Section: The Nature of Chemical Reactions

1. Identify the reactants and products in each of the following chemical reactions.
   - Fe₂O₃ + 2Al → 2Fe + Al₂O₃
   - 2AgNO₃ + H₂SO₄ → Ag₂SO₄ + 2HNO₃

2. Explain where the energy to cook food comes from when a gas stove burns natural gas, CH₄, and oxygen, O₂.

3. Describe three signs that a chemical reaction has taken place, and give an example of each sign.

4. Identify the elements present in the original compound using the following statement of a chemical reaction. A white solid is heated and gives off carbon dioxide, CO₂, and water, H₂O, leaving behind sodium carbonate, Na₂CO₃.

5. Contrast endothermic and exothermic reactions.

6. Predict the products of the decomposition reactions of the following substances:
   - mercury oxide, HgO
   - silver oxide, Ag₂O
Concept Reviews

SECTION: THE NATURE OF CHEMICAL REACTIONS
1. a. reactants: Fe₂O₃ and Al; products: Fe and Al₂O₃  
   b. reactants: AgNO₃ and H₂SO₄; products: Ag₂SO₄ and HNO₃
2. When the natural gas burns, the bonds in the molecule are broken and the energy is released as heat.
3. Energy is released as light, heat, or sound: examples may include the flame produced by a match when it is struck; the production of a gas: examples may include that apples turn brown when exposed to air
4. sodium, carbon, oxygen, and hydrogen
5. Energy is transferred to the reactants from the surroundings in an endothermic reaction. Energy is transferred to the surroundings from the reactants in an exothermic reaction.
6. a. Hg and O₂  
   b. Ag and O₂

SECTION: REACTION TYPES
1. oxygen
2. A single-replacement reaction will have one compound and one element as reactants and one compound and one element as products, while a double-replacement reaction has two compounds as reactants and two compounds as products.
3. Electrons are transferred between elements during the reaction. The substance that gains electrons is reduced and the substance that loses electrons is oxidized.
4. a. Ag is reduced, Cu is oxidized  
   b. Cu is reduced, Al is oxidized
5. a. combustion  
   b. synthesis  
   c. double-displacement  
   d. single-displacement  
   e. decomposition
6. Synthesis reactions join substances to make a new, more complex compound. Decomposition reactions break a compound into at least two products. In combustion reactions, a substance reacts with oxygen. In single-replacement reactions, atoms of one element appear to take the place of atoms of another element in a compound. In double-replacement reactions, ions appear to be exchanged between compounds, producing a gas, a solid precipitate, or a molecular compound.

SECTION: BALANCING CHEMICAL EQUATIONS
1. a. N₂O₅ + H₂O → 2HNO₃  
   b. 2Fe(OH)₃ → Fe₂O₃ + 3H₂O  
   c. 4Fe + 3O₂ → 2Fe₂O₃  
   d. 2Al + 3CuSO₄ → Al₂(SO₄)₃ + 3Cu  
   e. 2NaCl + H₂SO₄ → Na₂SO₄ + 2HCl
2. The mole ratio for C:O₂:CO is 2:1:2. (balanced equation is 2C + O₂ → 2CO)
3. 2 mol NaOH (balanced equation is 2Na + 2H₂O → 2NaOH + H₂)
4. 68 g CO  
   (78 g CH₃OH) (mol CH₃OH/32 g) = 2.4 mol CH₃OH  
   (2.4 mol CO)  
   (28 g CO/mol CO) = 68 g CO
5. Each side of the equation has three soudiums, seven oxygens, six hydrogens, and one phosphorus. Because both sides have the same number of atoms of each element, mass is conserved.

SECTION: RATES OF CHANGE
1. If a change is made to a system in chemical equilibrium, the equilibrium shifts to oppose the change until a new equilibrium is reached.
2. Answers may vary. The table salt can be ground up into small particles. The temperature of the water can be increased.
3. a. toward the left  
   b. toward the right  
   c. toward the right  
   d. toward the right
4. a. toward the left  
   b. toward the right  
   c. toward the right  
   d. toward the right

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