Chemistry 12
Lab 20H Titration Curves

NAME _____

Partner's _____

DATE _____ BLOCK _____

Pre-Lab Questions:

1. Define the following "points". . . .

   (A) stoichiometric or equivalence point

   _____

   _____

   (B) end point

   _____

   _____

2. The pH meter must be internally compensated for temperature because the pH of neutral water decreases as the temperature increases. Explain the reason for this occurance.

   _____

   _____

   _____

3. In relation to a neutral pH of 7, what would be the pH at the equivalence point when nitrous acid is titrated with sodium hydroxide? Explain your answer.

   _____

   _____

   _____

4. In a titration between 0.20 M nitric acid and 0.10 M potassium hydroxide,

   (A) what would be the starting pH of the system before any base has been added?

   (B) what would be the approximate pH of the system after a large volume of base has been added?

   (C) If 40 mL of acid is needed for neutralization, how many mL of base would be added?

Titration of a Strong Acid with a Strong Base. . . .

Rinse a 25 mL volumetric pipet with some 0.100 M HCl and then discard the acid. VERY CAREFULLY, transfer exactly 25.00 mL of the 0.100 M HCl into a clean 100 mL beaker.

Add a few drops of phenolphthalein to the beaker.

Place the beaker on top of a magnetic stirrer and place a stirring bar into the solution.

THE EQUIPMENT YOU WILL BE USING IS WORTH $800.00 ! ! ! PLEASE BE CAREFULL. . . .

Place the sensor electrode of the pH meter into the solution, being careful that the stirring bar does NOT strike the electrode tip. Secure the electrode using utility clamps and a utility stand. In the same manner, secure the temperature probe into the solution.

Rinse a 50 mL burete with some 0.100 M NaOH and then discard the base. Fill the burete to above the "0.00" line and then allow base to flow through the burete until the liquid level is exactly at the 0.00 line.

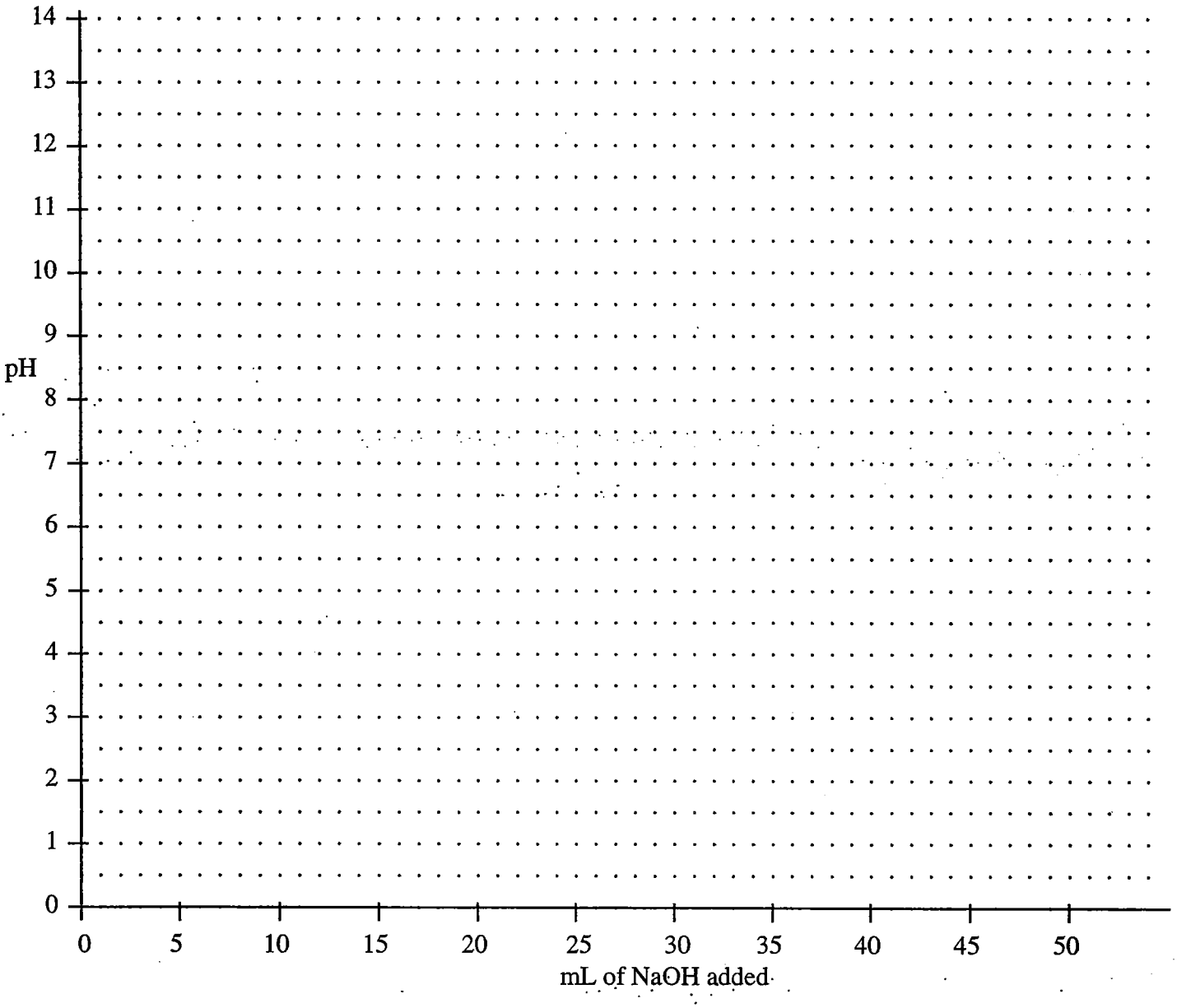
Secure the burete above the acid beaker with a burete clamp.

You are now ready to begin the titration.

Complete the following chart as you perform the titration. The volumes listed in the left column are suggestions - in the middle column write down the volumes that you actually used - try to be as close as possible to the suggested volumes.

Suggested Volume of NaOH added	**Actual** Volume of NaOH added	pH of solution	**Suggested** Volume of NaOH added	**Actual** Volume of NaOH added	pH of solution
0.00 mL	_____	_____	25.05	_____	_____
5.00	_____	_____	25.10	_____	_____
10.00	_____	_____	25.20	_____	_____
15.00	_____	_____	25.50	_____	_____
20.00	_____	_____	26.00	_____	_____
22.00	_____	_____	28.00	_____	_____
24.00	_____	_____	30.00	_____	_____
24.50	_____	_____	35.00	_____	_____
24.80	_____	_____	40.00	_____	_____
24.90	_____	_____	45.00	_____	_____
25.00	_____	_____	50.00	_____	_____
25.01	_____	_____			

Chemistry 12 AP - Titration Curve of ~0.20 M HCl with ~0.25 M NaOH . . .



Use a pencil to draw the best smooth line through the majority of your data points. Do NOT try to connect the data points "dot-to-dot". Think "university" quality for this graph, eh?
CUT YOUR TITRATION CURVE OUT **NEATLY** FOR INSERTION IN YOUR LAB BOOK

On your graph, label. . .

(A) the stoichiometric point by drawing a vertical dotted line through the graph at the steepest point on the titration curve. Or, try measuring the half-way point in the section of the curve which is nearly vertical.
(B) the pH range in which phenolphthalein would change color from colorless to pink (Look it up in your Provincial Data Sheet)
(C) Knowing that this was a strong acid (HCl), what is the beginning pH expected from the given molarity of the acid?
(D) Knowing that the base used was NaOH, what is the final pH expected from the given molarity of the base?
(E) In terms of the balanced equation for this acid / base neutralization, why is the stoichiometric pH expected to be 7?

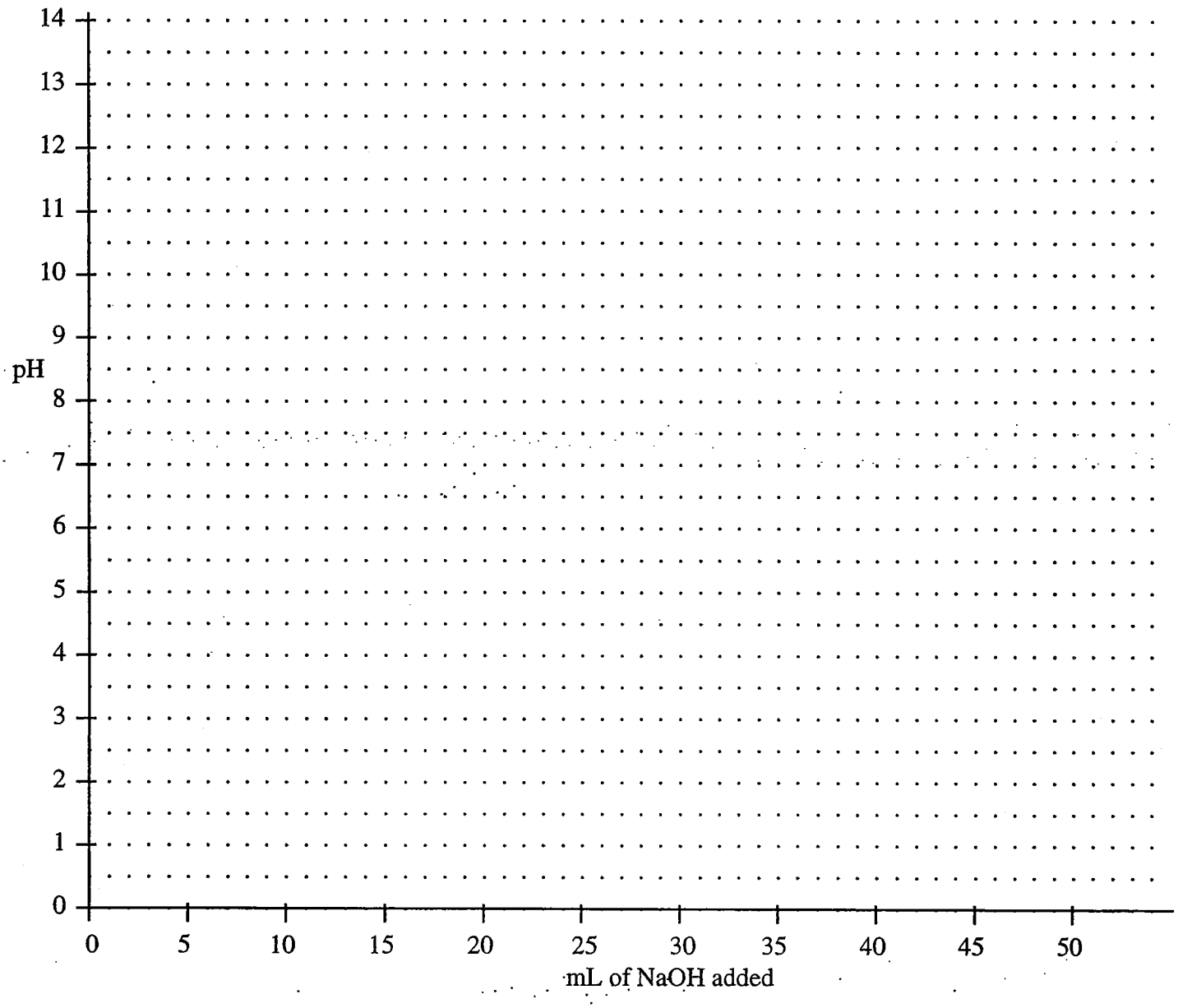
Titration of an Unknown 0.100 M WEAK acid with 0.100 M NaOH. . .

Repeat the steps used to perform the titration of strong acid with NaOH with the 0.100 M unknown weak acid.

Complete the following data table and then plot your results on the following page.

Suggested Volume of NaOH added	**Actual** Volume of NaOH added	pH of solution	**Suggested** Volume of NaOH added	**Actual** Volume of NaOH added	pH of solution
0.00 mL	_____	_____	24.90	_____	_____
1.00	_____	_____	25.00	_____	_____
2.00	_____	_____	25.01	_____	_____
3.00	_____	_____	25.05	_____	_____
5.00	_____	_____	25.10	_____	_____
7.00	_____	_____	25.20	_____	_____
10.00	_____	_____	25.50	_____	_____
15.00	_____	_____	26.00	_____	_____
20.00	_____	_____	28.00	_____	_____
22.00	_____	_____	30.00	_____	_____
24.00	_____	_____	35.00	_____	_____
24.50	_____	_____	40.00	_____	_____
24.80	_____	_____	45.00	_____	_____
			50.00	_____	_____

Chemistry 12 AP - Titration Curve of ~0.20 M unknown weak acid with ~0.25 M NaOH . . .



Use a pencil to draw the best smooth line through the majority of your data points. Do NOT try to connect the data points "dot-to-dot". Think "university" quality for this graph, eh? CUT YOUR TITRATION CURVE OUT **NEATLY** FOR INSERTION IN YOUR LAB BOOK

On your graph, label. . .

(A) the stoichiometric point.

(B) Draw a vertical dotted line up from the point on your graph where exactly half the volume of NaOH used to reach the stoichiometric point is attained. When this vertical line intersects the titration curve, draw a horizontal dotted line over to the pH axis.

What pH did you obtain from this "half-way" point?
What is the k_a of your unknown acid?
Can you identify the unknown acid from your k_a value?

(C) If the [acid] for both of your titrations was ~ 0.20 M, why was there such a big difference in starting pH?

(D) Why was the final pH the same for both titration curves (or should have been)?

(E) In terms of the balanced equation for this acid / base neutralization, why is the stoichiometric pH expected to be above 7?

Questions. . .

1. List four major differences between the titration curves of the weak acid with NaOH compared to the curve found when a strong acid is used.

   (A) _____

   (B) _____

   (C) _____

   (D) _____

2. If the unknown acid molarity and the strong acid (HCl) were both 0.100 M, why is the starting point for the weak acid higher than for the HCl?

   _____

   _____

3. Knowing the starting pH and the molarity of the weak acid, calculate the K_a for this weak acid.

4. STUDY Hebden pages 168 - 170 and calculate the K_a of the weak acid using the $\mathbf{pH_{1/2}}$ calculation.

5. Using your K_a chart, identify the unknown weak acid. _____