

The Structure of Matter Lesson 7.1

This lesson will help you practice working with concepts related to the structure and properties of different kinds of matter and how elements are organized in the periodic table. Use it with core lesson 7. 1 The Structure of Matter to reinforce and apply your knowledge.

Key Concept

All matter is made of atoms. Atoms of different elements have unique properties that determine the properties of the substance they make up.

Core Skills & Practices

- Understand and Explain Textual Scientific Presentations
- Apply Scientific Models

The Structure of Matter

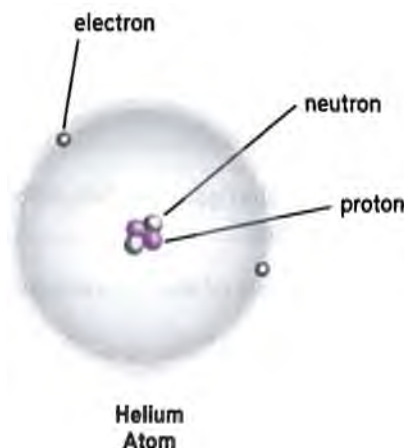
Matter is anything that has mass and takes up space. All matter is made up of one or more elements, and each element is made up of atoms. Elements are represented by chemical symbols.

Directions: Answer the questions below.

1. Which question is most likely the subject of current scientific research on atomic structure?
 - A. Where are neutrons and protons found in an atom?
 - B. What is the role of subatomic particles in an atom?
 - C. What charge do protons, neutrons, and electrons carry?
 - D. Are atoms made of only protons, neutrons, and electrons?
2. Electrolysis uses electricity to decompose water (H_2O), forming the products hydrogen (H_2) and oxygen (O_2). How should the products resulting from the electrolysis of water be classified?
 - A. atoms
 - B. elements
 - C. molecules
 - D. compounds

Directions: Use the image below to answer question 3.

3. The image shows all of the particles that make up a helium atom. The overall electrical charge of the helium is _____. Explain your answer.



Lesson 7.1 The Structure of Matter

Periodic Table of the Elements

The periodic table of elements organizes elements according to similar chemical and physical properties. Each element has a square in the table that includes its name, chemical symbol, atomic number, atomic mass, and natural state.

Directions: Use the image below to answer questions 4-6.

Chlorine
17
Cl
35.453

4. Which conclusion about chlorine is supported by its location in the periodic table?
- A. Chlorine is a metal.
B. Chlorine is a nonmetal.
C. Chlorine is a metalloid.
D. Chlorine is a synthetic element.
5. Atoms of an element generally exist in a neutral state. Which part of chlorine's square in the periodic table provides information about the number of electrons that a neutral atom of chlorine has?
- A. 17
B. Cl
C.
D. 35.453
6. Explain how information in the periodic table can be used to determine the number of neutrons in the nucleus of an atom of an element.
- _____
- _____
- _____
- _____

Directions: Use the passage to answer question 7.

- Elements are classified as metals, nonmetals, or metalloids, according to their properties.
- Metals—elements that are good conductors of electricity and are malleable (can be softened by striking with a hammer), shiny, and ductile (can be stretched)
- Nonmetals—elements that are not good conductors of electricity, and are not shiny, malleable, or ductile
- Metalloids—elements that have some of the properties of metals and some of the properties of nonmetals

7. You have a sample of an element that you think might be a metal. Which investigation could you use to determine if your sample is a metal?
- A. Use the sample in place of a piece of wire in a working electrical circuit to see if the circuit continues to conduct electricity.
- B. Compare the color of the unknown sample to that of a known metal to determine if the colors are shared by both substances.
- C. Attempt to bend the sample using only your hands to determine if it shows the property of malleability.
- D. Drop the sample into a container of water to determine if it sinks or floats. Repeat the process using oil instead of water and compare the results.

Compounds

When the atoms of two or more different elements combine chemically, they form a compound.

Directions: Answer the following questions.

8. Methane is a flammable, gaseous compound made up of only carbon (C) and hydrogen (H) atoms. The ratio of carbon to hydrogen in a methane molecule is 1 to 4. Which is the chemical formula for methane?
- A. C_4H
B. CH_4
C. $4CH$
D. C_2H_4
9. Chalk is a compound formed when one atom of calcium combines with one atom of carbon and three atoms of oxygen. The chemical formula for chalk is _____.

Directions: Use the table below to answer question 10.

Data Table: Determining Iron Content by Mass

Sample	Original Mass	New Mass
1	0.50 g	0.62 g
2	0.50 g	0.51 g
3	0.50 g	0.901g
4	0.50 g	0.55 g

10. Iron oxide, or rust, is a compound that forms as a result of a chemical reaction between iron and oxygen. The reaction occurs more rapidly in the presence of water. Suppose you are provided with four 0.50 gram metal samples. The samples contain varying amounts of iron mixed with other less reactive metals. To determine which sample has the highest iron content, you decide to place each sample in separate Petri dishes that contain small, but equal amounts of tap water and place all of the samples in the same outdoor location. After 3 weeks, you measure the mass of each of sample and record it in a data table. Based upon the new masses, which of your original samples had the highest iron content?



Test-Taking Tip

Before answering a short answer question, rule out what the question is not asking. Then, organize your thoughts around what you do know about the topic. After you have written your answer, check back over the question to be sure you followed all directions accurately.

Lesson 7.2 Physical and Chemical Properties of Matter

This lesson will help you practice working with concepts related to the properties of matter. Use it with core lesson 7. 2 Chemical and Physical Properties of Matter to reinforce and apply your knowledge.

Key Concept

Matter can be described by its physical properties and chemical properties. The properties of elements are similar within groups on the periodic table.

Core Skills & Practices

- Cite Textual Evidence
- Evaluate Conclusions

Properties of Matter

Physical and chemical properties can be used to identify types of matter.

Directions: Answer the questions below.

1. A student is designing an investigation to identify a chemical property of matter. Which procedure would be most useful?
 - A. bending a steel rod
 - B. sawing a wooden board in half
 - C. painting a sheet of metal a different color
 - D. placing an antacid tablet in a beaker of water
2. A scientist is investigating the properties of an unknown sample. Which observation is most useful in identifying the sample?
 - A. The sample reflects light.
 - B. The mass of the sample is 56. 8 g.
 - C. The density of the sample is 10. 49 g/cm³.
 - D. The sample tarnishes when exposed to air.

- B. A student places a sample of salt crystals on a lab table and observes its physical properties. The student then removes half of the sample and again observes the physical properties of the sample. Some properties stayed the same and some changed. Using the properties listed, write the properties the student observed in the correct category of the chart.

Color	Volume	Mass
Temperature	Density	Shape

Stayed the Same	Changed



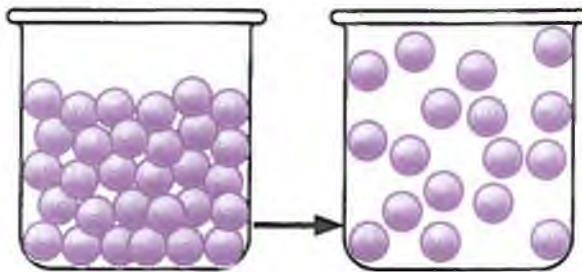
Test-Taking Tip

When completing a drag and drop sorting item, read the directions carefully to make sure you understand the criteria you should use to sort the items. Read the headings of the categories provided. Then after you place the items in the categories, review your answers to make sure the items were placed in the correct categories.

Changes of State

Matter can change from one state to another when thermal energy is absorbed or released.

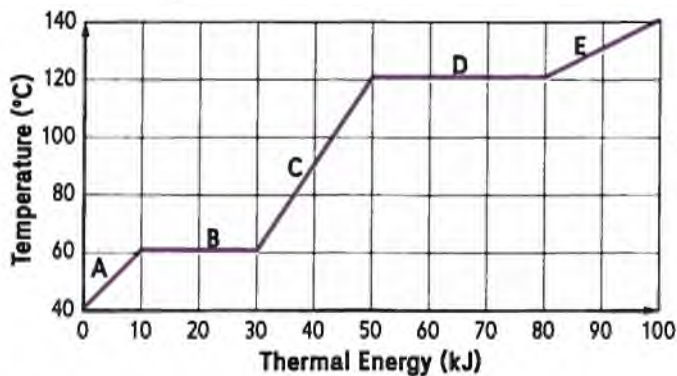
Directions: Use the diagram to answer questions 4-5.



The diagram shows a sample of matter undergoing a change.

4. The sample begins in the _____ state and changes to the _____ state.
5. Explain how thermal energy is related to the change shown in the diagram.

Directions: Use the diagram to answer questions 6-8.



6. According to the graph, the melting point for the substance is _____ degrees and the boiling point is _____ degrees.
7. A student states that the temperature of a substance increases whenever thermal energy is absorbed. Evaluate this statement, and either support it or refute it using evidence from the graph.
8. Which processes are represented by section D?
- A. melting and freezing
- B. sublimation and boiling
- C. evaporation and sublimation
- D. vaporization and condensation

Lesson 7.2 Physical and Chemical Properties of Matter

Predicting Properties

Knowing the location of an element on the periodic table makes it possible to predict its physical and chemical properties

Directions: Use the diagram to answer questions 9-12.

1																	18
1 H	2											13 B	14 C	15 N	16 O	17 F	2 He
3 Li	4 Be											13 Al	14 Si	15 P	16 S	17 Cl	10 Ne
11 Na	12 Mg	3	4	5	6	7	8	9	10	11	12	13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57-71	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	89-103	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Uut	114 Fl	115 Uup	116 Lv	117 Uus	118 Uuo
57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu			
89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr			

9. Which pair of elements is likely to have the most similar physical and chemical properties?

A. iron (Fe) and cadmium (Cd)
B. hydrogen (H) and helium (He)
C. lithium (Li) and beryllium (Be)
D. magnesium (Mg) and calcium (Ca)

10. Computer designers require certain kinds of materials to build the inner parts of a computer. To control the transmission of information, they need to use elements that can be made to conduct electricity under certain conditions but not others. Which of the following elements would be best suited for this purpose?

A. iron (Fe)
B. silicon (Si)
C. xenon (Xe)
D. rubidium (Rb)

11. A student states that elements on both sides of the periodic table are likely to be highly reactive. Agree or disagree, and support your response with evidence from the periodic table.

12. A student suggests that carbon (C) and lead (Pb) have similar properties because they are in the same group of the periodic table. Suggest a reason why their properties are very different.

A. Carbon is a gas at room temperature whereas lead is a solid.
B. Carbon has fewer outermost electrons than lead.
C. Carbon is a nonmetal whereas lead is a metal.
D. Carbon has fewer total electrons than lead.

This lesson will help you practice working with concepts related to chemical reactions. Use it with core lesson 7.3 Chemical Reactions to reinforce and apply your knowledge.

Key Concept

Changes in matter and energy occur during a chemical reaction, although matter is neither created nor destroyed. A balanced chemical equation shows the rearrangement of atoms and describes a chemical reaction.

Core Skills & Practices

- Identify and Reduce Sources of Error
- * Determine Central Ideas

What Happens During a Chemical Reaction?

During a chemical reaction, one or more substances are changed into new substances.

Directions: Use the information to answer questions 1-2.

A student follows this procedure to conduct an investigation:

1. Use a funnel to half-fill a bottle with vinegar.
2. Determine the mass of the bottle with the vinegar.
3. Dry the funnel and use it to add 20 g of baking soda to the bottle.
4. Observe the chemical reaction that takes place.
5. After the reaction is complete, determine the mass of the bottle with its contents.

1. The student concludes that mass is not conserved because the mass after the reaction is less than the total mass before the reaction. What is one way the student can correct the error made during the investigation to produce the correct result?
 - A. Add the baking soda to the bottle before the vinegar.
 - B. Measure the mass of the vinegar and bottle separately.
 - C. Decrease the mass of baking soda added to the vinegar.
 - D. Stretch a balloon of known mass over the opening of the bottle.
2. Which of the following is an example of a chemical reaction?
 - A. An iron nail rusts.
 - B. Butter melts in a hot pan.
 - C. Clay is molded into a sculpture.
 - D. Rubbing alcohol evaporates from skin.



Test-Taking Tip

When trying to determine the correct answer to a multiple-choice question, begin by deciding the correct answer before looking at the answer choices. Then, match the answer you believe to be correct with one of the possible choices.

Lesson 7.3 Chemical Reactions

How Are Chemical Reactions Represented?

Chemical reactions can be described in words or through symbols in a balanced chemical equation.

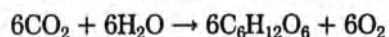
Directions: Use the passage to answer questions 3-5.

A chemical equation is similar to a mathematical sentence. It consists of chemical symbols that represent elements and molecules. It includes abbreviations to indicate the state of matter, and it includes numbers in the form of coefficients and subscripts. Understanding the difference between a subscript and a coefficient is essential to balancing equations. A subscript is a number that indicates the number of atoms of an element in a molecule. For example, the 2 in H_2O is a subscript that shows that a molecule of water contains two hydrogen atoms. A coefficient is a number written before a chemical symbol or formula. It indicates the number of atoms or molecules taking place in a reaction. A coefficient can be changed in order to balance an equation, but a subscript cannot.

3. What is the central idea of the paragraph?

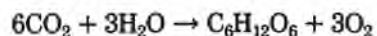
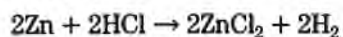
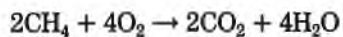
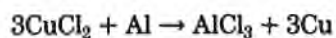
- A. Chemical equations must be balanced because of the law of conservation of mass.
- B. Coefficients are used to balanced equations, but subscripts must remain the same.
- C. Chemical reactions can be represented by chemical equations.
- D. Chemical symbols can be used to represent elements and molecules.

4. In the chemical equation for photosynthesis shown below, _____ molecules of water enter into the reaction.

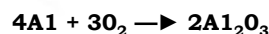


Directions: Answer the questions below.

6. Circle the equation that is balanced.



5. The chemical equation below represents the equation in which aluminum and oxygen react to form aluminum oxide. Which statement about the chemical equation is true?



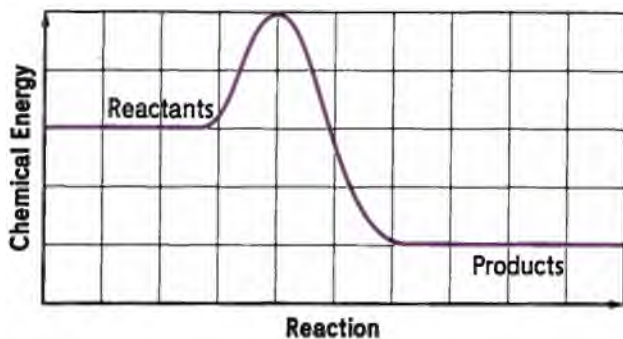
- A. The subscript for aluminum in the reactants is 4.
- B. There are 2 atoms of oxygen in the reactants.
- C. There are 6 atoms of oxygen in the products.
- D. There are 7 molecules of aluminum oxide formed.

7. Hydrogen peroxide, H_2O_2 , reacts to produce water, H_2O , and oxygen, O_2 . Write a balanced equation for this reaction.

Energy Changes in Chemical Reactions

Exothermic reactions release energy, whereas endothermic reactions absorb energy.

Directions: Use the diagram to answer questions 8-9.



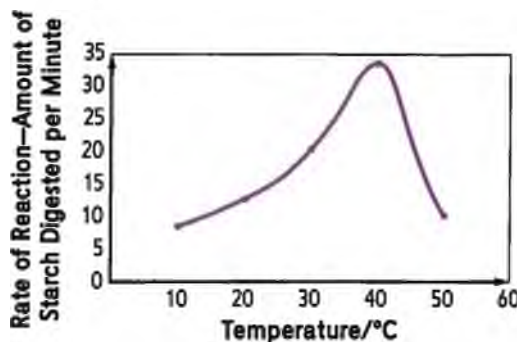
8. Which of the following processes might be represented by the diagram?
- A. A plant uses carbon dioxide, water, and energy to produce glucose and oxygen.
 - B. An ice cube melting into a puddle of water.
 - C. Water in a beaker on a hot plate is brought to a boil.
 - D. An animal uses glucose and oxygen to release energy, water, and carbon dioxide.

9. Based on the energy change shown, the graph represents an _____ chemical reaction. Explain how you made your choice and how you know if a reaction is endothermic or exothermic.

Chemical Reaction Rate

The rate of a chemical reaction depends on several factors, including the temperature and concentration of the substances involved.

Directions: Use the diagram to answer questions 10-11.



10. Which conclusion is best supported by the data?
- A. The reaction rate decreases as the temperature is increases.
 - B. The reaction rate increases to some maximum, and then decreases as temperature increases.
 - C. The reaction rate is independent of any changes in temperature.
 - D. The reaction rate increases as temperature increases.
11. The student places starch in a Petri dish with saliva and measures the rate at which the starch is changed into sugar. The student begins at 0°C and slowly raises the temperature to 30°C over the course of 30 minutes. What error does the student make that will lead to an incorrect conclusion, and how can the error be corrected?

Lesson 7.4 Solutions

This lesson will help you practice working with concepts related to the composition and formation of solutions and of acids and bases. Use it with core lesson 7. 4 Solutions to reinforce and apply your knowledge.

Key Concept

A solution forms when one or more pure substances dissolve in another pure substance. A solution can be a gas, a liquid, or a solid.

Core Skills & Practices

- Identify and Interpret Independent and Dependent Variables in Scientific Investigations
- Determine Hypotheses

Nature of Solutions

A solution is a mixture in which one or more substances are distributed completely and uniformly throughout another substance. The dissolved substance is called the solute, while the dissolving substance is called the solvent.

Directions: Answer the questions below.

1. Sort the given substances into solutes, solvents, or solutions. Complete the missing information in the chart by listing each substance in the correct space in the table.

club soda	detergent	oxygen	water
copper	nitrogen	soap	zinc

Solute	Solvent	Solution
carbon dioxide		
		brass
	water	
		air

2. Fish breathe oxygen that is dissolved in water. What type of solution is this?
- A. gas dissolved in gas
- B. gas dissolved in liquid
- C. solid dissolved in liquid
- D. liquid dissolved in liquid



Test-Taking Tip

When completing a drag-and-drop activity, first check to see which information you recall, and then sort the parts of that known piece of information first. This will shorten the list and make it easier for you to sort the remaining pieces of information, especially if a logical pattern begins to appear.

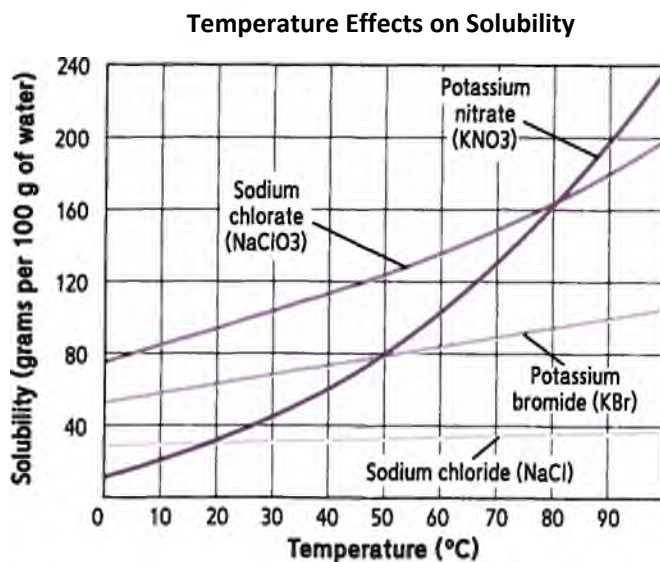
The Solution Process and Solubility

How easily and quickly a solute dissolves in a solvent to form a solution depends on factors such as solute surface area, solvent temperature, the molecular structure of both substances, and the concentration of solute in a given solvent.

Directions: Answer the question below.

3. Suppose you wish to test the hypothesis "The rate at which a solute dissolves increases with the temperature of solvent." Which experiment would best allow you to do so?
- A. Dissolve identical amounts of solute in equal amounts of solvent, and measure the temperature of the resulting solutions.
 - B. Dissolve excess amounts of solute in equal amounts of solvent at different temperatures, and measure how much solute does not dissolve.
 - C. Raise the temperature of a quantity of solvent, and add measured amounts of solute until no more will dissolve at that temperature.
 - D. Place a fixed amount of solute in a quantity of solvent, raise the solvent's temperature until all of the solute has dissolved, then measure the temperature.

Directions: Use the graph below to answer questions 4-5.



4. In the graph above, _____ is the independent variable, and _____ is the dependent variable.
5. Suppose you mix an aqueous solution of potassium bromide (KBr) at 90°C. How many grams of KBr will dissolve in 100 g of water to produce a saturated solution?
- A. 60 g
 - B. 80 g
 - C. 100 g
 - D. 120 g

Lesson 7.4 Solutions

Acids and Bases

Acids are substances that, in aqueous solutions, typically increase the hydrogen ion (H^+) concentration.

Bases are substances that, in aqueous solutions, increase the concentration of hydroxide (OH^-) ions.

Directions: Use the reading passage below to answer questions 6-8.

A variety of acids, both weak and strong, can be found in the human body. Your body actually does a remarkable job in controlling its own pH balance. Your blood, for example, needs to remain within the range of 7.35 and 7.45. If your blood is more acidic, you suffer acidosis. If it is more basic, you are said to have alkalosis.

The body opposes the change in pH by natural chemical balancers called buffers. A buffer solution has both a weak acid (that is, an acid that does not dissociate completely) and its conjugate base in equal amounts. The liquid portion of blood is an example of a buffer solution. Among the important weak acids in the blood buffer system are carbonic acid (H_2CO_3) and phosphoric acid (H_3PO_4).

Another case in which the body generates too much acid is when someone experiences the condition called "heartburn." This occurs when too much hydrochloric acid (HCl), the strong acid generated by the stomach, is produced. This condition can be temporarily relieved by taking an antacid, which typically consists of a weak base such as sodium bicarbonate ($NaHCO_3$), to neutralize the excess stomach acid.

6. Under normal conditions, the pH of blood is slightly _____ than that of water. This makes blood _____ basic than water. Even in a severe case of _____ when the pH of blood is 7.15, water is, by comparison, a(n) _____.
7. According to the passage, which of the following is an example of an acid produced within the human body that completely dissociates?
- A. carbonic acid
 - B. phosphoric acid
 - C. hydrochloric acid
 - D. sodium bicarbonate
8. According to the passage, which value would indicate alkalosis?
- A. 7.55
 - B. 7.45
 - C. 7.35
 - D. 7.25

Directions: Answer the question below.

9. The value of pH is obtained from an equation based on the concentration of hydrogen ions in an aqueous solution. By taking 10 to the power of negative pH, the H^+ concentration can be determined.

$$\text{concentration of } H^+ \text{ ions} = [H^+] = 10^{-pH}$$

By using the logarithmic function, pH can be written in terms of H^+ ion concentration.

$$pH = -\log (\text{concentration of } H^+ \text{ ions}) = -\log [H^+]$$

The "concentration of H^+ ions" is written as " $[H^+]$." For this function, what are the independent and dependent variables, respectively?

- A. pH, $-\log$
- B. $[H^+]$, pH
- C. pH, $[H^+]$
- D. $-\log$, H^+