concentration of methylamine in this sample?
 - 0.100 mol KOH was added to 1.00 L of a 0.200 M CH_3NH_2 solution. What is the pH of this solution?
 - 50.00 g of methylammonium chloride, $\text{CH}_3\text{NH}_3\text{Cl}$, was dissolved in water to prepare a 150.0 mL solution.
 - Write the net ionic equation for this process.
 - Find the value of the acid ionization constant, K_a , of the methylammonium ion, CH_3NH_3^+ .
 - Calculate the pH of this solution.

17. Consider the following acids:

Acetic acid CH ₃ COOH	Chloroacetic acid CH ₂ ClCOOH	Dichloroacetic acid CHCl ₂ COOH	Trichloroacetic acid CCl ₃ COOH
$ \begin{array}{c} \text{H} \quad \text{O} \\ \quad // \\ \text{H}-\text{C}-\text{C} \\ \quad \backslash \\ \text{H} \quad \text{O}-\text{H} \end{array} $	$ \begin{array}{c} \text{:Cl:} \quad \text{O} \\ \quad // \\ \text{H}-\text{C}-\text{C} \\ \quad \backslash \\ \text{H} \quad \text{O}-\text{H} \end{array} $	$ \begin{array}{c} \text{:Cl:} \quad \text{O} \\ \quad // \\ \text{:Cl}-\text{C}-\text{C} \\ \quad \backslash \\ \text{H} \quad \text{O}-\text{H} \end{array} $	$ \begin{array}{c} \text{:Cl:} \quad \text{O} \\ \quad // \\ \text{:Cl}-\text{C}-\text{C} \\ \quad \backslash \\ \text{:Cl:} \quad \text{O}-\text{H} \end{array} $
pK _a = 4.76	pK _a = 2.86	pK _a = 1.35	pK _a = 0.66

- Which is the strongest among the four acids? Justify your answer quantitatively.

- Provide a reason using the molecular structure to explain why the acid in part a. is the strongest.

- Consider the salts NaCH₃COO and NaCCl₃COO. If 0.100 mol of each were used to make a 1.00 L solution, which would have the lower pH? Explain.