CHAPTER 3 CHEMICAL REACTIONS

Reflect on your Learning

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1. Clues that indicate that a chemical reaction has taken place include: a change in colour, a change in odour, formation of a gas/solid, release/absorption of heat.
2. Combustion, synthesis, decomposition, single displacement and double displacement reactions.
3. Whether or not one element displaces another in a compound depends on the relative reactivities of the two elements. The collision–reaction theory suggests that particles must collide with the correct orientation and at sufficient speed to react.

Try This Activity: Observing Chemical Change

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(a) A change in colour is evidence that a chemical change has taken place.
(b) Iron(II) sulfate and elemental copper

3.1 RECOGNIZING AND UNDERSTANDING CHEMICAL CHANGES

Try This Activity: The KMT in Action

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(a) The food colouring starts as a small drop, but soon begins to spread throughout the beaker of tap water.
(b) According to kinetic molecular theory, the motion of all particles results in random collisions. The food colouring particles collide with each other and with molecules of water, bounce off in different directions, and thus spread throughout the beaker of tap water.

Try This Activity: A Model for the Collision–Reaction Theory

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(a) When the box is gently shaken, the particles exhibit the continuous random motion of all particles of matter.
(b) The student is to count the number of free and combined particles, and to indicate the proportion of particles that have formed a "compound."
(c) The vigorous shaking of the box represents the effect of higher temperature — greater speeds of the motion of particles.
(d) The student is to again count the number of free and combined particles, and to indicate the proportion of particles that have formed a compound. It is expected that a greater number of compounds will have formed.
(e) All of the particles may, or may not, have reacted.
(f) The collision–reaction theory suggests that particles must collide with the correct orientation and at sufficient speed to react. It is possible that there may not have been the correct orientation, and/or sufficient speed, for all particles to react.
(g) A lower number of particles within the same space should result in fewer collisions and a lower proportion of particles forming a compound.

PRACTICE

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Understanding Concepts

1. The formation of gas is evidence that a chemical reaction has occurred.
2. When gasoline evaporates (a physical change) it absorbs heat from its surroundings. A visual observation of this absorption of heat might lead to a conclusion that a chemical change has taken place. Thus it is important not to rely solely on visual observation when drawing conclusions about chemical change.
3. According to kinetic molecular theory, the motion of all particles results in random collisions. At lower temperatures, the colliding molecules of liquid gasoline and oxygen simply bounce off one another unchanged. However, at higher

temperatures, the molecules of gaseous gasoline and oxygen collide at greater speeds and with greater energy. In some collisions, the valence shells of the reactants overlap, and their electrons can be rearranged to form new bonds.

4. According to the collision–reaction theory, the occurrence of a chemical reaction is dependent on the energy and orientation of the collisions.

ACTIVITY 3.1.1 UNDERSTANDING CHEMICAL REACTIONS

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Analysis

(a) $CH_{4(g)} + 2\ O_{2(g)} \rightarrow CO_{2(g)} + 2\ H_2O_{(g)}$

$2\ H_2O_{(l)} \rightarrow 2\ H_{2(g)} + O_{2(g)}$

$C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$

Synthesis

(b) The law of conservation of mass.

EXPLORE AN ISSUE TAKE A STAND: CATALYTIC CONVERTERS

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The student is to use the Internet to carry out research on catalytic converters, to assemble arguments for and against making catalytic converters compulsory in all vehicles, and to put together a presentation — pamphlet or video — aimed at people who are about to purchase a used vehicle.

GO TO www.science.nelson.com, Chemistry 11, Teacher Centre

PRACTICE

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Understanding Concepts

5. (a) Change in colour, change in odour, formation of gas/solid, release/absorption of heat.
   (b) Change in colour: iron nails that rust turn brownish in colour.

Change in odour: food that decomposes gives off an odour.
Formation of gas/solid: seltzer tablets added to water give off a gas.
Release/absorption of heat: wood that burns gives off heat.

6. (a) Reactant: the substances that combine in a chemical reaction.
   (b) Product: the substances that are formed in a chemical reaction.
   (c) Coefficient: a whole number indicating the ratio of formula units of each substance involved in a chemical reaction.
   (d) Balanced: the reactants and products contain equal numbers of atoms of each type.

7. (a) $2\ H_{2(g)} + O_{2(g)} \rightarrow 2\ H_2O_{(g)}$
   (c) $Pb_{(s)} + 2\ AgNO_{3(aq)} \rightarrow 2\ Ag_{(s)} + Pb(NO_3)_{2(aq)}$
   (b) and (d) are balanced.

SECTION 3.1 QUESTIONS

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Understanding Concepts

1. (a) sodium chloride and water → chlorine and hydrogen and sodium hydroxide
   (b) $2\ NaCl_{(aq)} + 2\ H_2O_{(l)} \rightarrow Cl_{2(s)} + H_{2(s)} + 2\ NaOH_{(aq)}$
   (c) The reaction takes place in a sealed container because chlorine is a poisonous gas at SATP.
   (d) The formation of gases — $Cl_{2(s)} + H_{2(s)}$
   (e) $NaCl_{(aq)}$ and $NaOH_{(aq)}$ are ionic compounds, $H_2O_{(l)}$ is a molecular compound, $Cl_{2(s)} + H_{2(s)}$ are molecular elements.
   (f) $H_2O_{(l)}$ can be classified as a polar molecule.
   (g) Chlorine compounds have different chemical properties than does chlorine gas.

