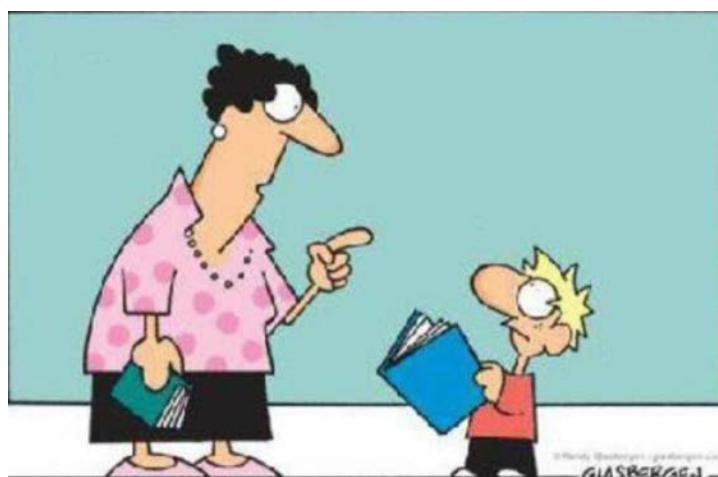


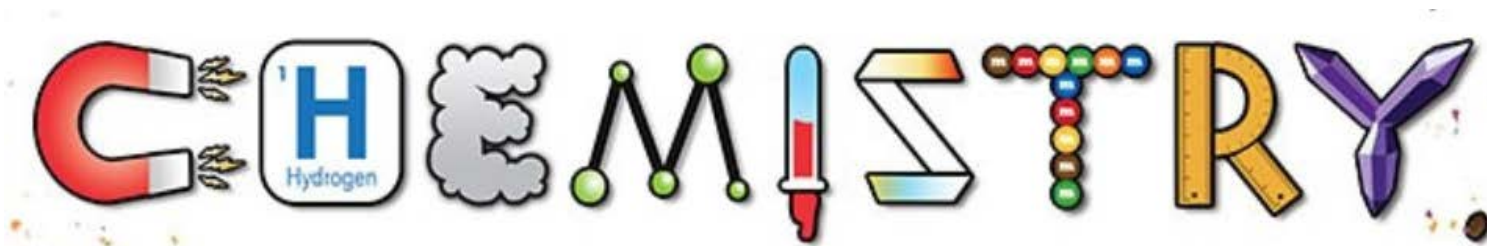
# SCIENCE 10

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## FINAL EXAM REVIEW BOOK 1



It's called 'reading'. It's how people install new software into their brains.



CHEMICAL PROCESSES REQUIRE ENERGY CHANGE AS ATOMS ARE REARRANGED

NAME: Key

BLOCK: \_\_\_\_\_

# Study Checklist

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This review booklet is by no means a "practice final". It is a collection of practice questions on each unit, meant to guide your final exam studying and prepare you for the types of questions you are likely to see. DO NOT treat this booklet as a practice test. If you're stuck on a question, look it up and ask for help! DO NOT go straight to the answer key when you come across a question you cannot remember how to do. Difficult questions SHOULD guide your study! Always look up a concept in your class notes if you are stuck, then attempt the question again.

### BEFORE beginning this booklet you should:

- read through your class notes booklet on *each topic*
- make your own "quick summary page" of important formulas & key concepts for the unit
- review quizzes & tests from the unit to recall strengths & weaknesses (*a great study method would be to re-do old quizzes & tests on a separate piece of paper*)

### WHILE working through this booklet you should:

- look up concepts & example problems in your class notes when you come across a problem you are stuck on
- make a list of "questions to ask my teacher" so you can come to class and use your time efficiently.

### Questions I'm having difficulty with:

Page	Question Number #	Topic

# Unit 1: Chemistry - Ionic/Covalent Naming & Formula, Balancing, Types of Chemical Reactions + Endo/Exothermic Reactions

*use this page to make your own KEY summary notes*

# Chemistry Summary

## ESSENTIAL QUESTION

### What happens to the energy and atoms of substances in chemical reactions?



#### TOPIC 2.3:

##### How is energy involved in chemical processes?

- Matter and energy interact in physical and chemical changes.
- Energy is transferred between chemical reactions (the system) and the surroundings.

##### Key Terms

exothermic reaction  
endothermic reaction



#### TOPIC 2.1:

##### How are chemical processes part of our lives?

- Applications of chemistry are everywhere in the world around you.
- Knowing how to handle chemicals helps keeps us and our environment safe.

##### Key Term

chemical reaction



#### TOPIC 2.2:

##### What happens to atoms in a chemical reaction?

- Atoms bond together to form ionic and covalent compounds.
- Bonds are broken, atoms are rearranged, and new bonds are formed.
- Mass cannot be created or destroyed in a chemical reaction.
- A chemical equation represents what happens to the atoms in a reaction.

##### Key Terms

ionic compound      molecule      reactant  
ionic bond<sup>a</sup>      law of conservation of mass      product  
covalent compound      chemical equation      coefficient  
covalent bond

#### TOPIC 2.4:

##### How do atoms rearrange in different types of chemical reactions?

- A compound forms in a synthesis reaction and breaks down in a decomposition reaction.
- In replacement reactions, elements replace other elements.
- Most combustion reactions release heat and light.
- In a neutralization reaction, an acid reacts with a base.





##### Key Terms

synthesis reaction      acid  
decomposition reaction      base  
single replacement reaction      acid-base indicator  
double replacement reaction      pH scale  
combustion reaction      neutralization reaction

# UNIT 1: LAB SAFETY

## Understanding Key Ideas

1. What do WHMIS and SDS stand for? What are their purposes and how are they associated with each other? [2]
2. Describe how to properly heat a test tube using a Bunsen burner.
3. Describe one precaution you should take when you see each of the following.
  - a) 
  - b) 
4. Name three things to do when preparing to carry out an investigation or activity that involves the use of chemicals. [2]

## Connecting Ideas

5. Make a sketch of your science classroom. Include the safety equipment and where it is located.
6. Create a graphic organizer to summarize the positive and negative effects of chemicals introduced in the Topic.
7. Many farmers apply chemical fertilizers and other substances, such as insecticides, to help maintain their crops and improve the yields. Describe two things the farmer could do to reduce the risk of personal exposure and exposure to others of these chemicals.



8. You have been asked to develop a safety plan for performing an investigation. [2]
  - a) How do WHMIS symbols help to do this?
  - b) Describe how an SDS could be used.
  - c) Why should chemical disposal be part of your plan?

## Making New Connections

9. Iron-containing hemoglobin molecules in red blood cells carry oxygen to the cells of your body. Carbon monoxide binds to iron in hemoglobin molecules 200 times more strongly than oxygen does. When carbon monoxide molecules bind to hemoglobin, they tend to stay bound. Oxygen cannot bind to hemoglobin that is already bound to a carbon monoxide molecule. [2] [3]



- a) Use the models of oxygen and carbon monoxide to infer why a hemoglobin molecule might accept a carbon monoxide molecule as well as an oxygen molecule.
  - b) Carbon monoxide poisoning can lead to effects such as headaches, dizziness, nausea, loss of consciousness, and death. These effects increase with increased concentrations of the compound. Use your understanding of gas exchange to explain why carbon monoxide is toxic. Recall your previous studies about cellular respiration and gas exchange in the body, or aid your recall by consulting suitable information resources.
10. Use your experiences in answering question 9 to pose at least one other question that you could investigate about the cause or effect of toxic chemicals on the body. [2]

## ANSWERS: Unit 1: Lab Safety

1. WHMIS - Workplace Hazardous Materials Information System, SDS - safety data sheet  
WHMIS was created to fulfill workplace obligations to let workers know about potential safety and health hazards associated with the materials and chemicals they use at work. A safety data sheet for each chemical used is part of creating a safer environment for workers, students, etc.
2. Use tongs to handle test tube, ensure the test tube is pointed away from others
3. a) AVOID BREATHING DUST OR VAPOURS AND AVOID CONTACT WITH SKIN OR EYES • Wear protective clothing which is effective against fumes and vapours • Wear face and eye protection • Work in well ventilated areas and wear breathing protection  
b) ENSURE CONTAINER IS ALWAYS SECURED • Store in appropriate designated areas • Do not drop or allow to fall
4. Know the safety precautions associated with the chemical, know what to do in case of an accident or spill, know how to dispose of the chemical.
5. OMIT
6. OMIT
7. Wear appropriate personal protective equipment (goggles, mask, long sleeve shirt, pants, closed toe shoes, etc.). Store the chemical in an appropriate manner. Ensure that any vessels containing the chemical are labeled to warn others of dangers. Apply chemicals to fields correctly to limit exposure for other people.
8. a) WHMIS symbols help identify the risks and precautions associated with each chemical  
b) To look up important information such as what to do in case of an accident or spill, how to dispose of chemicals safely  
c) It is not always safe to put the chemicals down the drain. If you are going to use a chemical you need a way to get rid of the waste products at the end to ensure a safe environment.
9. a) they have a similar looking structure in the models  
b) If carbon monoxide binds to hemoglobin rather than oxygen then the cells will be deprived of oxygen and can eventually die
10. OMIT

# Ionic & Covalent Bonds + Intro to Reactions

Q Questioning and Predicting  
 PC Planning and Conducting  
 PA Processing and Analyzing  
 E Evaluating  
AI Applying and Innovating  
 C Communicating

## Understanding Key Ideas

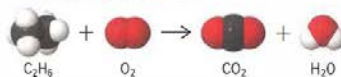
- What is the difference between a coefficient and a subscript of a chemical formula? Q
- Give an example of an anion and an example of a cation. Describe how each forms. When an ionic compound forms, is it possible for a cation to form but not an anion? Justify your answer. E
- Using a graphic organizer, such as a T-chart, compare and contrast the bonds in covalent compounds and ionic compounds. Q C
- Iron metal reacts with oxygen gas to form solid iron(III) oxide. Write a word equation, a skeleton equation, and a balanced chemical equation for this reaction. Q E C
- Write balanced chemical equations for each of the following. You do not need to include states for parts a) and b). Q E C
  - potassium + iodine  $\rightarrow$  potassium iodide
  - lead(II) nitrate + sodium chloride  $\rightarrow$  lead(II) chloride + sodium nitrate
  - $\text{H}_2\text{O}_2(\text{aq}) \rightarrow \text{H}_2\text{O}(\ell) + \text{O}_2(\text{g})$
  - $\text{MgO}(\text{s}) \rightarrow \text{Mg}(\text{s}) + \text{O}_2(\text{g})$
  - $\text{Fe}(\text{s}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{H}_2(\text{g}) + \text{Fe}_2(\text{SO}_4)_3(\text{aq})$

## Connecting Ideas

- Explain why energy is required to break chemical bonds. Why do some bonds require more energy to break than others? Q E
- Choose a Group 2 metal element and a halogen element that could combine to form a compound. Q C
  - Provide the name and chemical formula for the compound that is predicted to form.
  - Explain why this compound would form. As part of your answer, use Bohr diagrams or Lewis diagrams to show how bond formation occurs.

- Consider the definition of the term matter. The law of conservation of mass is sometimes referred to as the law of conservation of matter. Do you think this is an appropriate alternative? Justify your opinion. Q E

- Using the image below, describe how a balanced chemical equation represents the law of conservation of mass. Redraw the image so it represents a balanced chemical equation. E



- Using a table format, list the bonds that are broken and formed during the reaction. Also include whether energy is absorbed or released in each process. E

## Making New Connections

- Identify the open and closed systems that are represented below. Explain why each represents that type of system. Then give as many examples of each type of system as you can, with a minimum of five examples each. Describe what each example is used for and why it is necessary for it to be that type of system. E C



6

## ANSWERS: Ionic and Covalent Bonds + Intro to Reactions

- Coefficient - large number in front of a formula (ex.  $2\text{NaCl}$ ) tells you number of molecules of each compound. Subscript - small number within formula (ex.  $\text{CaCl}_2$ ) tells you number of each atom in compound.
- Anion - negative ion ( $\text{Cl}^-$ ) forms by gaining electrons, cation - positive ion ( $\text{Na}^+$ ) forms by losing electrons
- Covalent bonds - 2 nonmetals, share electrons, Ionic bonds - metal and a nonmetal, transfer of electrons
- Word Equation: Iron metal plus oxygen gas form iron (II) oxide, Skeleton equation:  $\text{Fe} + \text{O}_2 \rightarrow \text{FeO}$   
Balanced equation:  $2\text{Fe} + \text{O}_2 \rightarrow 2\text{FeO}$
- $2\text{K} + \text{I}_2 \rightarrow 2\text{KI}$
  - $\text{Pb}(\text{NO}_3)_2 + 2\text{NaCl} \rightarrow 2\text{NaNO}_3 + \text{PbCl}_2$
  - $2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2$
  - $2\text{MgO} \rightarrow 2\text{Mg} + \text{O}_2$
  - $2\text{Fe} + 3\text{H}_2\text{SO}_4 \rightarrow 3\text{H}_2 + \text{Fe}_2(\text{SO}_4)_3$
- Some bonds are stronger and therefore require more energy to be broken
- Group 2 element: Mg, halogen: Cl,  $\text{MgCl}_2$  magnesium chloride
  - forms as chlorine needs one electron for a full valence shell and Mg needs to get rid of 2 electrons to have a full valence shell therefore two atoms of chlorine are needed.
- Matter is anything that occupies space and has mass so this would be an appropriate alternative.
  - balanced chemical equation should have the same type/same number of atoms on each side of the equation and therefore the same mass on either side of the equation.
  - OMIT
- Left side - open system as matter and energy can leave the system. Right side - system is closed to matter but energy can be lost or gained.

Key

**Goal** • Use this page to review the concepts of the atomic theory and bonding.

**What to Do**

Circle the letter of the best answer.

- Which statement is true of elements in the same period in the periodic table?
  - They share similar properties.
  - They have the same atomic mass.
  - They cannot react with each other.
  - They have the same number of energy levels.
- Which Lewis diagram correctly represents a nitrogen atom?
  - $\cdot \ddot{\text{N}} \cdot$
  - $\cdot \ddot{\text{N}} \cdot$
  - $\cdot \ddot{\text{N}} \cdot$
  - $\cdot \ddot{\text{N}} :$
- How many protons does an atom of silver contain?
  - 47
  - 108
  - 61
  - 60
- What does a Lewis diagram show?
  - unpaired electrons only
  - valence electrons only
  - electrons from the innermost energy level only
  - all the electrons in an atom
- An atom is found to have seven valence electrons. To which family of elements in the periodic table does this atom belong?
  - noble gases
  - halogens
  - alkaline earth metals
  - alkali metals
- What is the nucleus of any atom, except hydrogen, made up of?
  - only neutrons
  - only protons
  - equal numbers of electrons and protons
  - neutrons and protons

7. What is the name of the compound  $\text{Fe}_2\text{O}_3$ ?
- A. iron(III) oxide
  - B. iron oxide
  - C. iron(II) oxide
  - D. iron(II) trioxide
8. What is the name of the compound  $\text{S}_2\text{O}_3$ ?
- A. sulphur oxide
  - B. sulphur(III) oxide
  - C. sulphur trioxide
  - D. disulphur trioxide
9. What is the correct formula for the compound that contains magnesium and phosphate ions?
- A.  $\text{MgPO}_4$
  - B.  $\text{Mg}_3\text{PO}_4$
  - C.  $\text{Mg}_2(\text{PO}_4)_3$
  - D.  $\text{Mg}_3(\text{PO}_4)_2$
10. Which compound has no covalent bonds?
- A.  $\text{Na}_2\text{SO}_4$
  - B.  $\text{KCl}$
  - C.  $\text{KClO}_3$
  - D.  $\text{CH}_3\text{Cl}$
11. The name of  $\text{PbSO}_3$  is
- A. lead sulphur oxide
  - B. lead sulphate
  - C. lead(II) sulphur oxide
  - D. lead(II) sulphite
12. What is the key difference between an ionic bond and a covalent bond?

**Ionic bonds**

- 
- occur between metals + non metals (or negative polyatomic ions such as  $\text{OH}^-$ )
  - involve a + charged ion (has lost electrons) and a - charged ion (has gained electrons)
  - electrons are transferred from the metal to the non-metal to form the bond
- 

**Covalent bonds:**

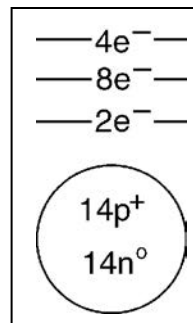
- occur between non-metals and non-metals
- do not involve + or - charges
- valence electrons are shared in order to create an overlap that forms the covalent bond



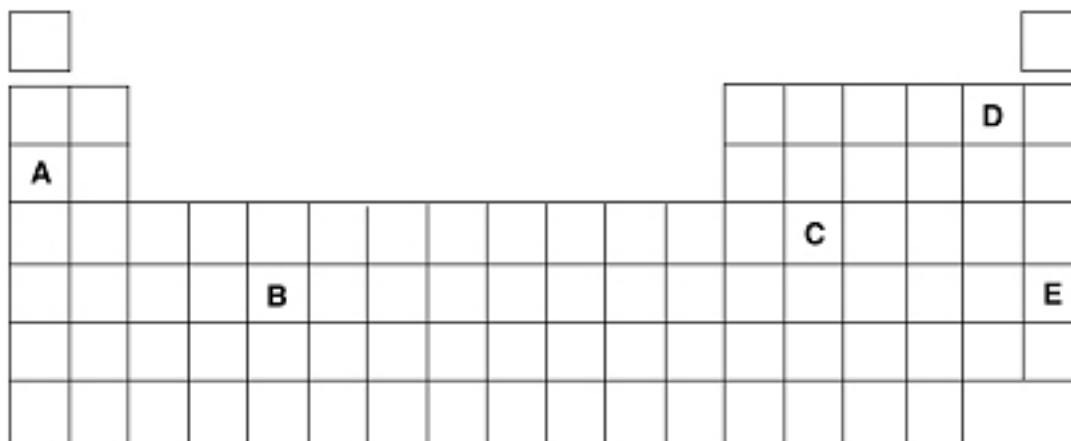
**Goal** • Use this page to review your understanding of atoms, ions, and compounds.

Circle the letter of the best answer.

- Which statement *best* fits the currently accepted model of the atom?  
A. Electrons associated with specific energy levels surround the nucleus of an atom.  
B. An atom is a sphere of positive charge in which electrons are embedded.  
C. An atom is a small indivisible sphere.  
D. An atom has a nucleus surrounded by positively charged particles.
- When metal atoms form ions in compounds, they tend to  
A. gain electrons and form positive ions  
B. lose electrons and form positive ions  
C. gain electrons and form negative ions  
D. lose electrons and form negative ions
- An  $\text{Al}^{3+}$  ion contains  
A. 13 electrons and 13 protons  
B. 10 electrons and 10 protons  
C. 10 electrons and 13 protons  
D. 13 electrons and 10 protons
- What does the diagram on the right represent?  
A. a nickel ion  
B. a silicon atom  
C. a nickel atom  
D. an oxygen ion
- If you were asked to draw electron Bohr diagrams for the following elements, which element would have a different number of occupied energy levels?  
A.  $\text{Mg}^{2+}$   
B.  $\text{F}^-$   
C. Ne  
D.  $\text{Cl}^-$
- Which list includes only substances with no ionic bonds?  
A.  $\text{N}_2\text{O}_4$ , HBr, LiCN  
B.  $\text{CO}_2$ ,  $\text{NH}_3$ ,  $\text{N}_2$   
C.  $\text{SO}_3$ ,  $\text{BaCl}_2$ ,  $\text{O}_2$   
D. NaCl,  $\text{CH}_4$ ,  $\text{Al}(\text{OH})_3$



Use the following diagram to answer the next three questions.



7. Which unknown represents an element in the halogen family?
  - A. A
  - B. B
  - C. C
  - D. D**
  - E. E
  
8. Which unknown represents an element that can be classified as a metalloid, having properties of both metals and non-metals?
  - A. A
  - B. B
  - C. C**
  - D. D
  - E. E
  
9. An experiment shows that an unknown element does not easily lose or gain electrons. Which unknown represents this element?
  - A. B
  - B. C
  - C. D
  - D. E**
  - E. E**
  
10. The reaction of solid copper(II) oxide with hydrogen gas at high temperatures produces copper metal and water. Which chemical equation represents this reaction?
  - A.  $\text{CuO}_2 + 2\text{H}_2 \rightarrow \text{Cu} + 2\text{H}_2\text{O}$
  - B.  $\text{Cu}_2\text{O}_2 + 2\text{H}_2 \rightarrow 2\text{Cu} + 2\text{H}_2\text{O}$
  - C.  $\text{CuO} + \text{H}_2 \rightarrow \text{Cu} + \text{H}_2\text{O}$**
  - D.  $\text{Cu}_2\text{O} + 2\text{H} \rightarrow 2\text{Cu} + \text{H}_2\text{O}$

**Goal** • Use this worksheet to review chemical equations and formulas.

Circle the letter of the best answer.

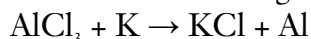
1. Which name and formula match correctly?

- A. magnesium fluoride,  $MgF_2$
- B. sodium sulphide,  $NaS$
- C. aluminum iodide,  $Al(IO_3)_3$
- D. iron(II) oxide,  $FeO_2$

2. Which is the formula for aluminum carbonate?

- A.  $AlC_3$
- B.  $AlCO_3$
- C.  $Al_2C_3$
- D.  $Al_2(CO_3)_3$

3. Which of the following sets of coefficients will balance the following skeleton equation?



- A. 1, 2, 1, 2
- B. 2, 6, 6, 1
- C. 1, 3, 3, 1
- D. 1, 2, 3, 1

4. Write the chemical formula for each of the following.

(a) potassium nitride  $K_3N$

(b) lithium oxide  $Li_2O$

(c) iron(II) sulphide  $FeS$

(d) nickel(III) bromide  $NiBr_3$

(e) copper(I) oxide  $Cu_2O$

(f) nitrogen dioxide  $NO_2$

(g) nickel(III) carbonate  $Ni_2(CO_3)_3$

(h) sodium phosphate  $Na_3PO_4$

(i) iron(III) hydroxide  $Fe(OH)_3$

(j) ammonium sulphate  $(NH_4)_2SO_4$

when ionic  
check +/- charges  
remember to  
"swap + drop" to  
balance charges

(covalent)

$NH_4^+$  (the only + charged polyatomic ion)

5. Write the name for each of the following compounds.

(a)  $\text{PbO}_2$  lead (IV) oxide

(b)  $\text{CuCl}$  copper (I) chloride

(c)  $\text{Fe}_2\text{S}_3$  iron (III) sulphide

(d)  $\text{Ni}_3(\text{PO}_4)_2$  nickel (II) phosphate

(e)  $\text{CuCO}_3$  copper (II) carbonate

6. (a) Write the corresponding skeleton equation for the following word equation.

calcium + water  $\rightarrow$  calcium hydroxide + hydrogen

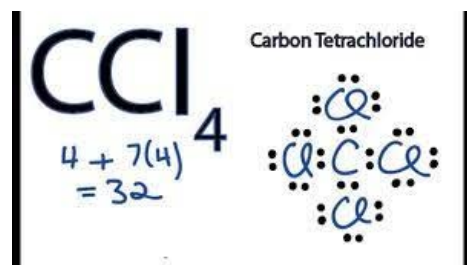


(b) Balance the skeleton equation.

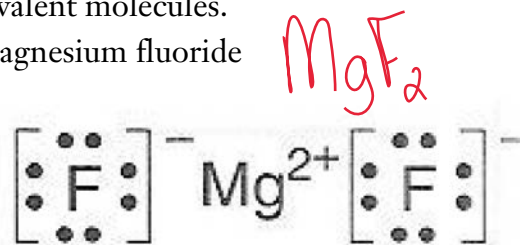


7. Draw Lewis diagrams for each of the following covalent molecules.

(a) carbon tetrachloride

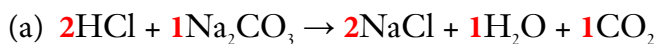


(b) magnesium fluoride



*\*note: covalent compounds like  $\text{CCl}_4$  should be drawn to show electrons sharing. ionic compounds like  $\text{MgF}_2$  must have square brackets to indicate ion charge.*

8. Balance each of the following skeleton equations.



**Goal** • Use this page to record your answers to questions 11 and 18 in Chapter 4 Review.

**What to Do**

Use these charts to record your answers to questions 11 and 18 on page 217 of your student book.

11.

	Reactants	Name	Formula
(a)	sodium and nitrogen	sodium nitride	Na <sub>3</sub> N
(b)	magnesium and oxygen	magnesium oxide	MgO
(c)	aluminum and sulphur	aluminum sulphide	Al <sub>2</sub> S <sub>3</sub>
(d)	gallium and fluorine	gallium fluoride	GaF <sub>3</sub>
(e)	silver and selenium	silver selenide	Ag <sub>2</sub> Se
(f)	zinc and chlorine	zinc chloride	ZnCl <sub>2</sub>

18.

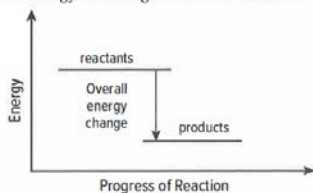
	Formula	Ionic or Covalent?	Name of Compound
(a)	CaCl <sub>2</sub>	ionic	calcium chloride
(b)	CuCl <sub>2</sub>	ionic	copper (II) chloride
(c)	SCl <sub>2</sub>	Covalent	sulphur dichloride
(d)	CoS	ionic	cobalt (II) sulphide

# Energy or Chemical Reactions (endo/exo)

Questioning and Predicting   Planning and Conducting   Processing and Analyzing   Evaluating  
Applying and Innovating   Communicating

## Understanding Key Ideas

- Describe an example of a physical change or chemical change that is endothermic and a physical or chemical change that is exothermic.
- Compare the overall energy changes that occur in endothermic reactions with those that occur in exothermic reactions. How are the energies of bond formation and bond breaking involved?
- Draw a sketch of the overall transfer of energy between the system and surroundings for an endothermic reaction.
- An energy-level diagram is shown below.



- Does the diagram represent an exothermic or endothermic reaction? Explain.
- Draw a diagram that would represent a greater overall energy change.

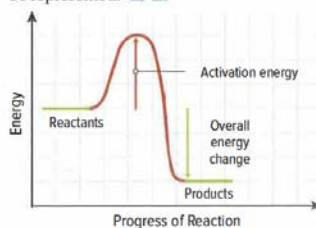
## Connecting Ideas

- Students perform a chemical reaction in a glass test tube. They notice that the test tube feels cooler than it did before the reactants were added.
  - Did the students most likely perform an exothermic or endothermic reaction?
  - What data could the students collect to confirm the type of reaction?
  - Identify the system and the surroundings in this investigation.

- Is melting an ice cube an endothermic or exothermic process? Explain.
- Although many individual reactions are part of photosynthesis and cellular respiration, the following chemical equations can be used to represent the overall processes.  
Photosynthesis:  
 $6\text{H}_2\text{O} + 6\text{CO}_2 + \text{energy} \rightarrow 6\text{O}_2 + \text{C}_6\text{H}_{12}\text{O}_6$   
Cellular respiration:  
 $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + \text{energy}$   
Is photosynthesis an endothermic process or an exothermic process? What about cellular respiration? Explain your answers.

## Making New Connections

- The image below shows another way that energy changes in a chemical reaction can be represented.



- What is activation energy? Why do you think it is represented as a "hill"?
- Describe the relative energy levels of the reactants and products.
- Does this diagram represent an exothermic or endothermic reaction? Explain your answer.
- Infer which are the most stable particles in the reaction. Which are the least stable? Justify your responses based on the energies of the particles.

## ANSWER KEY: Energy or Chemical Reactions (endo/exo)

- Physical change - crumbling paper into a ball, Chemical change - burning the paper (exothermic), instant ice pack (endothermic)
- Endothermic reactions - temperature decreases as energy is absorbed from surroundings to system to break bonds, exothermic reaction - when bonds are formed energy is released
- Surroundings energy  $\rightarrow$  system
- a) Exothermic as energy has been released   b) diagram where difference between reactant level and product level is greater
- a) endothermic reaction   b) temperature measurements before, during, after reaction   c) system chemicals in test tube, surroundings classroom
- Ice melting is endothermic as for it to happen energy must be added to the system
- Photosynthesis is endothermic as it requires an input of energy, cellular respiration is exothermic as it has an output of energy
- a) energy required for a reaction to happen, hill since top must be reached to get over to the other side  
b) reactants have more energy than products   c) exothermic as heat has been released   d) products are more stable as they are at a lower energy level

**Goal** • Check your understanding of Chapter 5.

### What to Do

Circle the letter of the best answer. You may refer to a periodic table, ion chart, pH scale, and pH indicator colour change chart.

- Which of the following household items is basic?
  - baking soda
  - grapes
  - bananas
  - water
- What are the colours of methyl red indicator and bromothymol blue indicator in separate samples of water at pH 7?
  - Methyl red indicator is red, and bromothymol blue indicator is yellow.
  - Methyl red indicator is yellow, and bromothymol blue indicator is blue.
  - Methyl red indicator is yellow, and bromothymol blue indicator is green.
  - Methyl red indicator is orange, and bromothymol blue indicator is green.
- Which are properties characteristic of an acid but not a base?
  - sour, reacts with magnesium, turns litmus blue
  - bitter, reacts with magnesium, turns litmus red
  - slippery touch, does not react with magnesium, turns litmus blue
  - sour, turns phenolphthalein indicator colourless, turns litmus red
- What the best chemical definition of a salt?
  - a material found by evaporating sea water
  - a material formed by the reaction of an acid with a base
  - a material containing a metal ion and an oxide ion
  - a material containing a metal ion and carbonate ion
- Burning magnesium in air produces a brilliant white flame and a white powder. When the white powder is placed in water, it dissolves. What is the colour when bromothymol blue indicator is added to this solution?
 

*burning magnesium reaction is:*  
 $\text{Mg} + \text{O}_2 \rightarrow \text{MgO}$   
*when MgO is placed in water it reacts with H<sub>2</sub>O*  
 $\text{MgO} + \text{H}_2\text{O} \rightarrow \text{Mg}(\text{OH})_2$

  - colourless
  - yellow
  - green
  - blue

the "OH" indicates this product is **basic**. **bromothymol blue is BLUE in a basic substance**
- What is formed when HCl and NaOH solutions are combined?
  - NaCl and H<sub>2</sub>O
  - NaH and ClOH
  - NaOCl and H<sub>2</sub>
  - There is no reaction.
  -

7. Which list shows the elements that are the most reactive towards water on the left and least reactive towards water on the right?

- A. cesium, magnesium, potassium
- B. cesium, potassium, magnesium
- C. potassium, cesium, magnesium
- D. magnesium, potassium, cesium

Term	Descriptor
<u>D</u> 11. indigo carmine	A. releases OH <sup>-</sup> ions in solution
<del>_____</del> 12. inorganic	B. compounds that do not contain carbon
<del>_____</del> 13. solvent	C. releases H <sup>+</sup> ions in solution
<u>C</u> 14. acid	D. acid-base indicator
<u>H</u> 15. concentration	E. a set of numbers that measure acidity levels
<u>E</u> 16. pH scale	F. a liquid capable of dissolving other substances
	G. turns red in acid
	H. a measure of the quantity of a substance dissolved in a given volume

### Short Answer Questions

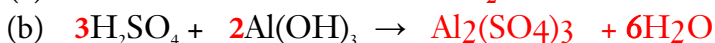
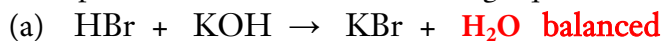
17. Name the following compounds and indicate whether each is an acid, a base, or neither.

	Compound	Name	Acid, Base, or Neither?
(a)	H <sub>2</sub> SO <sub>4</sub>	<b>sulphuric acid</b>	<b>acid</b>
(b)	HCl	<b>hydrochloric acid</b>	<b>acid</b>
(c)	Ca(OH) <sub>2</sub>	<b>calcium hydroxide</b>	<b>base</b>

18. Complete the following chart.

Indicator	Colour at pH 4	Colour at pH 7	Colour at pH 10
Blue litmus paper	<b>red</b>	<b>purple</b>	<b>blue</b>
Red litmus paper	<b>red</b>	<b>purple</b>	<b>blue</b>

19. Complete and balance the following equations.



(c) The reactions in (a) and (b) are both of the same type. What is the name of this type of reaction? *They are BOTH neutralization reactions (acid + base --> water + salt compound)*



# Types of Chemical Reactions

## Understanding Key Ideas

- Synthesis reactions are also often referred to as combination reactions. Explain why this other name makes sense.
- Explain why most synthesis reactions are exothermic. What does this imply about the energy needed to break the reactant bonds compared to energy released when the product bonds form? Draw an energy level diagram that could represent a synthesis reaction.
- Develop a general equation that could represent a decomposition reaction. Why can you consider a decomposition reaction to be the reverse of a synthesis reaction?
- Copy and complete the following table in your notebook.

	H <sup>+</sup> concentration greater than, less than, or equal to OH <sup>-</sup> concentration?	pH greater than, less than, or equal to 7?
Acid solution		
Base solution		
Neutral solution		

## Connecting Ideas

- Use the following chemical equations to answer the questions below.  

$$\text{Mg(s)} + \text{AgNO}_3(\text{aq}) \rightarrow \text{Ag(s)} + \text{Mg(NO}_3)_2$$

$$\text{Na}_2\text{SO}_4(\text{aq}) + \text{BaCl}_2(\text{aq}) \rightarrow \text{BaSO}_4(\text{s}) + \text{NaCl(aq)}$$
  - Identify each type of reaction.
  - Write the balanced chemical equation for each.
- For each skeleton equation below, classify the type of reaction as a synthesis, decomposition, single replacement, double replacement, neutralization, or combustion reaction. Justify your classification. Then write the balanced chemical equation for each.
  - $\text{C}_4\text{H}_{10}(\text{g}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{g})$
  - $\text{Li(s)} + \text{N}_2(\text{g}) \rightarrow \text{Li}_3\text{N(s)}$
  - $\text{AgNO}_3(\text{aq}) + \text{Na}_2\text{CrO}_4(\text{aq}) \rightarrow \text{NaNO}_3(\text{aq}) + \text{Ag}_2\text{CrO}_4(\text{s})$
  - $\text{MgO(s)} \rightarrow \text{Mg(s)} + \text{O}_2(\text{g})$
  - $\text{HI(aq)} + \text{KOH(aq)} \rightarrow \text{KI(aq)} + \text{H}_2\text{O(l)}$
  - $\text{AlPO}_4(\text{aq}) + \text{Mg(s)} \rightarrow \text{Al(s)} + \text{Mg}_3(\text{PO}_4)_2(\text{aq})$
- For each of the following, identify the type of reaction that is represented. Then, predict the products and write the balanced chemical equations. You do not need to provide the states of the products.
  - $\text{HCl(aq)} + \text{Mg(OH)}_2(\text{aq}) \rightarrow$
  - $\text{Al}_2\text{O}_3(\text{s}) \rightarrow$
  - $\text{Na(s)} + \text{Cl}_2(\text{g}) \rightarrow$
  - $\text{NH}_4\text{Cl(aq)} + \text{AgCH}_3\text{COO(aq)} \rightarrow$
  - $\text{NaI(aq)} + \text{Br}_2(\text{g}) \rightarrow$
  - $\text{Al(s)} + \text{CuCl}_2(\text{aq}) \rightarrow$

## Making New Connections

- Society relies on hydrocarbon combustion.
  - What are the dangers associated with incomplete combustion of hydrocarbons?
  - Do you think hydrocarbons with a greater number of carbon and hydrogen atoms will produce more or less energy than smaller hydrocarbons? Explain.
  - Describe one advantage and one disadvantage of our use of hydrocarbon combustion.

## ANSWER KEY: Types of Chemical Reactions

- This other name makes sense as the reactants are combining to form a product
- More energy is released as the bonds form compared to the amount of energy needed to break any bonds in this example. Energy level diagram would have reactants at a higher level than products.
- One compound  $\rightarrow$  two or more parts, reverse as it is breaking apart a compound rather
- Acid solution - H<sup>+</sup> concentration greater/pH less than 7, Base solution - H<sup>+</sup> concentration less than OH<sup>-</sup> concentration/pH greater than 7, Neutral solution - H<sup>+</sup> concentration equals OH<sup>-</sup> concentration/pH 7
- first reaction - single replacement, second reaction - double replacement
  - $\text{Mg} + 2\text{AgNO}_3 \rightarrow 2\text{Ag} + \text{Mg(NO}_3)_2$  and  $\text{Na}_2\text{SO}_4 + \text{BaCl}_2 \rightarrow \text{BaSO}_4 + 2\text{NaCl}$
- combustion, coefficients to balance 2, 13, 8, 10
  - synthesis, coefficients to balance 6, 1, 2
  - double replacement 2, 1, 2, 1
  - decomposition 2, 2, 1
  - neutralization, balanced
  - single replacement 2, 3, 2, 1
- neutralization  $2\text{HCl} + \text{Mg(OH)}_2 \rightarrow 2\text{H}_2\text{O} + \text{MgCl}_2$
  - decomposition  $2\text{Al}_2\text{O}_3 \rightarrow 4\text{Al} + 3\text{O}_2$
  - synthesis  $2\text{Na} + \text{Cl}_2 \rightarrow 2\text{NaCl}$
  - double replacement  $\text{NH}_4\text{Cl} + \text{AgCH}_3\text{COO} \rightarrow \text{AgCl} + \text{NH}_4\text{CH}_3\text{COO}$
  - single replacement  $2\text{NaI} + \text{Br}_2 \rightarrow 2\text{NaBr} + \text{I}_2$
  - $2\text{Al} + 3\text{CuCl}_2 \rightarrow 2\text{AlCl}_3 + 3\text{Cu}$
- production of carbon monoxide
  - more as more bonds broken equals more energy released
  - advantage - infrastructure is set up for fossil fuel use, disadvantage - contribution to global warming

**Goal** • Review the types of chemical reactions.

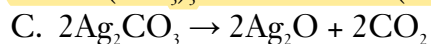
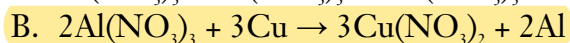
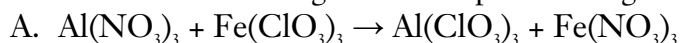
Circle the letter of the best answer.



What kind of chemical reaction is this?

- A. synthesis reaction
- B. decomposition reaction
- C. replacement reaction
- D. double replacement reaction

2. Which of the following is an example of a single replacement reaction?



### Short Answer Questions

3. What is the difference between the following?

(a) a single and a double replacement reaction

Single replacement - 1 element and 1 compound, double replacement - two compounds

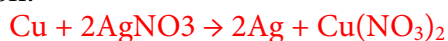
(b) a synthesis and a decomposition reaction

synthesis - two elements combine to form one compound, decomposition - one compound breaks apart.

4. Complete and balance the following neutralization reaction.

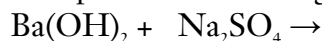


5. (a) Complete the following reaction.



(b) Identify the type of reaction. single replacement

6. (a) Complete the following reaction  $\text{Ba}(\text{OH})_2 + \text{Na}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + 2\text{NaOH}$



(b) Identify the type of reaction. double replacement

**Goal** • Check your understanding of Chapter 6.

### What to Do

Circle the letter of the best answer. You may refer to a periodic table and an ion chart.

1. What type of reaction is the following?  
silver + gold(III) nitrate  $\rightarrow$  silver nitrate + gold  
A. synthesis  
B. neutralization  
C. single replacement  
D. double replacement
2. What type of reaction is the following?  
 $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$   
A. single replacement  
B. combustion  
C. decomposition  
D. double replacement
3. Classify the reaction type and predict the products of the following reaction.  
 $HCl + Mg(OH)_2 \rightarrow ?$   
A. double replacement; products are  $MgCl$  and  $H(OH)_2$   
B. double replacement; products are  $MgCl_2$  and  $H_2O$   
C. neutralization; products are  $MgCl$  and  $H(OH)_2$   
D. neutralization; products are  $MgCl_2$  and  $H_2O$
4. Which of the following reactions is double replacement?  
A.  $Pb + 2CuCl_2 \rightarrow PbCl_2 + 2Cu$   
B.  $Na_2CO_3 + CaBr_2 \rightarrow CaCO_3 + 2NaBr$   
C.  $MgCO_3 + 2HBr \rightarrow MgBr_2 + CO_2 + H_2O$   
D.  $Mg(OH)_2 + 2HBr \rightarrow MgBr_2 + 2H_2O$
5. What are the products in the decomposition reaction involving aluminum oxide?  
A. Al and O  
B.  $Al_2O_3$   
C. Al and  $O_2$   
D. AlO
6. In order to start a campfire, wood is chopped into many small pieces, called kindling. Which factor makes it easier to light a fire using kindling instead of large pieces of wood?  
A. temperature  
B. concentration  
C. surface area  
D. catalyst

6. When hydrogen gas is mixed with oxygen gas in a closed container, both gases mix but no noticeable reaction takes place. When a piece of platinum metal is placed in the gas mixture, the mixture suddenly explodes. After the explosion, analysis shows that the amount of platinum metal did not change during the explosion. What factor is responsible for the onset of the explosion?
- The concentration of the oxygen was high.
  - The concentration of the hydrogen was high.
  - The platinum was a reactant.
  - The platinum was a catalyst.
7. The chain on a bicycle rusts faster when the bicycle is left outside in damp conditions. Which of the following factors affect the rate at which the bicycle chain rusts?

I	The surface area of the metal in the chain
II	The concentration of oxygen in the air
III	The temperature

- I only
  - II and III only
  - III only
  - I, II, and III
9. A zinc metal strip is placed in hydrochloric acid. Which of the following changes could be made to decrease the rate of this reaction?

I	Add water to dilute the hydrochloric acid.
II	Place the beaker on a hot plate in order to raise the temperature.
III	Add a catalyst.
IV	Change the shape of the magnesium to make it thicker and less wide.

- I and II only
- II and III only
- I and IV only
- II and IV only

Match the Term on the left with the best Descriptor on the right.  
Each Descriptor may be used only once.

Term	Descriptor
<u>G</u> 11. synthesis	A. a reaction in which a compound splits into two elements
<u>D</u> 12. precipitate	B. the reaction involving a burning candle
<u>B</u> 13. combustion	C. the reaction of an acid with a base
<u>N/A</u> 14. surface area	D. a solid that forms when two ionic solutions are mixed
<u>C</u> 15. neutralization	E. a substance that increases reaction rate without being used up by the reaction
<u>N/A</u> 16. catalyst	F. affects the rate of a reaction between a solid and a liquid
	G. a reaction in which two elements combine to form a compound

### Short Answer Questions

17. Identify each of the following descriptions as synthesis, decomposition, single replacement, double replacement, neutralization, or combustion.

- (a) There is only one reactant. decomposition
- (b) One reactant is an element. The other is a compound. single replacement
- (c) Two ionic compounds react to form two new ionic compounds. double replacement

~~18. Which of the four factors affecting reaction rate is most important in each question below? Choose from ~~among~~ concentration, temperature, surface area, and catalyst.~~

- ~~(a) Dust in a granary explodes ~~when it comes in contact with a spark.~~ \_\_\_\_\_~~
- ~~(b) Table sugar is digested in the mouth when it ~~dissolves~~ in saliva, which contains a digestive enzyme. \_\_\_\_\_~~
- ~~(c) A person blows on a fire to help get it burning better. \_\_\_\_\_~~

19. Complete and balance each of the following equations. Then classify each reaction type.

- (a)  $\text{Zn} + \text{Cu(OH)}_2 \rightarrow$   $\text{Zn} + \text{Cu(OH)}_2 \rightarrow \text{Cu} + \text{Zn(OH)}_2$  type: single replacement  
Reaction type: \_\_\_\_\_
- (b)  $\text{C}_2\text{H}_4 + \text{O}_2 \rightarrow$   $\text{C}_2\text{H}_4 + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 2\text{H}_2\text{O}$   
Reaction type: combustion
- (c)  $\text{Al} + \text{S}_8 \rightarrow$   $16\text{Al} + 3\text{S}_8 \rightarrow 8\text{Al}_2\text{S}_3$   
Reaction type: synthesis

Practice Worksheet Naming Acids

Review:

- When the anion does NOT contain Oxygen:

Use the prefix *hydro* + **root of the anion's name** – *ic* + the word acid

Examples: HCl - *hydrochloric* acid; HBr- *hydrobromic* acid

- When the anion contains Oxygen:

The name will depend on the name of the polyatomic anion. **DO NOT** use the prefix hydro. Examples: H<sub>2</sub>SO<sub>4</sub> the anion is **sulfate**, therefore the acid name will end in **ic** – **Sulfuric acid**. H<sub>2</sub>SO<sub>3</sub> the anion is **sulfite**, therefore the name of the acid will end in **ous** – **sulfurous acid**.

ATE → IC

ITE → OUS

	<u>Formula of Acid</u>	<u>Name of Acid</u>
1.	HCl	<b>Hydrochloric Acid</b>
2.	H <sub>2</sub> S	<b>Hydrosulfuric Acid</b>
3.	H <sub>3</sub> PO <sub>3</sub>	<b>Phosphorous Acid</b>
4.	H <sub>2</sub> SO <sub>4</sub>	<b>Sulfuric Acid</b>
5.	HClO <sub>3</sub>	<b>Chloric Acid</b>
6.	H <sub>3</sub> PO <sub>4</sub>	<b>Phosphoric Acid</b>
7.	HI	<b>Hydroiodic Acid</b>
8.	H <sub>2</sub> SO <sub>3</sub>	<b>Sulfurous Acid</b>
9.	HC <sub>2</sub> H <sub>3</sub> O <sub>2</sub>	<b>Acetic Acid</b>
10.	H <sub>3</sub> P	<b>Hydrophosphoric Acid</b>
11.	HF	<b>Hydrofluoric Acid</b>
12.	HNO <sub>2</sub>	<b>Nitrous Acid</b>
13.	HBr	<b>Hydrobromic</b>
14.	HNO <sub>3</sub>	<b>Nitric Acid</b>
15.	H <sub>2</sub> CO <sub>3</sub>	<b>Carbonic Acid</b>
16.	H <sub>2</sub> CrO <sub>4</sub>	<b>Chromic Acid</b>

	<u>Name of Acid</u>	<u>Formula of Acid</u>
1.	Nitric Acid	<b>HNO<sub>3</sub></b>
2.	Sulfic Acid/Sulfuric Acid	<b>H<sub>2</sub>SO<sub>4</sub></b>
3.	Hydrophosphic Acid/Hydrophosphoric Acid	<b>H<sub>3</sub>P</b>
4.	Chloric Acid	<b>HClO<sub>3</sub></b>
5.	Hydrobromic Acid	<b>HBr</b>
6.	Nitrous Acid	<b>HNO<sub>2</sub></b>
7.	Oxalic Acid	<b>H<sub>2</sub>C<sub>2</sub>O<sub>4</sub></b>
8.	Hydroiodic Acid	<b>HI</b>
9.	Phosphic Acid/Phosphoric Acid	<b>H<sub>3</sub>PO<sub>4</sub></b>
10.	Hydrosulfic Acid/Hydrosulfuric Acid	<b>H<sub>2</sub>S</b>
11.	Hydrochloric Acid	<b>HCl</b>
12.	Chromic Acid	<b>H<sub>2</sub>CrO<sub>4</sub></b>
13.	Hydrofluoric Acid	<b>HF</b>
14.	Phosphous Acid/Phosphorous Acid	<b>H<sub>3</sub>PO<sub>3</sub></b>
15.	Acetic Acid	<b>HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub></b>
16.	Sulfous Acid/Sulfurous Acid	<b>H<sub>2</sub>SO<sub>3</sub></b>
17.	Chlorous Acid	<b>HClO<sub>2</sub></b>

# 1 Exothermic and endothermic reactions

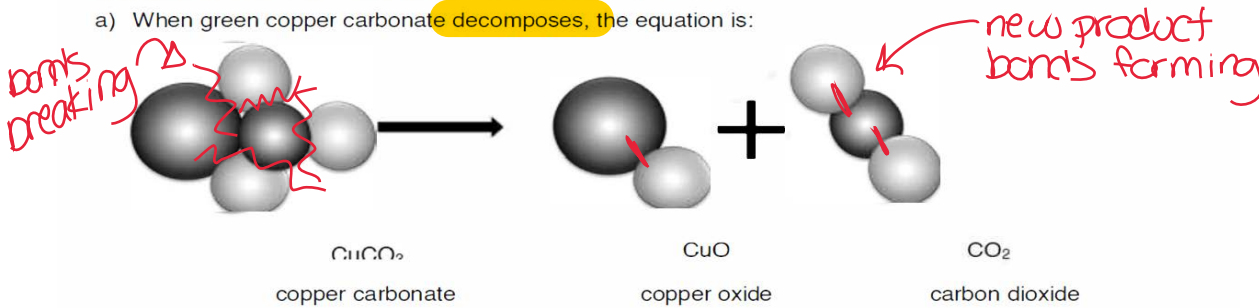
Decide whether each of these reactions is **exothermic** or **endothermic**:

- a) When two chemicals mix their temperature rises: exothermic
- b) A solid burns brightly and releases heat, light and sound: exothermic
- c) When two chemicals are mixed their temperature drops: endothermic
- d) Two chemicals will only react if you heat them continually: endothermic (require heat) input
- e) Plants take in light energy for photosynthesis: endothermic (require energy)

# 2 Making and breaking bonds

During chemical reactions the bonds between atoms break and new bonds form. Energy must be absorbed to break a bond, so breaking bonds is endothermic. Making new bonds is exothermic because energy is released.

a) When green copper carbonate decomposes, the equation is:



Is the reaction exothermic or endothermic? Use ideas about bonds to explain why.

The reaction is endothermic. Decomposition reactions always require a large energy input to break bonds.

b) Draw diagrams to show what happens when hydrogen reacts with oxygen. Mark the bonds broken in blue and the new bonds formed in red. The equation is:



## Energy Changes in Chemical reactions

1. In an exothermic reaction does the temperature go up or down?

**an exothermic reaction releases energy, so the temperature would go up**

2. In an endothermic reaction does the temperature go up or down?

**an endothermic reaction requires energy input, so the temperature would decrease**

3. Name two examples of exothermic reactions

**combustion reactions, many acid base reactions, acid-metal (single replacement reactions)**

4. Name two examples of endothermic reactions

**decomposition reactions, photosynthesis**

5. Circle the correct answers.

The bonds between the atoms of the **reactants** / products need to be broken first, this is an **endothermic** / exothermic process. Then bonds are made between the atoms of the reactants / **products**, this is an endothermic / **exothermic** process.



6. Use the table to answer this question

Reaction	Starting temperature °C	Final temperature °C
A	20	31
B	22	18
C	21	25

a. Decide whether each reaction is endothermic or exothermic, explain how you could tell.

..... A) temperature increase --> exothermic .....

..... B) temperature decrease --> endothermic .....

..... C) temperature increase --> exothermic .....

b. Which reaction has the largest energy change?

..... reaction A) increases in temperature the most, so it likely has the largest energy change

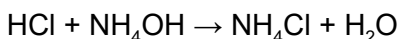
7. In an exothermic reaction, is enthalpy change positive or negative?

..... Enthalpy ( $\Delta H$ ) is negative for an exothermic reaction ( $E_{\text{products}} - E_{\text{reactants}} = \text{negative}$ )

8. In an endothermic reaction, is enthalpy change positive or negative?

..... Enthalpy ( $\Delta H$ ) is positive for an endothermic reaction ( $E_{\text{products}} - E_{\text{reactants}} = \text{positive}$ )

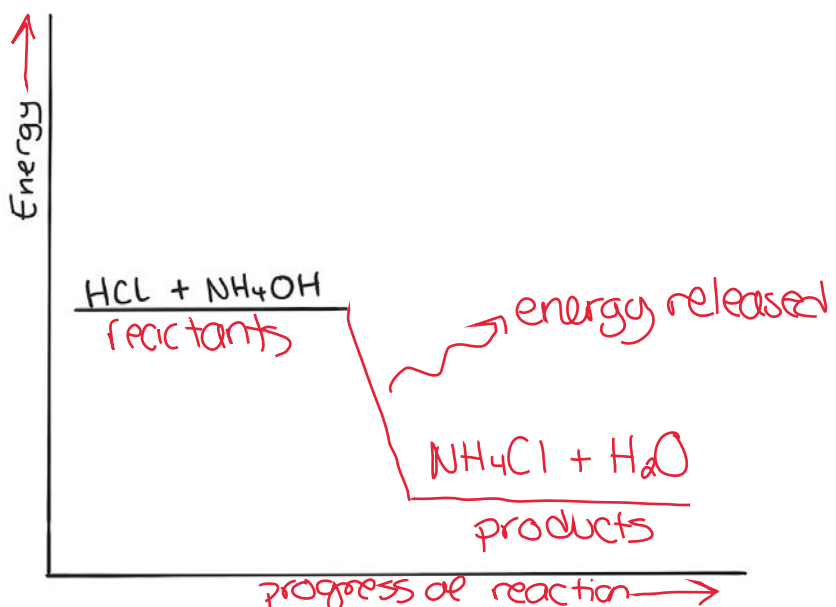
9. When hydrochloric acid reacts with ammonium hydroxide in a beaker, the temperature goes up. (energy is released)



$$\Delta H = -53.4 \text{ kJ/mol}$$

$\ominus \Delta H = \text{exothermic reaction } (E_{\text{products}} < E_{\text{reactants}})$

Complete the energy profile diagram and state whether the reaction is endothermic or exothermic, explain your answer.

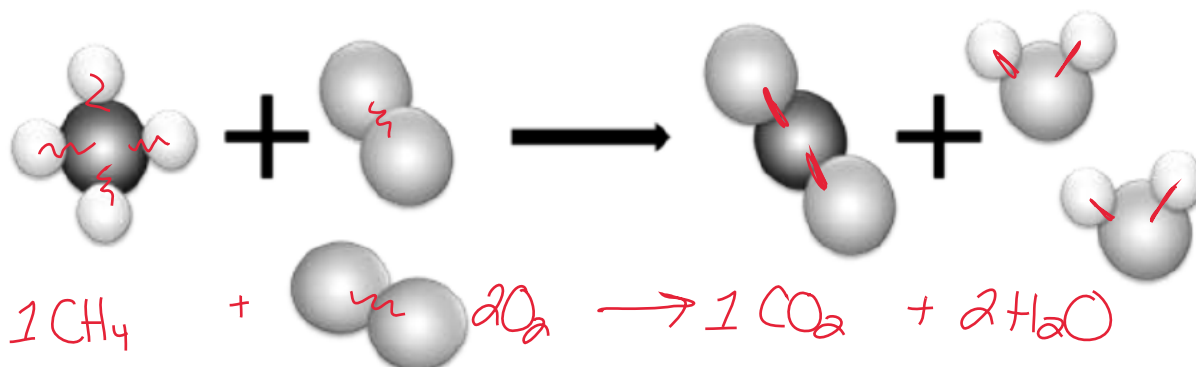


10. What are the units for enthalpy change,  $\Delta H$

kJ/mol

### 3 'Make or break'

- a) Most reactions involve bond breaking and bond making. This equation shows what happens when methane (CH<sub>4</sub>) burns in oxygen (O<sub>2</sub>). Mark the bonds broken in blue and the bonds formed in red.



- b) Complete the table to show the number of bonds broken and formed:

Bonds broken	Number	Bonds formed	Number
between carbon and hydrogen	4	between carbon and oxygen	2
between oxygen atoms	2	between hydrogen and oxygen	4

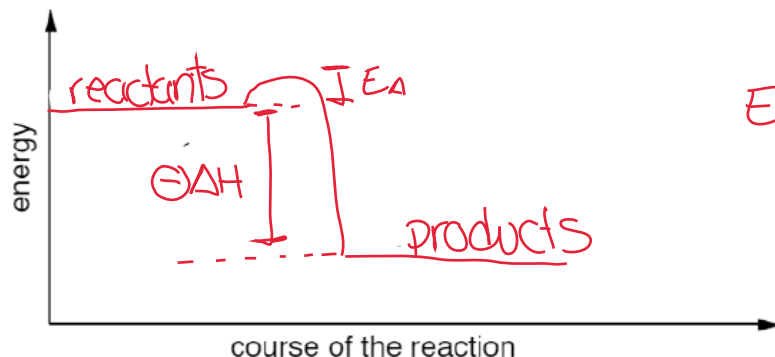
- c) Is the reaction exothermic or endothermic overall?

The reaction is exothermic because combustion reactions release energy in the form of heat.

- d) The overall energy change is decided by the strength of the bonds that are broken or formed during the reaction. The stronger the bond the larger the energy change. Which bonds must be stronger in this reaction – the bonds broken or the new bonds formed?

The reactant bonds must be stronger because more energy is required in the reactants. The formation of product bonds requires less energy, that is why the excess is released.

- e) An energy level diagram shows the energy taken in and released during the reaction. Add the reactants, products and their separated atoms to the correct places on the diagram.



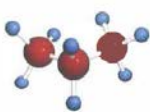
$E_{\text{reactants}} > E_{\text{products}}$   
 $\ominus \Delta H$  (Enthalpy)  
 exothermic reaction.

# Chemistry Review

## What Do You Know? Connecting to Concepts

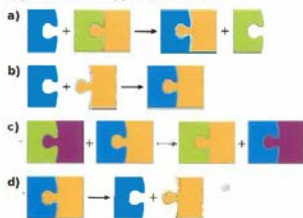
### Visualizing Ideas

1. A ball-and-stick model of propane,  $C_3H_8$ , is shown. Use the model to answer the following questions.



- Is this an ionic or covalent compound? Explain how you know.
- Using Bohr or Lewis diagrams, show how electrons are involved in the formation of one of the bonds in this compound.
- Describe the bonds that are broken and new bonds that form when propane undergoes a combustion reaction.
- Sketch an energy level diagram that would represent the combustion of propane. Label your diagram as endothermic or exothermic, and provide evidence that supports your decision.

2. For each image below, identify the reaction type it represents, and explain why it represents that type of reaction.



### Using Key Terms

- What does the term *formula unit* refer to?
- What do coefficients in balanced chemical equations represent? Give an example of a chemical formula with a coefficient.
- Describe, in sentences or with a graphic organizer, the relationships between the following terms: *bond breaking*, *bond forming*, *energy release*, *energy absorption*, *exothermic*, *endothermic*.
- Describe what an acid and a base are. Give the name and chemical formula for an example of each.
- Use a graphic organizer to compare and contrast ionic and covalent bonds.

### Communicating Concepts

- Determine the number of atoms of each element for the following compounds.  
a)  $4CO$     b)  $3MgCl_2$     c)  $2(NH_4)_2SO_4$
- Why is it incorrect to change the subscripts in chemical formulas when you are balancing a chemical equation?
- Balance each of the following chemical equations.  
a)  $Na(s) + O_2(g) \rightarrow Na_2O(s)$   
b)  $KCl(s) \rightarrow K(s) + Cl_2(g)$   
c)  $N_2(g) + O_2(g) \rightarrow NO_2(g)$   
d)  $CuSO_4(aq) + Na(s) \rightarrow Cu(s) + Na_2SO_4(aq)$   
e)  $Pb(NO_3)_2(aq) + KI(aq) \rightarrow PbI_2(s) + KNO_3(aq)$   
f)  $Al(s) + Cl_2(g) \rightarrow AlCl_3(s)$

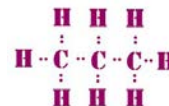
11. Use the diagram to answer the questions below.




- Two atoms are shown. What elements are represented? Explain how you know.
- What type of bond is represented? Why?
- Is energy released or absorbed in this process?

## ANSWER KEY: Chemistry Review

- covalent, involves sharing of electrons and two elements acting as nonmetals
  - bonds broken between carbon/carbon and carbon/hydrogen atoms, new bonds formed with carbon and oxygen and hydrogen and oxygen
  - exothermic reaction - products have less energy than reactants
- single replacement - one piece is being replaced only
  - synthesis - two pieces form one piece
  - double replacement - two pieces are swapped
  - decomposition - one piece breaks into two
- Way of representing a chemical compound, indicates the lowest reduced ratio of ions in the compound. Ex.  $Pb_2S_4 \rightarrow PbS_2$
- The number of molecules of each compound ex.  $2NaCl$  is two molecules of sodium chloride
- Bond breaking  $\rightarrow$  energy absorbed (endothermic), bond forming  $\rightarrow$  energy released (exothermic)
- Acid - contains  $H^+$  ions ex.  $HCl$     Base - contains  $OH^-$  ions ex.  $NaOH$
- Ionic bonds - metal and nonmetal/transfer of electrons      Covalent bonds - two nonmetals/sharing of electrons
- a) 4 C, 4 O    b) 3 Mg, 6 Cl    c) 4N, 16H, 2S, 8O
- As the subscripts indicate how many of each atom are necessary to form a stable compound and can't be changed.
- coefficients to balance 4, 1, 2    b) 2, 2, 1    c) 1, 2, 2    d) 1, 2, 1, 1    e) 1, 2, 1, 2
  - 2, 3, 2
- Li and F - since it is an atom the number of electrons = the number of protons which is the atomic number  
b) Ionic bond - transfer of electrons      c) released



12. Why are ionic compounds not considered molecules?
13. Draw a Bohr diagram that represents the chemical bond in a molecule of  $\text{Cl}_2$ .
14. What elements exist as diatomic or polyatomic molecules? Write their names and chemical formulas.
15. Indicate if each of the following is an acidic, basic, or neutral solution.
- lemon juice
  - a solution with  $\text{pH} = 9$
  - an aqueous solution of sodium chloride, using water with a  $\text{pH} = 7$
16. Bacteria are used to make cheese ( $\text{pH} = 5.5$ ) and yogurt ( $\text{pH} 4.5$ ) from milk ( $\text{pH} 6.5$ ). Place these foods in the order of least acidic to most acidic.

17. The photo shows what happens when zinc metal is placed in a solution of hydrochloric acid.
- 
- What evidence suggests that a chemical change is occurring?
  - How does the mass of zinc metal change as the reaction proceeds?
  - Name the gaseous product that forms bubbles in this reaction. How do you know?
  - Write the balanced chemical equation for this reaction.
  - What type of reaction is this? Explain your choice.
  - After the reaction, the test tube feels warm. Describe the overall energy change for this reaction.

18. You have learned about single replacement and double replacement reactions in this unit. Explain why the names of these types of reactions are appropriate.

## What Do You Know?

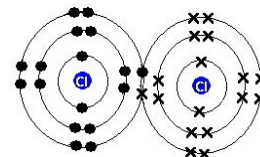
### Connecting to Competencies

#### Developing Skills

19. Represent these reactions using word, skeleton, and balanced chemical equations. Include the states of reactants and products.
- Freshly cut sodium reacts with oxygen gas in air and forms solid sodium oxide.
  - When a piece of magnesium ribbon is placed into an aqueous solution of copper(II) chloride, copper metal and an aqueous solution of magnesium chloride form.
  - Solid magnesium oxide and carbon dioxide gas form when powdered magnesium carbonate is heated.
  - When aqueous solutions of chromium(III) chloride and potassium hydroxide are mixed, a solution of potassium chloride and a precipitate of chromium(III) hydroxide form.
20. Identify the type of reaction for each part in question 19. Explain your reasoning.
21. For the following reactants, identify the type of reaction they will undergo, predict the products, and write the balanced chemical equations. (Do not include the states of the products.)
- $\text{Au}(\text{NO}_3)_3(\text{aq}) + \text{Ag}(\text{s}) \rightarrow$
  - $\text{CuO}(\text{s}) \rightarrow$
  - $\text{BaCl}_2(\text{aq}) + \text{K}_2\text{SO}_4(\text{aq}) \rightarrow$
  - $\text{C}(\text{s}) + \text{O}_2(\text{g}) \rightarrow$
  - $\text{HBr}(\text{aq}) + \text{Al}(\text{OH})_3(\text{aq}) \rightarrow$
  - $\text{AgCl}(\text{s}) \rightarrow$
  - $\text{Ca}(\text{s}) + \text{S}_8(\text{s}) \rightarrow$
  - $\text{Mg}(\text{s}) + \text{HCl}(\text{aq}) \rightarrow$
  - $\text{NaCl}(\text{aq}) + \text{AgNO}_3(\text{aq}) \rightarrow$
  - $\text{C}_4\text{H}_{10}(\ell) + \text{O}_2(\text{g}) \rightarrow$

## ANSWER KEY: Chemistry Review

12. Because they don't contain covalent bonds
13. Diagram:



14. Diatomic molecules - hydrogen  $\text{H}_2$ , nitrogen  $\text{N}_2$ , oxygen  $\text{O}_2$ , fluorine  $\text{F}_2$ , chlorine  $\text{Cl}_2$ , bromine  $\text{Br}_2$ , iodine  $\text{I}_2$
15. a) acidic      b) bas      c) neutr
16. Milk, cheese, yogurt
17. a) formation of a gas      b) decreas      c) hydrogen gas, started with HCl and Zn single replaceme  
d)  $2\text{Zn} + 2\text{HCl} \rightarrow \text{H}_2 + \text{ZnCl}_2$       e) single replacement, one element is replac      f) exotherm
18. They are appropriate as they represent the number of replacements that happen in the reaction
19. a) word: sodium plus oxygen produces sodium oxide, skeleton:  $\text{Na} + \text{O}_2 \rightarrow \text{Na}_2\text{O}$ , balanced:  $4\text{Na} + \text{O}_2 \rightarrow 2\text{Na}_2\text{O}$     b) word: magnesium plus copper (II) chloride produces copper and magnesium chloride, skeleton:  $\text{Mg} + \text{CuCl}_2 \rightarrow \text{Cu} + \text{MgCl}_2$  balanced:  $\text{Mg} + \text{CuCl}_2 \rightarrow \text{Cu} + \text{MgCl}_2$     c) word: magnesium carbonate produces magnesium oxide and carbon dioxide, skeleton:  $\text{MgCO}_3 \rightarrow \text{MgO} + \text{CO}_2$ , balanced:  $\text{MgCO}_3 \rightarrow \text{MgO} + \text{CO}_2$   
d) chromium (III) chloride plus potassium hydroxide produces potassium chloride and chromium (II) hydroxide, skeleton:  $\text{CrCl}_3 + \text{KOH} \rightarrow \text{KCl} + \text{Cr}(\text{OH})_3$ , balanced:  $\text{CrCl}_3 + 3\text{KOH} \rightarrow 3\text{KCl} + \text{Cr}(\text{OH})_3$
20. a) synthesis      b) single replaceme      c) decompositi      d) double replaceme
21. a) single replacement, products:  $\text{AgNO}_3$  and  $\text{Au}$ , coefficients to balance: 1,3,3,1    b) decomposition, products:  $\text{Cu} + \text{O}_2$ , coefficients to balance: 2, 2, 1    c) double replacement, products:  $\text{BaSO}_4 + 2\text{KCl}$ , coefficients to balance: 1, 1, 1, 2    d) synthesis, products:  $\text{CO}_2$ , coefficients to balance: 1, 1, 1  
e) double replacement, products:  $\text{H}_2\text{O}$  and  $\text{AlBr}_3$ , coefficients to balance: 3, 1, 3, 1    f) decomposition, products:  $\text{Ag}$  and  $\text{Cl}_2$ , coefficients to balance: 2, 2, 1    g) synthesis, products:  $\text{CaS}$ , coefficients to balance: 8,1,8    h) single replacement, products:  $\text{H}_2$  and  $\text{MgCl}_2$ , coefficients to balance: 1, 2, 1, 1    i) double replacement, products:  $\text{NaNO}_3$  and  $\text{AgCl}$ , coefficients to balance 1, 1, 1, 1    j) combustion, products:  $\text{CO}_2$  and  $\text{H}_2\text{O}$ , coefficients to balance: 2, 13, 8, 10

## Unit 2 Review *(continued)*

### Thinking Critically and Creatively

22. An element in Group 1 on the periodic table forms ionic compounds with elements in Group 17 in a 1:1 ratio. In what ratio would you expect an element from Group 2 and elements from Group 16 to react when they form ionic compounds? Explain your answer.
23. In this unit, pictorial representations were used to help you understand what happens to elements and compounds in the different types of chemical reactions. These representations used coloured spheres. Develop a different method to represent what happens in the types of chemical reactions you have learned about. Be creative—for example, you might consider using cartoons of different people dancing.
24. Draw a sketch that represents how energy can be exchanged between a system and its surroundings.
- For chemical reactions, what represents the system and what represents the surroundings?
  - If there is a net absorption of energy by a chemical reaction, what does that tell you about the energy of the surroundings?

### What Do You Know? Making New Connections

### Applying Your Understanding

25. Develop an image that represents energy changes that occur during a chemical reaction. Your image should include the following labels: endothermic, exothermic, bond formation, bond breaking, reactant, product, and energy.

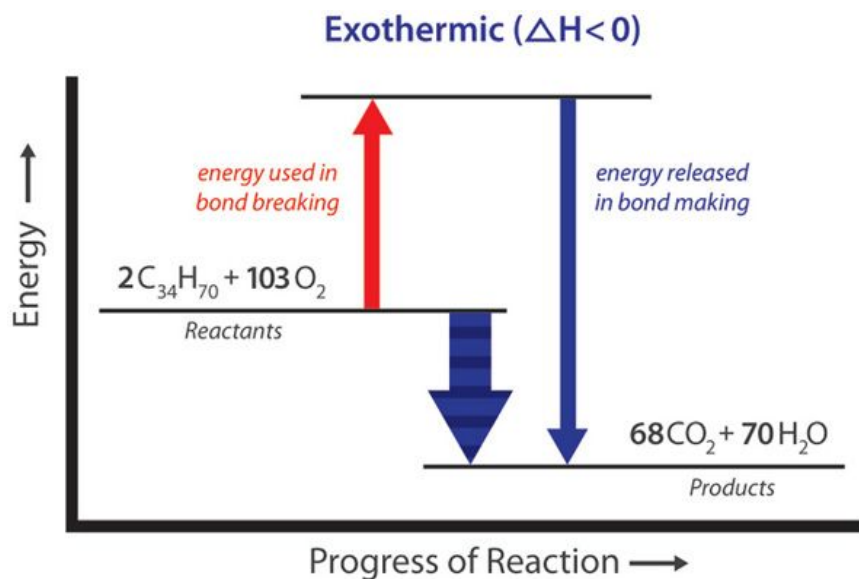
26. The photo below shows wood burning.



- What type of chemical reaction is this?
  - Is it exothermic or endothermic? What evidence supports your answer?
  - Does this reaction require an input of energy to get started? How do you know?
27. When wood burns completely, a pile of ash remains. The mass of the ash is much less than the mass of the original wood.
- Does this observation invalidate the law of conservation of mass? Why or why not?
  - Describe an experiment that would provide evidence to support your answer to part a).
28. Think of five ways you rely on chemistry in your daily life.
- Discuss the advantages and the disadvantages that are associated with using the chemicals.
  - What alternatives are available that might counter the disadvantages?
29. In a highly exothermic reaction, solid carbon dioxide (dry ice) sublimates and reacts with hot magnesium to produce solid magnesium oxide and solid carbon. Fire extinguishers commonly contain carbon dioxide, which is heavier than air and smothers a fire. How does the chemical reaction described above demonstrate the limited usefulness of carbon dioxide fire extinguishers?

## ANSWER KEY: Chemistry Review

22. 1:1
23. OMIT
24. OMIT
25. → shown to the right
26. a) combustion  
b) exothermic  
c) yes doesn't spontaneously happen
27. a) It doesn't invalidate as the mass difference is due to loss to the surrounding environment.  
b) try the same experiment closed system and compare, it will vary.
28. Answers
29. OMIT



## Thinking Critically and Creatively

30. A chemist performs an experiment that involves reacting 1.6 g of sodium carbonate with 1.1 g of calcium chloride in an aqueous solution.

- What type of chemical reaction is this? Describe what is happening to the ions during the reaction.
- Predict the products of this reaction.
- Write the word equation, skeleton equation, and balanced chemical equation for this reaction. One product is not soluble in water and forms a precipitate. The other product is soluble in water.

d) The precipitate that forms is isolated using a filtration apparatus, shown here. The filter paper and solid are dried overnight.

The next day the mass of the solid product is determined to be 1.0 g. What is the mass of the second product expected to be? How do you know?



e) The chemist expected to isolate a greater amount of precipitate. Describe one thing that might have contributed to the lower amount actually obtained.

31. The photo shows a pH meter is being used to measure the pH of a solution.

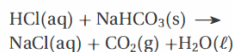
- The number displayed represents the pH of the solution. Is it acidic or basic?
- Should HCl(aq) or KOH(aq) be added to neutralize this solution? Explain your reasoning.



## Connecting to Self and Society

32. Baking soda, sodium hydrogen carbonate, can be used to neutralize an acid spill.

The chemical equation is



- Will the pH increase or decrease by adding baking soda? Explain.
- Why is baking soda a safer alternative to other bases, such as NaOH(aq)?
- Write the balanced chemical equation for the neutralization of hydrochloric acid with magnesium hydroxide.

33. One way to treat a body of water polluted with acid precipitation is to add calcium hydroxide, Ca(OH)<sub>2</sub>.

- How does this help?
- In what way is liming a lake similar to taking an antacid for heartburn?
- Why is lake liming a short-term solution to the problem?
- Describe a longer-term solution to the problem of acidic lakes due to acid precipitation?

34. While working in a laboratory as a summer student, you notice that the Safety Data Sheets for many of the chemicals cannot be found. What could you say to your supervisor to help convey the importance of maintaining up-to-date SDS records?

35. What decisions about chemical products and processes do you make, personally, on a daily basis? What are the benefits and risks associated with your decisions? How can an understanding of chemistry help you better assess the benefits and risks?

## ANSWER KEY: Chemistry Review

30. a) double replacement    b) NaCl and CaCO<sub>3</sub>    c) word: sodium carbonate plus calcium chloride produce calcium carbonate and sodium chloride (precipitate is calcium carbonate), skeleton: Na<sub>2</sub>CO<sub>3</sub> + CaCl<sub>2</sub> → NaCl + CaCO<sub>3</sub>, balanced: Na<sub>2</sub>CO<sub>3</sub> + CaCl<sub>2</sub> → 2NaCl + CaCO<sub>3</sub>    d) 1.7 g, Law of conservation of mass.    e) loss to environment.
31. a) acidic    b) KOH    acid plus base equals salt plus water, KOH is a base so it will neutralize the acid
32. a) Increase the pH as it becomes less acidic    b) since it is a weaker base    c) 2HCl + Mg(OH)<sub>2</sub> → MgCl<sub>2</sub> + 2H<sub>2</sub>O
33. a) increases pH → less acidic    b) both increase pH → less acidic    c) as acid rain will continue and the pH will change back to a more acidic level over time    d) decrease fossil fuel combustion that leads to acid rain
34. Remind them of WHMIS requirements
35. Answers will vary.