

Applied Practice  
in

*Reactions and  
Stoichiometry*

AP\* Chemistry Series  
**RESOURCE GUIDE**

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**APPLIED PRACTICE**  
**Resource Guide**  
*Reactions and Stoichiometry*

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## A NOTE FOR TEACHERS

The *Applied Practice in AP Chemistry* series was designed for use by teachers as an instructional supplement to major units in the AP Chemistry curriculum. This series was also conceived as a resource for teachers in preparing students for the AP Chemistry Exam. As you teach each unit, your students will have the opportunity to practice and to develop those skills required on the exams.

Each book in the series includes:

- Teaching notes and strategies
- Glossary of terms
- 75 multiple-choice questions replicating Section I of the AP Chemistry Exam
- Multiple-choice answer keys and answer explanations
- 6 free-response questions replicating Section II of the AP Chemistry Exam
- Free-response answer keys and scoring guide

We offer a few suggestions and explanations to help you receive the maximum benefit from our materials:

1. Applied Practice booklets do not purport to duplicate exactly an Advanced Placement Examination. However, questions are modeled on those typically encountered on these exams. Thus, students using these materials will become familiar and comfortable with the format, question types, and terminology of Advanced Placement Examinations.
2. Each Applied Practice booklet focuses on one topic within the AP Chemistry curriculum. These booklets are excellent resources for teachers and their students. Their unique format includes questions designed for use during the initial teaching of the required topics. Other questions are exceptional for the review phase of the course, as students pull the entire year together leading up to the AP Chemistry Exam. The AP exam often will require knowledge in multiple content areas on the same question.
3. You have the option of using the Applied Practice booklets for your own lesson and test preparation or, if you so choose, students may work through an Applied Practice test booklet on their own as they progress through the course. The students can check their own answers with the answer key and read the answer explanations provided in the teacher edition, conferring with the teacher as needed.
4. The order of topics in the Applied Practice booklets has been organized to follow a logical progression that is similar to the sequence in many of the most widely selected AP chemistry textbooks. You will find that they can easily be adapted to whatever sequence you find most productive at your school.

5. The free-response questions in each topic were created to provide practice questions similar to both those given in part A of the AP Chemistry Exam, which allows use of a calculator, and those given in part B, in which no calculator is allowed. In a few cases, the specific content is best assessed with a combination of both types.
6. Due to the emphasis on laboratory experience in the College Board's AP Chemistry program, the Applied Practice booklets in AP Chemistry frequently include laboratory-based questions appropriate to the subtopic addressed. A required laboratory-based question does appear on the AP Chemistry Exam. While most Applied Practice booklets in the AP Chemistry series do contain laboratory-based free-response questions, some topics do not lend themselves to the College Board-recommended laboratory experiments. However, each Applied Practice booklet does contain multiple-choice questions related to both laboratory and descriptive chemistry. Only one of the six free-response questions included on the AP Chemistry Exam is laboratory based.
7. Each booklet includes a glossary of terms that applies to the vocabulary of that particular topic.
8. If the teacher wishes to replicate the conditions under which students will take the actual AP Chemistry Exam, he or she should understand the following about multiple-choice versus free-response questions when using Applied Practice booklets: When answering multiple-choice questions (AP Exam, Section I) students are not allowed the use of a calculator, and the only reference information available to them is a periodic table (with only symbol, mass number, atomic number) and a small table of abbreviations/symbols used in the questions. When answering free-response questions (AP Exam, Section II), much more information is available to the student. In addition to the periodic table, a table of standard reduction potentials in aqueous solutions and a relatively complete list of equations, constants, and abbreviations/symbols are provided.

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## GLOSSARY OF TERMS

**anhydrous**—without water; a crystal that has had water molecules driven off through heating; has a similar formula to a hydrate; ex: *hydrated* crystal  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ , *anhydrous* crystal  $\text{CuSO}_4$

**anion**—a negatively charged ion, an atom or molecule that has gained one or more electrons

**aqueous**—dissolved in water, in a water solution

**atom**—an extremely small particle of matter, the smallest particle of an element which retains the properties of that element

**atomic mass**—(*atomic weight*) the average atomic mass for the naturally occurring isotopes of an element

**balanced equation**—chemical equation representing conservation of mass, where the same number of atoms of each element appear on both sides (before and after the arrow)

**catalyst**—a substance that increases the rate of a chemical reaction without being consumed in the reaction

**cation**—a positively charged ion, an atom or molecule that has lost one or more electrons

**coefficient**—number written before a formula in a balanced equation to show the relative number of moles of that substance in the reaction

**combustion**—burning, a type of reaction where a substance reacts with molecular oxygen, forming oxides

**compound**—a substance composed of two or more elements that are chemically combined, in fixed ratios with its own set of properties different from the elements'

**concentration**—a general term concerning the relative quantity of material (solute) dissolved into a solution

**decomposition**—a type of reaction in which a single compound reacts forming two or more substances, often requiring heating

**displacement**—(*single displacement*) a type of reaction in which an element reacts with a compound, displacing an element within the compound (takes its place)

**empirical formula**—(*simplest formula*) the formula of a substance written with the set of smallest whole number subscripts

## Masses and the Mole

**Questions 1-3 refer to the following series of answer choices. They may be used once, more than once, or not at all.**

- (A) 1 mole
- (B) 2 moles
- (C) 3 moles
- (D) 5 moles
- (E) 8 moles

1. The number of moles of  $\text{NH}_3$  molecules in 17.0 g of  $\text{NH}_3$
2. The number of moles in  $3.011 \times 10^{24}$  atoms of carbon atoms
3. The number of moles of sulfur atoms in  $6.022 \times 10^{23}$   $\text{S}_8$  molecules.

4. Which of the following statements is true?

- I. The molar mass of  $\text{CaCO}_3$  is  $100.091 \text{ g mol}^{-1}$ .
- II. 50 g of  $\text{CaCO}_3$  contains  $9.033 \times 10^{23}$  oxygen atoms.
- III. A 200.182 g sample of  $\text{CaCO}_3$  contains 2 moles of  $\text{CaCO}_3$ .

- (A) I only
- (B) II only
- (C) III only
- (D) I and III only
- (E) I, II, and III

5. Which of the following represents the correct method for converting 11.0 g of copper metal to the equivalent number of copper atoms?

(A)  $\left(\frac{11.0\text{g of Cu atoms}}{\quad}\right)\left(\frac{1\text{ mole of Cu atoms}}{63.55\text{g}}\right)\left(\frac{6.022 \times 10^{23}\text{ Cu atoms}}{1\text{ mole of Cu atoms}}\right)$

(B)  $\left(\frac{11.0\text{g of Cu atoms}}{\quad}\right)\left(\frac{1\text{ mole of Cu atoms}}{63.55\text{g}}\right)$

(C)  $\left(\frac{11.0\text{g of Cu atoms}}{\quad}\right)\left(\frac{1\text{ mole of Cu atoms}}{63.55\text{g}}\right)\left(\frac{63.55\text{ g of Cu}}{6.022 \times 10^{23}\text{ moles of Cu atoms}}\right)$

(D)  $\left(\frac{11.0\text{g of Cu atoms}}{\quad}\right)\left(\frac{63.55\text{g}}{1\text{ mole of Cu atoms}}\right)\left(\frac{6.022 \times 10^{23}\text{ Cu atoms}}{1\text{ mole of Cu atoms}}\right)$

(E)  $\left(\frac{11.0\text{g of Cu atoms}}{\quad}\right)\left(\frac{1\text{ mole of Cu atoms}}{63.55\text{g}}\right)\left(\frac{1\text{ mole of Cu atoms}}{6.022 \times 10^{23}\text{ Cu atoms}}\right)$

6. Which of the following contain approximately  $3.011 \times 10^{23}$  particles?

(A) 32.0 g of oxygen molecules

(B) 16.0 g of oxygen molecules

(C) 16.0 g of oxygen atoms

(D) 4.0 g of helium atoms

(E) 23.0 g of sodium ions

7. Which of the following contain(s) the same number of atoms as 48.6 g of magnesium?

(A) 1 mole of calcium atoms

(B) 56.028 g of nitrogen molecules

(C) 48.6 g of calcium atoms

(D) 4 moles of magnesium atoms

(E)  $1.204 \times 10^{24}$  atoms of carbon

2. For each of the following three statements write the balanced net ionic equation (show significantly ionized species as separate ions and cancel out spectators) and answer the question that follows. There is no need to include phase labels. In every case, a reaction does occur. One point may be awarded for reactants (no partial credit given) up to two points may be awarded for products (partial credit given), one point for balancing and one point for the follow-up question.

(a) (i) A sample of 1-butanol is burned in an excess of oxygen gas.



(ii) Name an isomer of 1-butanol.

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(b) (i) Solutions of potassium chromate and lead(II) nitrate are mixed in a test tube



(ii) What color will sodium ions impart to a flame test?

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(c) (i) Liquid bromine is added drop wise to a solution that contains lithium iodide.



(ii) How can this reaction be classified?

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