

## Answers to Unit 2 Review Questions

- covalent, no ions are present
  - Students' depictions should show either paired electrons or lines representing chemical bonds that would result from electron pairing.
  - broken: C-H bonds; formed: C-O bonds and H-O bonds
  - The diagram will show the reaction is exothermic because heat is released in a combustion reaction. The energy-level diagram should show more energy being released from the reaction than going into the reaction.
- single replacement
  - synthesis
  - double replacement
  - decomposition
- The term formula unit refers to the smallest possible part of an ionic compound that is a complete compound.
- Coefficients in a balanced chemical equation show the number of each kind of compound in the equation. For example, four water molecules is represented as  $4\text{H}_2\text{O}$ .
- For example: In a chemical reaction, energy is absorbed while old bonds are breaking, and energy is released as new bonds are forming. If more energy is absorbed than released overall, then the reaction is endothermic. Otherwise, it is exothermic.
- An acid is a substance that releases hydrogen ions into solutions. A base is a substance that releases hydroxide ions into solutions.
- For example, use a Venn diagram. In the ionic side, write composed of ions, formed by electron transfer, metal is positive, the non-metal is negative. In the overlap, write strong bonds, holds components together. In the covalent bonds side, write shared pair of electrons, atoms are neutral.
- 4 carbon, 4 oxygen
  - 3 magnesium, 6 chlorine
  - 4 nitrogen, 16 hydrogen, 2 sulfur, 8 oxygen
- Changing the subscripts makes the formula of the compound incorrect.
- $4 \text{Na(s)} + \text{O}_2\text{(g)} \rightarrow 2 \text{Na}_2\text{O(s)}$

- b)  $2 \text{KCl(s)} \rightarrow 2 \text{K(s)} + \text{Cl}_2\text{(g)}$   
 c)  $\text{N}_2\text{(g)} + 2 \text{O}_2\text{(g)} \rightarrow 2 \text{NO}_2\text{(g)}$   
 d)  $\text{CuSO}_4\text{(aq)} + 2 \text{Na(s)} \rightarrow \text{Cu(s)} + \text{Na}_2\text{SO}_4\text{(aq)}$   
 e)  $\text{Pb(NO}_3)_2\text{(aq)} + 2 \text{KI(aq)} \rightarrow \text{PbI}_2\text{(s)} + 2 \text{KNO}_3\text{(aq)}$  f)  $2 \text{Al(s)} + 3 \text{Cl}_2\text{(g)} \rightarrow 2 \text{AlCl}_3\text{(s)}$

11. a) The atoms are Li, with 3 electrons, and F, with 9 electrons  
 b) The bond between them is ionic, because each member of the compound is an ion, as seen by their charges  
 c) energy is released  
 12. A molecule is a collection of atoms covalently bonded with an overall charge of zero. Ions have a nonzero charge, and so they are not molecules.  
 13. Students' diagrams should feature the pairing of electrons between chlorine atoms.  
 14. For example:  $\text{H}_2$ ,  $\text{N}_2$ ,  $\text{O}_2$ ,  $\text{F}_2$ ,  $\text{Cl}_2$ ,  $\text{Br}_2$ ,  $\text{I}_2$ ,  $\text{P}_4$ ,  $\text{S}_8$   
 15. a) acidic

b) basic

Copyright © 2018 by Nelson Education Ltd. 96

BC Science Connections 10 Teaching Notes Unit 2 Assessment

c) neutral

16. least to most acidic: milk, cheese, yogurt  
 17. a) bubbles are forming and Zn is corroding  
 b) the mass of Zn metal decreases  
 c) hydrogen gas, in this single replacement reaction the zinc metal replaces the positive hydrogen ion  
 $\text{Zn} + 2\text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2$   
 d) Zn  
 e) single replacement; one element replaces another in a compound  
 f) The reaction is exothermic.  
 18. Single replacement reactions replace one ion, while double replacement reactions replace two ions.  
 19. a) sodium+oxygen  $\rightarrow$  sodiumoxide;  $\text{Na} + \text{O}_2 \rightarrow \text{Na}_2\text{O}$ ;  $4\text{Na(s)} + \text{O}_2\text{(g)} \rightarrow 2\text{Na}_2\text{O(s)}$   
 b) magnesium + copper(II) chloride  $\rightarrow$  copper + magnesium chloride;  $\text{Mg} + \text{CuCl}_2 \rightarrow \text{Cu} + \text{MgCl}_2$ ;  
 $\text{Mg(s)} + \text{CuCl}_2\text{(aq)} \rightarrow \text{Cu(s)} + \text{MgCl}_2\text{(aq)}$   
 c) magnesium carbonate  $\rightarrow$  magnesium oxide + carbon dioxide;  $\text{MgCO}_3 \rightarrow \text{MgO} + \text{CO}_2$ ;  $\text{MgCO}_3\text{(s)} \rightarrow \text{MgO(s)} + \text{CO}_2\text{(g)}$   
 d) chromium(III) chloride + potassium hydroxide  $\rightarrow$  potassium chloride + chromium(III) hydroxide;  $\text{CrCl}_3 + 3\text{KOH} \rightarrow 3\text{KCl} + \text{Cr(OH)}_3$ ;  
 $\text{CrCl}_3\text{(aq)} + 3\text{KOH(aq)} \rightarrow 3\text{KCl(aq)} + \text{Cr(OH)}_3\text{(s)}$   
 20. a) synthesis; two reactants and one product  
 b) single replacement; an element and a compound make an element and a compound  
 c) decomposition; one reactant and two products  
 d) double replacement; two ionic compounds trade ions

21. a) single replacement;  $\text{Au}(\text{NO}_3)_3 + 3\text{Ag} \rightarrow 3\text{AgNO}_3 + \text{Au}$  b) decomposition;  $2\text{CuO} \rightarrow 2\text{Cu} + \text{O}_2$   
 c) double replacement;  $\text{BaCl}_2 + \text{K}_2\text{SO}_4 \rightarrow 2\text{KCl} + \text{BaSO}_4$  d) synthesis;  $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$
- e) acid-base neutralization;  $3\text{HBr} + \text{Al}(\text{OH})_3 \rightarrow \text{AlBr}_3 + 3\text{H}_2\text{O}$  f) decomposition;  $2\text{AgCl} \rightarrow 2\text{Ag} + \text{Cl}_2$   
 g) synthesis;  $8\text{Ca} + \text{S}_8 \rightarrow 8\text{CaS}$   
 h) single replacement;  $\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$
- i) double replacement;  $\text{NaCl} + \text{AgNO}_3 \rightarrow \text{NaNO}_3 + \text{AgCl}$
- j) combustion;  $2\text{C}_4\text{H}_{10} + 13\text{O}_2 \rightarrow 8\text{CO}_2 + 10\text{H}_2\text{O}$
22. 1:1 ratio; this results from +2 ions combining with -2 ions
23. Accept all reasonable responses. Any form of recombination, such as exchanging blocks would be suitable.
24. a) In a chemical reaction, the system is where the reaction is occurring and the surroundings is everything else.
- b) The surroundings will get cooler.
25. Accept all reasonable responses. Students might, for example, use an energy level diagram or a visual similar to Figure 2.20 in the textbook.
26. a) combustion
- b) exothermic. Heat, light, and sound are released.
- c) Yes, an input of energy is needed to get started. This is done with a lighter. Wood does not normally spontaneously combust.
27. a) no, the rest of the mass escaped as gas  
 b) Perform the experiment in a sealed container.
28. a) and b)  
 For example: gasoline powers a car but burning it contributes to global warming; batteries could replace the need for gasoline; bleach cleans stains but is a potential poison; other less powerful bleaching agents are used as replacements; oil-based paints hold up well in outside applications but need solvents to clean brushes; water-based paints eliminate the need for solvents; soaps are good for cleaning but can contain chemicals like phosphates that pollute the environment; use phosphate-free chemicals; insecticides will keep insects away

from crops, but might hurt other insects; non-chemical pest control methods such as ladybugs can reduce the need for pesticides.

29. Active metals such as Mg will react with carbon dioxide, and so  $\text{CO}_2$  extinguishers should not be used to try to put out metal fires.

30. a) Double replacement. The ions recombine with ions from the other compound.
- b) sodium chloride and calcium carbonate
- c) sodium carbonate + calcium chloride → sodium chloride + calcium carbonate  
 $\text{Na}_2\text{CO}_3 + \text{CaCl}_2 \rightarrow \text{NaCl} + \text{CaCO}_3$   
 $\text{Na}_2\text{CO}_3(\text{aq}) + \text{CaCl}_2(\text{aq}) \rightarrow 2\text{NaCl}(\text{aq}) + \text{CaCO}_3(\text{s})$
- d)  $(1.6 \text{ g} + 1.1 \text{ g}) - 1.0 \text{ g} = 1.7 \text{ g}$  by the law of conservation of mass
- e) Students might suggest experimental error or errors in measuring. Accept all reasonable answers.
31. a) acidic, since 5.72 is less than 7
- b) Add KOH to neutralize the solution, because KOH is a base and the solution is acidic.
32. a) The pH will increase. The removal of HCl by the base lowers the acid concentration.
- b) Students will likely suggest that baking soda is weaker or has a lower pH than sodium hydroxide. (Answers involving words such as weak(er) and strong(er) should be interpreted in terms of common-language usage, since students do not yet know about strong/weak acids and bases.)
- c)  $2\text{HCl} + \text{Mg}(\text{OH})_2 \rightarrow \text{MgCl}_2 + 2\text{H}_2\text{O}$
33. a) Calcium hydroxide is a base and will neutralize excess acid in the environment.
- b) An antacid neutralizes excess stomach acid, just as the lime does in the lake.
- c) The calcium hydroxide is used up by the acid in the lake, so for continued benefit more must be added in an ongoing basis. This can be very impractical in the long term.
- d) The longer-term solution to acid precipitation in lakes is to remove or at least limit the amount of acid precipitation. This is done by removing acid-causing sulfur oxide and nitrogen oxide from the environment. Removing sulfur oxides from smokestack emissions and from oil before burning it, as well as equipping automobiles with catalytic converters to remove nitrogen oxides, helps to reduce acid precipitation.
34. Accept all reasonable responses. For example, begin by letting your supervisor know you cannot find the Safety Data Sheets you are looking for, and ask for assistance in finding them. If this does not work, let them know that you would like to see them and remind them politely that it is by law the employer's responsibility to have the SDS on hand. Perhaps they could assign you on company time to fix this problem, for the sake of everyone's safety, and to avoid a fine should an inspection be made by the Workers' Compensation Board.
35. Accept all reasonable responses. For example, recycling food, expired medicines, and chemical wastes or products such as batteries or electronics. Benefits include safe disposal and avoiding polluting the environment. The risks of taking shortcuts and not taking good care and handling of chemicals can lead to personal injury, injury to others, and harm to the environment. Understanding the properties of the chemicals we work with makes us more able to make appropriate choices and good decisions about how to use them.