# CH 302 Worksheet 9

*For all of the problems on this worksheet, use the following K values:*

*$H_3PO_4$:* $pKa_1 = 2$ $pKa_2 = 6$ $pKa_3 = 10$

*$H_2CO_3$ :* $pKa_1 = 4$ $pKa_2 = 10$

**1.** You drop 0.1 mol of KOH into 1 L of water. What is the pH of solution?

**2.** You drop 0.1 mol of KOH into a 1 L solution of 1 M $H_3PO_4$ and $KH_2PO_4$. What is the pH of the solution?

**3.** You drop 0.1 mol of NaOH into a 1 L solution of 0.5 M $RbHCO_3$ and 0.5 M $Na_2CO_3$. What is the pH of the solution?

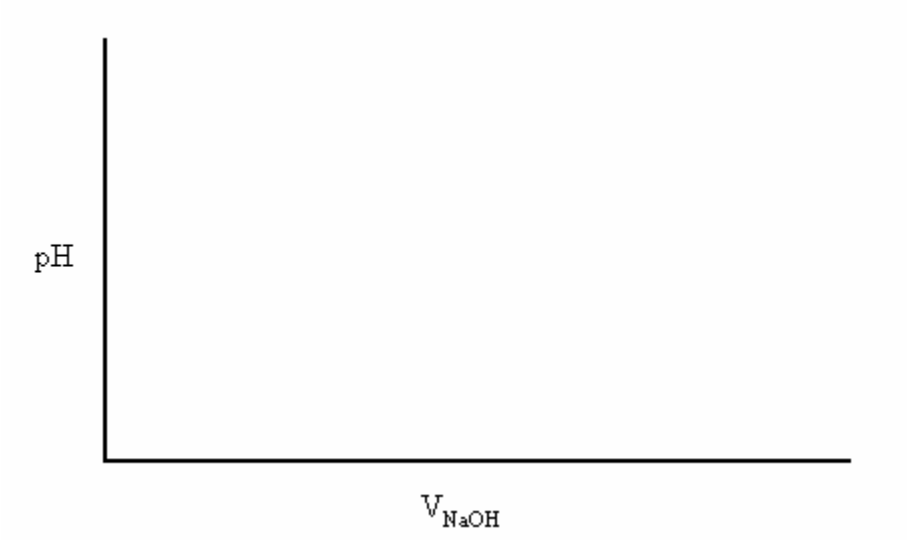
**4.** You drop 0.5 mol of NaOH into a 1 L solution of 0.5 M $RbHCO_3$ and 0.5 M $Na_2CO_3$. What is the pH of the solution?

**5.** You drop 1.0 mol of NaOH into a 1 L solution of 0.5 M $RbHCO_3$ and 0.5 M $Na_2CO_3$. What is the pH of the solution?

**For questions 6-13, 1.5 L 0.1 M $H_3PO_4$ is titrated with 1 M NaOH. Give the pH for the given amount of NaOH solution added to the $H_3PO_4$ solution.**

| | $V_{NaOH}$ | pH |
|---|---|---|
| **6.** | 0 mL | |
| **7.** | 50 mL | |
| **8.** | 150 mL | |
| **9.** | 250 mL | |
| **10.** | 300 mL | |
| **11.** | 400 mL | |
| **12.** | 450 mL | |
| **13.** | 500 mL | |

**14.** Sketch the titration curve for a triprotic acid such as $H_3PO_4$ and label the important areas including the end points and the places where pH = pK.




**15** Place the numbers 6 through 13 on the curve indicating the area of the titration curve corresponding to the calculation.

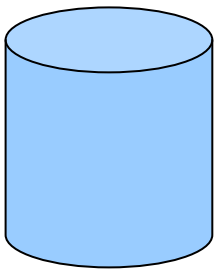
The 11 questions below represent the important areas of a triprotic acid titration curve. For each mixture, explain where you are on the curve after neutralization, provide the equation you would use for the calculation, and estimate the correct pH for the given mixture. DON'T USE A CALCULATOR. To guide you, draw the equilibrium species essential to determining the pH in the beaker provided (AFTER NEUTRALIZATION.) Hints: Assume there are no $K_w$ contribution in the calculations use these numbers a lot: *Phosphoric acid values: $pKa_1 = 2$ $pKa_2 = 6$ $pKa_3 = 10$*

**16. 1M HCl and 1 M $H_3PO_4$**

Where are you on a titration curve? _____

Equation used to determine the pH. _____

Estimated pH. _____

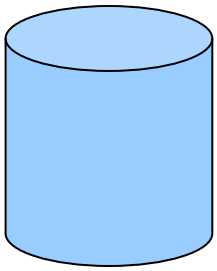


**17. 1 M $H_3PO4$**

Where are you on a titration curve? _____

Equation used to determine the pH. _____

Estimated pH. _____

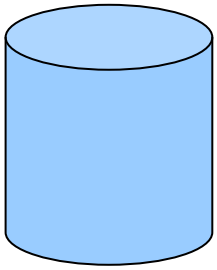


**18. 1M $H_3PO4$ and 1 M $NaH_2PO_4$**

Where are you on a titration curve? _____

Equation used to determine the pH. _____

Estimated pH. _____

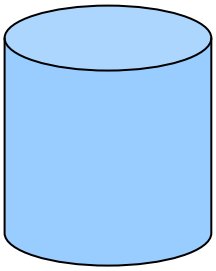


**19. 1M $H_3PO4$, 1 M $NaH_2PO_4$ and .002M NaOH**

Where are you on a titration curve? _____

Equation used to determine the pH. _____

Estimated pH. _____

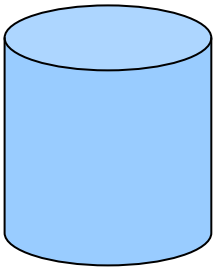


**20. 1 M $NaH_2PO_4$**

Where are you on a titration curve? _____

Equation used to determine the pH. _____

Estimated pH. _____

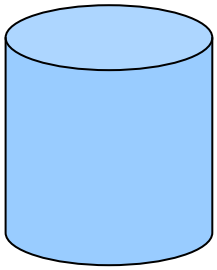


**21. 1 M $NaH_2PO_4$ and 1M $Li_2HPO_4$**

Where are you on a titration curve? _____

Equation used to determine the pH. _____

Estimated pH. _____

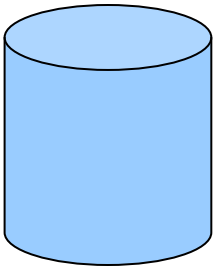


**22. 1 M $NaH_2PO_4$, $Li_2HPO_4$ and 0.002 HCl**

Where are you on a titration curve? _____

Equation used to determine the pH. _____

Estimated pH. _____

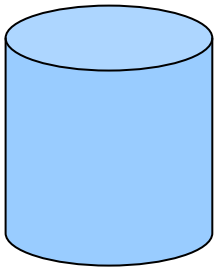


**23. 1M $Li_2HPO_4$**

Where are you on a titration curve? _____

Equation used to determine the pH. _____

Estimated pH. _____

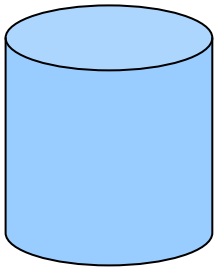


**24. 1M $Li_2HPO_4$ and 1M $NaLiRbPO_4$**

Where are you on a titration curve? _____

Equation used to determine the pH. _____

Estimated pH. _____

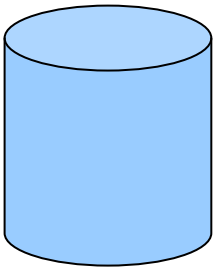


**25. 1M $Li_2HPO_4$ and 1M $NaLiRbPO_4$ and .002M NaOH**

Where are you on a titration curve? _____

Equation used to determine the pH. _____

Estimated pH. _____

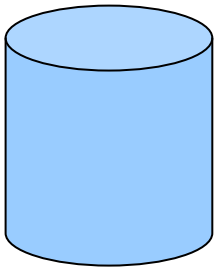


**26. 1M $NaLiRbPO_4$**

Where are you on a titration curve? _____

Equation used to determine the pH. _____

Estimated pH. _____



**27. 1M $NaLiRbPO_4$ and 1M NaOH**

Where are you on a titration curve? _____

Equation used to determine the pH. _____

Estimated pH. _____