

NONE OF THE MULTIPLE CHOICE PROBLEMS REQUIRES EXTENSIVE OR TIME CONSUMING CALCULATIONS. IF YOUR METHOD REQUIRES EXTENSIVE CALCULATIONS IT IS EITHER WRONG OR HARDER THAN WHAT IS REQUIRED.

1. The pH of a nitric acid, HNO_3 , solution is 1.43. What is the concentration of the nitrate ion?
(a) $7.24 \times 10^{-12} \text{ M}$ (b) $1.38 \times 10^{-3} \text{ M}$ (c) $2.69 \times 10^{-13} \text{ M}$ (d) $3.72 \times 10^{-2} \text{ M}$ (e) none of the above
2. Calculate the pH of a 0.005 M aqueous barium hydroxide solution, $\text{Ba}(\text{OH})_2$. Careful.
(a) 2.30 (b) 11.70 (c) 2.00 (d) 12.00 (e) 8.70
3. A solution consists of 0.080 M HCl, 0.055 M HBr, and 0.045 M HCN. What is the pH?
(a) 0.23 (b) 0.87 (c) 1.10 (d) 1.26 (e) Insufficient information
4. What is the pH of a solution formed by mixing 70. mL of 0.25 M HClO_4 (perchloric acid) and 140 mL of 0.15 M NaOH?
(a) 2.46 (b) 11.54 (c) 12.22 (d) 12.40 (e) 1.78
5. A 0.142 M aqueous solution of a weak acid, HB, has a pH of 1.50. Calculate K_a , the acid-dissociation constant.
(a) $7.2 \times 10^{-3} \text{ M}$ (b) $7.0 \times 10^{-3} \text{ M}$ (c) 0.22 M (d) $1.0 \times 10^{-3} \text{ M}$ (e) none of the above

11. Which of the following weak acids or bases is best suited to prepare a buffer whose pH is 8.50?
- (a) $\text{C}_6\text{H}_5\text{OH}$: $\text{pK}_a = 10$
 - (b) ClCH_2COOH : $\text{pK}_a = 2.87$
 - (c) HNO_2 : $\text{pK}_a = 3.35$
 - (d) NH_3 : $\text{pK}_b = 4.76$; $\text{pK}_a = ?$
 - (e) HCN : $K_a = 4.79 \times 10^{-10} \text{ M}$; $\text{pK}_a = ?$
12. A buffer with a pH = 3.35 is prepared using formic acid, HCOOH , and its conjugate base, HCOO^- ($\text{pK}_a = 3.75$). If the conjugate base concentration is 0.20 M, what is the approximate acid concentration?
- (a) 0.5 M
 - (b) 0.4 M
 - (c) 0.08 M
 - (d) 0.8 M
 - (e) 1 M
13. What volume of 0.08 M $\text{Ba}(\text{OH})_2$ completely neutralizes 35 mL 0.30 M HNO_3 ? Answers are for 1 sig. fig.
- (a) $4 \times 10 \text{ mL}$
 - (b) $5 \times 10 \text{ mL}$
 - (c) $7 \times 10 \text{ mL}$
 - (d) $9 \times 10 \text{ mL}$
 - (e) $1 \times 10^2 \text{ mL}$

14. For the reaction $2A(s) + B(g) \rightleftharpoons 2C(g) + D(g)$, $K = 1.5$ (*concentration units omitted*). 65 seconds into the reaction, there is some A, 0.40 moles B, 0.70 moles C, and 3.0 moles D in a 2.0 L container. What is the magnitude of Q and in which direction does the reaction go to reach equilibrium?
- (a) 3.7 and to the left
 - (b) 3.7 and to the right
 - (c) 2.6 and to the right
 - (d) 0.92 and to the left
 - (e) 0.92 and to the right
15. What is the pH of a 10^{-9} M NaOH?
- (a) 5
 - (b) 9
 - (c) slightly less than 7
 - (d) exactly 7
 - (e) slightly greater than 7
16. For reasonable concentrations, which pair of ions would produce a precipitate in a solution containing these ions?
- (a) Ti^{2+} , Cl^-
 - (b) Ti^{4+} , Cl^-
 - (c) Ni^{2+} , I^-
 - (d) Ni^{2+} , S^{2-}
 - (e) NH_4^+ , S^{2-}

Chem 126 Common 2 Spring March 11, 2011

I 100. mL of 0.40 M formic acid, HCOOH, are titrated with 0.60 M NaOH. K_a is 1.78×10^{-4} M.

(a) The pH of the formic acid solution after 20. mL of the NaOH solution are added will be calculated?

(1 PT) Calculate the initial mmol of formic acid. _____

(1 PT) Calculate the mmol of NaOH added. _____

(2 PTS) Write the appropriate reaction and ICE table

Reaction: _____

Initial: _____

Change: _____

Equilibrium: _____

(1 PTS) pH _____

(b) (3 PTS) At the midpoint, what is the pH? _____

(c) What is the pH after 90 ml of the NaOH solution are added?

(2 PTS) Write the appropriate reaction and ICE table

Reaction: _____

Initial: _____

Change: _____

Equilibrium: _____

(2 PTS) pH _____

II. The K_{sp} of $M(OH)_3$ is 9.0×10^{-18} at 25°C where M^{3+} is a hypothetical non-acidic metal ion.

(a) **4PTS** What is the solubility of $M(OH)_3$ in pure water at 25°C in mol/L? Write the reaction and make an ICE Table.

Reaction: _____

Initial: _____

Change: _____

Equilibrium: _____

(b) **4PTS** What is the solubility of $M(OH)_3$ in $0.60\text{ M }MCl_3$ at 25°C in mol/L? Write the reaction and make an ICE Table.

Reaction: _____

Initial: _____

Change: _____

Equilibrium: _____

(c) **4PTS** What is the solubility of $M(OH)_3$ in a solution buffered to a pH of 9.00 at 25°C ? Write the reaction and make an ICE Table.

Reaction: _____

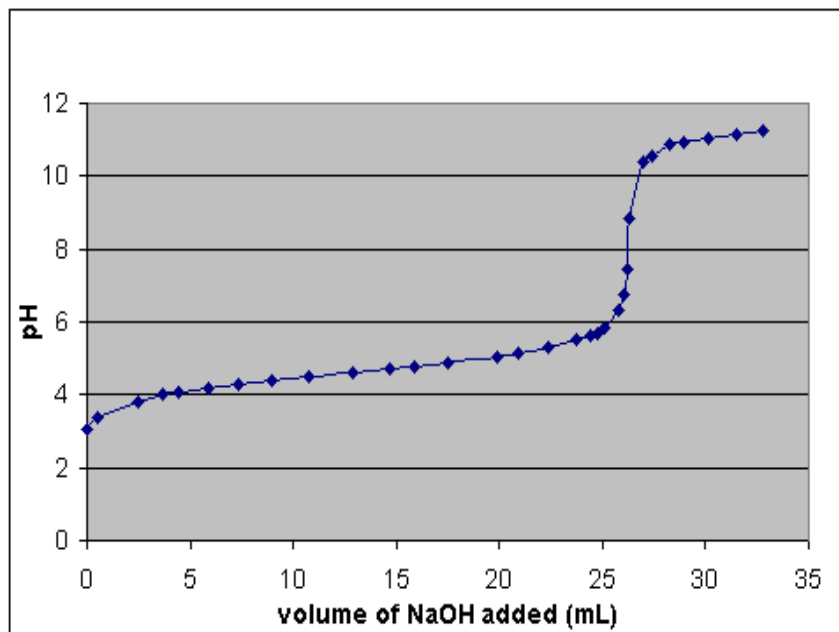
Initial: _____

Change: _____

Equilibrium: _____

III. The following questions are independent. So, you don't have to get the previous question right to answer the next one.

(a) **3PTS** The graph to the right shows the titration of a weak acid with a strong base. What is the approximate value of K_a for this acid?



(b) **4PTS** 10 mL of 1M HNO_3 is added to 40 mL of 0.25 M ammonia, NH_3 . What is the approximate equilibrium concentration of each of the following ions? For example, $5.4 \times 10^{-6} \approx 0$ or $3.6629 \times 10^{-2} \approx 4 \times 10^{-2}$.

$[\text{NO}_3^-] =$ _____

$[\text{H}^+] =$ _____

$[\text{NH}_3] =$ _____

$[\text{NH}_4^+] =$ _____

(c) **5PTS** Calculate the pH of 0.40 M NH_4Cl . Include the appropriate reaction and ICE table. K_b (for NH_3 !!!) is 1.8×10^{-5} .

Reaction: _____

Initial: _____

Change: _____

Equilibrium: _____

pH. _____