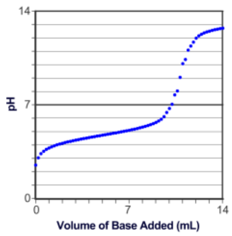
South Pasadena • AP Chemistry

Name ______________________________________
Period ___ Date ___/___/___

# 18 • Acids, Bases, & Buffers

## STATION 1: INITIAL pH




In this Review, we will walk ourselves through the calculations needed to sketch the Titration Curve for a weak acid titrated with a strong base.

Acetic acid, is often abbreviated as HAc.. $K_a$ acetic acid = $1.8x10^{-5}$
SHOW YOUR WORK FOR EACH STEP.

What is the pH of a 0.15 M solution of HAc?

Plot this point on your Titration Curve (Station 9).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## STATION 2: VM = VM

The acid is titrated with a 0.10 M solution of KOH.
Calculate the volume of base needed to neutralize a 10. mL sample of the 0.15 M HAc.

Note that this is the volume of base at the equivalence point on your titration curve.

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## STATION 3: EQUIVALENCE POINT CHEMICALS

a) Write the balanced **net** equation for the neutralization of HAc by KOH:

b) What chemicals are in the flask at the endpoint (equivalence point) of this titration?

c) How many moles of HAc are in the 10. mL of 0.15 M HAc that you used for the titration?

d) How many ***moles*** of $Ac^-$ are in the flask at the equivalence point?

e) What is the total volume of solution (in Liters) at the equivalence point?

f) What is the ***concentration*** of $Ac^-$ at the equivalence point? $[Ac^-]$ =

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## STATION 4: pH AT EQUIVALENCE POINT

Calculate the pH of a solution with the $[Ac^-]$ from Station 3. $K_a$ of HAc = $1.8 \times 10^{-5}$

Plot the pH at the equivalence point on your titration curve using the info from Stations 2 and 4.

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## STATION 5: HALF-WAY TO EQUIVALENCE POINT

a) What volume of base is half-way to the equivalence point? _____ mL

b) What do you know about the pH half-way to the equivalence point? pH = _____

c) What is the pH half-way to the equivalence point? ________

d) Plot this third point on your titration curve (Station 9).

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## STATION 6: BEFORE HALF-WAY

When 6.5 mL of KOH has been added to the solution:

a) How many moles of HAc are in 10. mL of 0.15 M HAc?

b) How many moles of OH- are in 6.5 mL of 0.10 M KOH?

c) What is the total volume (in Liters)?

d) Fill in this NEUTRALLIZATION chart using Molarities

| HAc | + $OH^-$ | → $H_2O(l)$ | + $Ac^-$ |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

e) Fill in this EQUILIBRIUM chart:

| HAc | + $H_2O(l)$ | ⇆ $H_3O^+$ | + $Ac^-$ |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

f) Write the equilibrium expression for HAc.
Substitute the equilibrium values into the expression and compute the $[H_3O^+]$ concentration and pH.

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## STATION 7: AFTER HALF-WAY

When 8.5 mL of KOH has been added to the solution:

a) How many moles of HAc are in 10. mL of 0.15 M HAc?

b) How many moles of OH- are in 8.5 mL of 0.10 M KOH?

c) What is the total volume (in Liters)?

d) Fill in this NEUTRALIZATION chart using Molarities

| HAc | + $OH^-$ | → $H_2O(l)$ | + $Ac^-$ |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

e) Fill in this EQUILIBRIUM chart:

| HAc | + $H_2O(l)$ | ⇆ $H_3O^+$ | + $Ac^-$ |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

f) Write the equilibrium expression for HAc.
Substitute the equilibrium values into the expression and compute the $[H_3O^+]$ concentration and pH.

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## STATION 8: AFTER THE EQUIVALENCE POINT

When 20. mL of KOH have been added to the solution:

a) How many moles of HAc are in 10. mL of 0.15 M HAc?

b) How many moles of $OH^-$ are in 20. mL of 0.10 M KOH?

c) How many moles of excess $OH^-$ are in solution?

d) What is the total volume (in Liters)?

e) What is the concentration of OH-, the pOH, and the pH of the solution?

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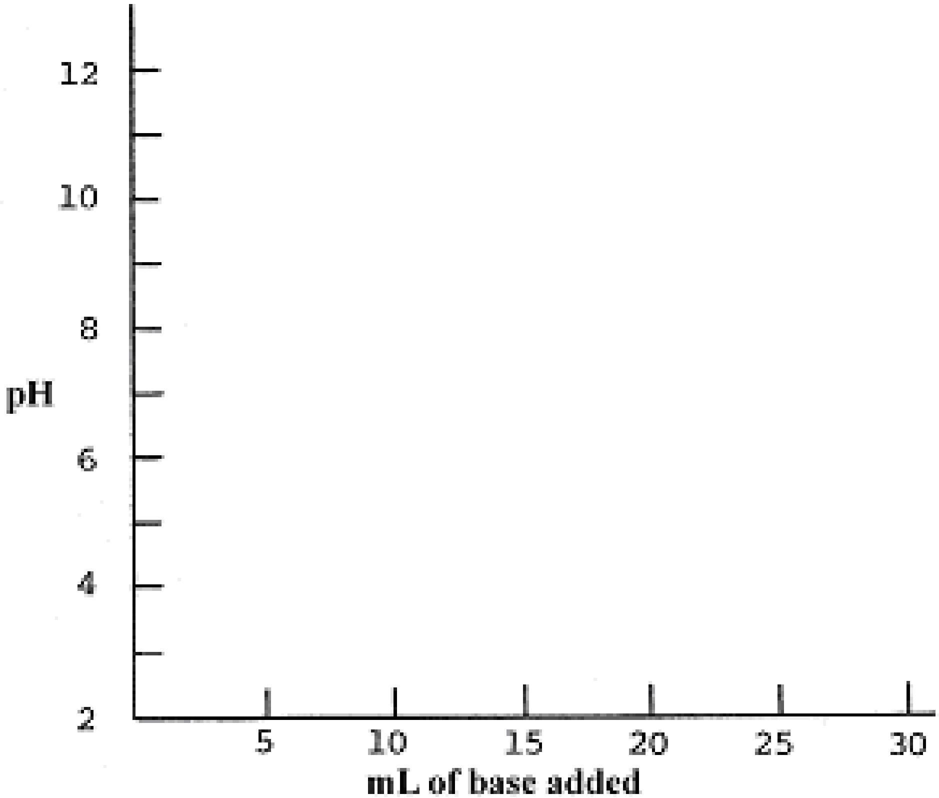
## STATION 9: SKETCH THE TITRATION CURVE




FYI: Formulas from the AP Exam:

**EQUILIBRIUM**

$$K_a = \frac{[H^+][A^-]}{[HA]}$$

$$K_b = \frac{[OH^-][HB^+]}{[B]}$$

$$K_w = [OH^-][H^+] = 1.0 \times 10^{-14} \quad @ \; 25^\circ C$$

$$= K_a \times K_b$$

$$pH = -\log[H^+], \; pOH = -\log[OH^-]$$

$$14 = pH + pOH$$

$$pH = pK_a + \log\frac{[A^-]}{[HA]}$$

$$pOH = pK_b + \log\frac{[HB^+]}{[B]}$$

$$pK_a = -\log K_a, \; pK_b = -\log K_b$$

$$K_p = K_c(RT)^{\Delta n},$$

where $\Delta n$ = moles product gas − moles reactant gas