

## Chapter 20 Review Answer Key (Corrected Title - Formerly titled Chapter 21 Review Answer Key)

### Vocabulary review

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#### Set One

1. c
2. e
3. d
4. b

#### Set Two

1. c
2. b
3. a
4. e

#### Set Three

1. f
2. c
3. e
4. b
5. d

### Concept review

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1. Physical changes result in a change of size or shape. Chemical changes result in different substances being formed. Atoms are rearranged, and often energy is released or absorbed in chemical changes.
2. Examples of a physical change include cutting something in half, evaporating water, or melting a substance.
3. Examples of a chemical change include striking a match, forming a precipitate by mixing two salts, and mixing vinegar and baking soda.
4. Answers will vary. Students should discuss that recipes and reactions have starting materials and products, and both usually require an input of energy. Both recipes and reactions identify the proportions of reactants or ingredients involved. Differences include that not all recipes involve chemical changes whereas all chemical reactions do. Recipes make products that are edible while chemical reactions can produce toxic substances. The conditions under which a reaction works are often not provided in a written chemical equation.
5. In chemical reactions, atoms are rearranged. This means that the bonds in reactant molecules must be broken and new ones formed to make product molecules.
6. The number and kinds of atoms in the reactants of a reaction must equal the number and kinds of atoms in the products. Atoms are rearranged, not created, in chemical reactions.
7. Lavoisier established the law of conservation of mass through careful experimentation. He recognized that mass is conserved in chemical reactions; the mass of reactants equals the mass of the products.
8. Answers will vary. A chemical equation tells you the kinds and quantities of reactants that are required to perform the reaction. The kinds and quantities of products in the reaction are also provided. Balanced equations show the ratio of the relative masses of all the molecules reacting or being produced in the reaction. Finally, equations illustrate that mass and atoms are conserved in reactions.

9. A limiting reactant is the reactant that is in short supply in a reaction. The amount of product produced is limited by this one substance in the reaction. Often a reactant is added in excess of what is needed. This is to make sure this (often less expensive) reactant does not limit the overall reaction.
10. Answers will vary. Possible answers may be that portions of the reactants are sometimes lost over the course of performing a reaction. Additionally, it is sometimes difficult to fully recover the entire amount of product. In some experiments, it is difficult to “trap” the product, especially if it is a gas. Finally, measurements throughout an experiment may not be accurate enough. Inaccurate measurements can lead to experimental error.

### Problems

1. c  
2. c  
3. d  
4. b  
5.

type of atom	total on reactants side	total on products side	balanced? (yes or no)
Al	1	1	yes
Br	2	3	no

6. c  
7. b  
8. d  
9. 3

10. Answers are:

- a.  $\text{Cl}_2 + 2\text{Br} \longrightarrow 2\text{Cl} + \text{Br}_2$   
 b. Balanced  
 c.  $\text{Na}_2\text{SO}_4 + \text{BaCl}_2 \longrightarrow \text{BaSO}_4 + 2\text{NaCl}$   
 d.  $2\text{ZnS} + 3\text{O}_2 \longrightarrow 2\text{ZnO} + 2\text{SO}_2$

11. Answers are:

- a.  $\text{Cl}_2(\text{g}) + 2\text{KBr}(\text{aq}) \longrightarrow 2\text{KCl}(\text{aq}) + \text{Br}_2(\text{l})$   
 b.  $4\text{NH}_3(\text{g}) + 5\text{O}_2(\text{g}) \longrightarrow 4\text{NO}(\text{g}) + 6\text{H}_2\text{O}(\text{g})$

12. Answers are:

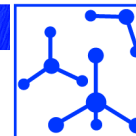
- a.  $4\text{NH}_3: 4 \times 17.0 \text{ amu} = 68.0 \text{ amu}$   
 b.  $5\text{O}_2: 5 \times 32.0 \text{ amu} = 160.0 \text{ amu}$   
 c.  $4\text{NO}: 4 \times 30.0 \text{ amu} = 120.0 \text{ amu}$   
 d.  $6\text{H}_2\text{O}: 6 \times 18.0 \text{ amu} = 108.0 \text{ amu}$

13. Answers are:

- a. 68.0 grams  
 b. 160.0 grams  
 c. 120.0 grams  
 d. 108.0 grams

14.  $20 \text{ grams O}_2 / 160 \text{ grams O}_2 = \text{predicted grams of H}_2\text{O} / 108 \text{ grams H}_2\text{O}$   
 $0.125 \times 108.0 \text{ grams H}_2\text{O} = 13.5 \text{ grams}$  is the predicted yield for  $\text{H}_2\text{O}$
15.  $10 \text{ grams Cl}_2 / (1 \times 71 \text{ grams Cl}_2) = \text{predicted grams of Br}_2 / (1 \times 160 \text{ grams Br}_2)$   
 $0.14 \times 160 \text{ grams Br}_2 = 22.5 \text{ grams}$  is the predicted yield for  $\text{Br}_2$

percent yield:  $19.8 \text{ grams} / 22.5 \text{ grams} \times 100 = 88\%$



### Applying your knowledge

- Steps that involve physical changes include chopping vegetables, mixing oil and vinegar, and tearing lettuce. The major example of a chemical change is digesting the salad!
- Answers are:
  - Chemical
  - Chemical
  - Physical
  - Physical
  - Chemical
- $461.5 \text{ grams} / 500 \text{ grams} \times 100 = 92.3\%$  yield of aspirin
- Answers are:
  - Carbon
  - Oxygen
  - Methane
- Answers are:
  - 10
  - The cherries
  - 5 cups of ice cream and 5 ounces of chocolate sauce
- Research on the Internet is helpful in figuring out the reactants and products for everyday reactions. Students should use key words that include the topic along with the word “reaction”.

Possible answers include:

**Breathing** (Respiration). Reactants = sugar and oxygen; products = carbon dioxide and water.

**Driving a car**. Reactants = octane and oxygen; products = carbon dioxide and water.

**Rusting**. Reactants = iron and oxygen; products = iron oxide.
- Research on the Internet will be helpful in figuring out the reactants and products for the chemical reactions used in industry. Students should first brainstorm industries, and then use the names of each industry as key words in their search. Alternatively, college level chemistry textbooks often discuss the chemical reactions used in industry and other applications.

Some example reactions include:

**Airbag reactions**. This is a three step reaction. The primary reactant is sodium azide ( $\text{NaN}_3$ ), potassium nitrate ( $\text{KNO}_3$ ), and silica ( $\text{SiO}_2$ ). These are ignited electrically and release a precalculated amount of nitrogen gas ( $\text{N}_2$ ) which fills the airbag.

**Manufacture of aspirin**. Reactants are salicylic acid and acetic anhydride. Products are aspirin (acetylsalicylic acid) and acetic acid.

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#### Set One

1. f
2. d
3. e
4. a
5. c

#### Set Two

1. e
2. d
3. a
4. c
5. f

### Concept review

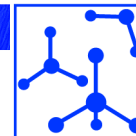
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1. Exothermic
2. Answers are:
  - a. Addition
  - b. Exothermic
3. Less energy is required to break the bonds in the reactants than is released when bonds are formed to make new products. Energy is always released and can be detected by a rise in temperature during the reaction.
4. b

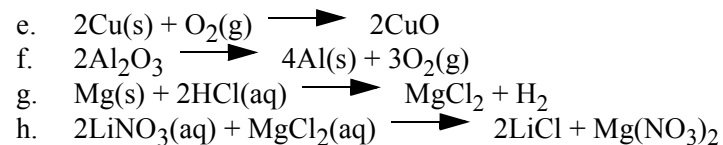
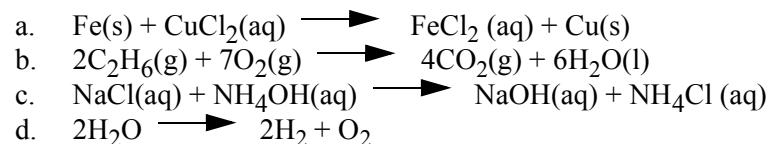
### Problems

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1. Answers are:
  - a. Double-displacement
  - b. Addition
  - c. Decomposition
  - d. Combustion
  - e. Single-replacement
2. Answers are:
  - a.  $\text{H}_2\text{SO}_4(\text{aq}) + \text{BaCl}(\text{aq}) \longrightarrow \text{BaSO}_4 + \text{H}^+ + \text{Cl}^-$
  - b.  $\text{ZnSO}_4(\text{aq}) + \text{Na}_3\text{PO}_4(\text{aq}) \longrightarrow \text{Zn}_3(\text{PO}_4)_2 + \text{Na}_2\text{SO}_4$
  - c.  $\text{HCl}(\text{aq}) + \text{K}_2\text{SO}_3 \longrightarrow \text{KCl} + \text{H}_2\text{SO}_3$
  - d.  $\text{SnCl}_2 + \text{Fe}_2(\text{SO}_4)_3 \longrightarrow \text{Sn}_2(\text{SO}_4)_4 + \text{FeCl}_2$
3. Answers are:
  - a.  $\text{BaSO}_4$
  - b.  $\text{Zn}_3(\text{PO}_4)_2$
  - c. No precipitate
  - d. No precipitate

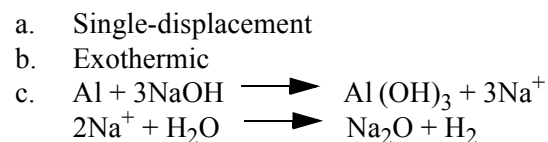


4. Answers are:

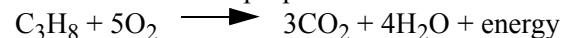


### Applying your knowledge

1. Answers are:



2. The combustion of propane:



3. Light bulbs are constructed so that the tungsten filament inside never comes in contact with oxygen in the air. Argon gas is usually the only gas inside light bulbs.