

## 2006 AP<sup>®</sup> CHEMISTRY FREE-RESPONSE QUESTIONS

Your responses to the rest of the questions in this part of the examination will be graded on the basis of the accuracy and relevance of the information cited. Explanations should be clear and well organized. Examples and equations may be included in your responses where appropriate. Specific answers are preferable to broad, diffuse responses.

Answer BOTH Question 5 below AND Question 6 printed on pages 11-12. Both of these questions will be graded. The Section II score weighting for these questions is 30 percent (15 percent each).

5. Three pure, solid compounds labeled  $X$ ,  $Y$ , and  $Z$  are placed on a lab bench with the objective of identifying each one. It is known that the compounds (listed in random order) are  $\text{KCl}$ ,  $\text{Na}_2\text{CO}_3$ , and  $\text{MgSO}_4$ . A student performs several tests on the compounds; the results are summarized in the table below.

Compound	pH of an Aqueous Solution of the Compound	Result of Adding 1.0 $M$ $\text{NaOH}$ to a Solution of the Compound	Result of Adding 1.0 $M$ $\text{HCl}$ Dropwise to the Solid Compound
$X$	$> 7$	No observed reaction	Evolution of a gas
$Y$	7	No observed reaction	No observed reaction
$Z$	7	Formation of a white precipitate	No observed reaction

- (a) Identify each compound based on the observations recorded in the table.

Compound  $X$  \_\_\_\_\_

Compound  $Y$  \_\_\_\_\_

Compound  $Z$  \_\_\_\_\_

- (b) Write the chemical formula for the precipitate produced when 1.0  $M$   $\text{NaOH}$  is added to a solution of compound  $Z$ .
- (c) Explain why an aqueous solution of compound  $X$  has a pH value greater than 7. Write an equation as part of your explanation.
- (d) One of the testing solutions used was 1.0  $M$   $\text{NaOH}$ . Describe the steps for preparing 100. mL of 1.0  $M$   $\text{NaOH}$  from a stock solution of 3.0  $M$   $\text{NaOH}$  using a 50 mL buret, a 100 mL volumetric flask, distilled water, and a small dropper.
- (e) Describe a simple laboratory test that you could use to distinguish between  $\text{Na}_2\text{CO}_3(s)$  and  $\text{CaCO}_3(s)$ . In your description, specify how the results of the test would enable you to determine which compound was  $\text{Na}_2\text{CO}_3(s)$  and which compound was  $\text{CaCO}_3(s)$ .