

## 2005 AP<sup>®</sup> CHEMISTRY FREE-RESPONSE QUESTIONS

Answer EITHER Question 2 below OR Question 3 printed on page 8-9. Only one of these two questions will be graded. If you start both questions, be sure to cross out the question you do not want graded. The Section II score weighting for the question you choose is 20 percent.

2. Answer the following questions about a pure compound that contains only carbon, hydrogen, and oxygen.

- (a) A 0.7549 g sample of the compound burns in  $\text{O}_2(g)$  to produce 1.9061 g of  $\text{CO}_2(g)$  and 0.3370 g of  $\text{H}_2\text{O}(g)$ .
- (i) Calculate the individual masses of C, H, and O in the 0.7549 g sample.
  - (ii) Determine the empirical formula for the compound.
- (b) A 0.5246 g sample of the compound was dissolved in 10.0012 g of lauric acid, and it was determined that the freezing point of the lauric acid was lowered by  $1.68^\circ\text{C}$ . The value of  $K_f$  of lauric acid is  $3.90^\circ\text{C } m^{-1}$ . Assume that the compound does not dissociate in lauric acid.
- (i) Calculate the molality of the compound dissolved in the lauric acid.
  - (ii) Calculate the molar mass of the compound from the information provided.
- (c) Without doing any calculations, explain how to determine the molecular formula of the compound based on the answers to parts (a)(ii) and (b)(ii).
- (d) Further tests indicate that a 0.10 *M* aqueous solution of the compound has a pH of 2.6. Identify the organic functional group that accounts for this pH.