CHEMISTRY
Section II
(Total time—90 minutes)

Part A
Time—40 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 the goldenrod booklet. Do NOT write your answers on the lavender insert.

Answer Question 1 below. The Section II score weighting for this question is 20 percent.

$$C_6H_5COOH(s) \rightleftarrows C_6H_5COO^-(aq) + H^+(aq) \qquad K_a = 6.46 \times 10^{-5}$$

1. Benzoic acid, C_6H_5COOH, dissociates in water as shown in the equation above. A 25.0 mL sample of an aqueous solution of pure benzoic acid is titrated using standardized 0.150 *M* NaOH.

   (a) After addition of 15.0 mL of the 0.150 *M* NaOH, the pH of the resulting solution is 4.37. Calculate each of the following.

   (i) $[H^+]$ in the solution

   (ii) $[OH^-]$ in the solution

   (iii) The number of moles of NaOH added

   (iv) The number of moles of $C_6H_5COO^-(aq)$ in the solution

   (v) The number of moles of C_6H_5COOH in the solution

   (b) State whether the solution at the equivalence point of the titration is acidic, basic, or neutral. Explain your reasoning.

   In a different titration, a 0.7529 g sample of a mixture of solid C_6H_5COOH and solid NaCl is dissolved in water and titrated with 0.150 *M* NaOH. The equivalence point is reached when 24.78 mL of the base solution is added.

   (c) Calculate each of the following.

   (i) The mass, in grams, of benzoic acid in the solid sample

   (ii) The mass percentage of benzoic acid in the solid sample