

2012 AP[®] CHEMISTRY FREE-RESPONSE QUESTIONS**CHEMISTRY****Section II****(Total time—95 minutes)****Part A****Time—55 minutes****YOU MAY USE YOUR CALCULATOR FOR PART A.**

CLEARLY SHOW THE METHOD USED AND THE STEPS INVOLVED IN ARRIVING AT YOUR ANSWERS. It is to your advantage to do this, since you may obtain partial credit if you do and you will receive little or no credit if you do not. Attention should be paid to significant figures. Be sure to write all your answers to the questions on the lined pages following each question in this booklet.

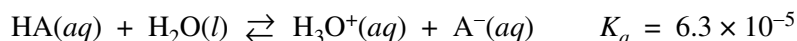
Answer Questions 1, 2, and 3. The Section II score weighting for each question is 20 percent.

1. A 1.22 g sample of a pure monoprotic acid, HA, was dissolved in distilled water. The HA solution was then titrated with 0.250 M NaOH. The pH was measured throughout the titration, and the equivalence point was reached when 40.0 mL of the NaOH solution had been added. The data from the titration are recorded in the table below.

Volume of 0.250 M NaOH Added (mL)	pH of Titrated Solution
0.00	?
10.0	3.72
20.0	4.20
30.0	?
40.0	8.62
50.0	12.40

- (a) Explain how the data in the table above provide evidence that HA is a weak acid rather than a strong acid.
- (b) Write the balanced net-ionic equation for the reaction that occurs when the solution of NaOH is added to the solution of HA.
- (c) Calculate the number of moles of HA that were titrated.
- (d) Calculate the molar mass of HA.

The equation for the dissociation reaction of HA in water is shown below.



- (e) Assume that the initial concentration of the HA solution (before any NaOH solution was added) is 0.200 M. Determine the pH of the initial HA solution.
- (f) Calculate the value of $[\text{H}_3\text{O}^+]$ in the solution after 30.0 mL of NaOH solution is added and the total volume of the solution is 80.0 mL.