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. Answer the following questions about the solubility of some fluoride salts of alkaline earth metals.

   (a) A student prepares 100. mL of a saturated solution of MgF_2 by adding 0.50 g of solid MgF_2 to 100. mL of distilled water at 25°C and stirring until no more solid dissolves. (Assume that the volume of the undissolved MgF_2 is negligibly small.) The saturated solution is analyzed, and it is determined that $[F^-]$ in the solution is 2.4×10^{-3} M.

      (i) Write the chemical equation for the dissolving of solid MgF_2 in water.

      (ii) Calculate the number of moles of MgF_2 that dissolved.

      (iii) Determine the value of the solubility-product constant, K_{sp}, for MgF_2 at 25°C.

   (b) A beaker contains 500. mL of a solution in which both $Ca^{2+}(aq)$ and $Ba^{2+}(aq)$ are present at a concentration of 0.10 M at 25°C. A student intends to separate the ions by adding 0.20 M NaF solution one drop at a time from a buret. At 25°C the value of K_{sp} for CaF_2 is 3.5×10^{-11}; the value of K_{sp} for BaF_2 is 1.8×10^{-6}.

      (i) Which salt will precipitate first, CaF_2 or BaF_2? Justify your answer.

      For parts (b)(ii) and (b)(iii) below, assume that the addition of the NaF solution does not significantly affect the total volume of the liquid in the beaker.

      (ii) Calculate the minimum concentration of $F^-(aq)$ necessary to initiate precipitation of the salt selected in part (b)(i).

      (iii) Calculate the minimum volume of 0.20 M NaF that must be added to the beaker to initiate precipitation of the salt selected in part (b)(i).

   (c) There are several ways to dissolve salts that have limited solubility. Describe one procedure to redissolve the precipitate formed in part (b).