

SI Chemistry - Full Discipline Demo

Introduction to Chemical Compounds

Final Report - Answer Guide

Institution	Science Interactive University
Session	SI Chemistry - Full Discipline Demo
Course	SI Chemistry - Full Discipline Demo
Instructor	Sales SI Demo

Test Your Knowledge

Match each term with the best description.

⌘ Compound	Mixture that is completely uniform	1
⌘ Element	Individual unit formed from the sharing of electrons	2
⌘ Heterogeneous	Simplest type of substance	3
⌘ Homogeneous	Mixture made of physically separate substances	4
⌘ Ion	Substance composed of more than one chemically combined element	5
⌘ Molecule	Charged particle forming when atoms of metal elements transfer electrons to atoms of nonmetal elements	6

Correct answers:

- 1 Homogeneous 2 Molecule 3 Element 4 Heterogeneous
5 Compound 6 Ion

Categorize each property as physical or chemical.

⚡ Appearance	⚡ Boiling point	⚡ Flammability	⚡ Melting point
⚡ Oxidation states	⚡ Reactivity with acid	⚡ State of matter	

Physical Property	Chemical Property
1	2

Correct answers:

1 Appearance State of matter Melting point Boiling point

2 Reactivity with acid Flammability Oxidation states

Categorize each property as being typical of an ionic or a molecular compound.

⚡ Consist of a metal and a nonmetal	⚡ Formed through covalent bonds
⚡ High melting and boiling points	⚡ Low melting and boiling points
⚡ Solid at room temperature	⚡ Solid, liquid, or gas at room temperature

Molecular Compound	Ionic Compound
1	2

Correct answers:

- 1 Formed through covalent bonds Low melting and boiling points
Solid, liquid, or gas at room temperature
- 2 Consist of a metal and a nonmetal High melting and boiling points
Solid at room temperature

Exploration

A compound is the simplest type of substance.

- ☐ True
☒ False



___ mixtures are uniform throughout, whereas ___ mixtures are composed of substances that remain physically separate.

- ☐ Heterogeneous; homogeneous
☒ Homogeneous; heterogeneous



Chemical properties are the characteristics of a substance that can be observed by altering the composition of the substance.

- ☐ True ✓
- ☐ False

Physical properties include the density, melting point, boiling point, and appearance.

- ☐ True ✓
- ☐ False

_____ bonds form when atoms from two nonmetals share electrons.

- ☐ Covalent ✓
- ☐ Ionic

Ionic compounds result from _____.

- ☐ ionic bonds
- ☐ oxidation and reduction reactions
- ☐ the combinations of metals and nonmetals
- ☐ All of the above ✓

Ions are _____.

- ☐ always metals
- ☐ always nonmetals
- ☐ charged particles ✓
- ☐ neutral compounds

Individual units called ____ are formed when atoms of nonmetal elements share electrons.

- ☐ electrons
- ☐ matter
- ☒ molecules
- ☐ None of the above



Exercise 1

Define physical and chemical properties and give at least 3 examples of each type of property.

Physical properties are the characteristics of a substance that can be observed without altering the composition of the substance. Physical properties include melting point, boiling point, density, solubility, appearance, and mass. Chemical properties are the characteristics that can only be observed by altering the composition of the substance through chemical changes or reactions. Chemical properties include reactivity with air and acid, flammability, thermodynamic stability, oxidation states, and heat of combustion.

Which substances in Data Table 1 have melting points below room temperature? Are these substances more likely to be ionic or molecular compounds based on melting point alone? Explain.

Water, rubbing alcohol, and cooking oil have melting points below room temperature and are more likely to be molecular compounds. Ionic compounds have very high melting points.

Which substances in Data Table 1 have melting points above room temperature? Are these substances more likely to be ionic or molecular compounds based on melting point alone? Explain.

All of the remaining substances: table salt, baking soda, sugar, and cornstarch have melting points above room temperature. Based on this information, we might conclude that these are all ionic compounds.

Which substance in Data Table 2 has the lowest melting point? Explain.

Sugar has the lowest melting point as it melted after 4 minutes in the hot oven.

Were there any substances that were unchanged at the end of the 400° heating step? Explain what this means about the melting point for the substance(s).

Table salt and baking soda were unchanged. Their melting points must be higher than the oven temperature of 400°F. Students may not include baking soda due to the changes possibly seen during the procedure from the decomposition to sodium carbonate.

Which substances appeared to be soluble in water? Are these likely to be ionic or molecular compounds based alone on solubility? Explain.

Table salt, baking soda, sugar, and rubbing alcohol were all soluble in water. Ionic compounds are typically soluble in water so these substances may be ionic compounds. However, not all ionic compounds are soluble in water so this test alone will not give clear answers on compound types.

Which substances appeared to be insoluble in water? Are these likely to be ionic or molecular compounds based alone on solubility? Explain.

Cornstarch and cooking oil did not dissolve in water. These substances may be molecular compounds as many molecular compounds are not soluble in water. However, many molecular compounds are soluble in water so this test alone will not give clear answers on the type of compound.

Data Table 1: Properties of Household Items
(SAMPLE ANSWER BELOW)

Substance	State of Matter	Appearance	Melting Point	Boiling Point
Water	Liquid	Colorless, transparent	Lower	Higher
Table Salt	Solid	White, crystalline	Higher	Higher
Baking Soda	Solid	White, fine powder	Higher	Higher
Sugar	Solid	White, crystalline	Higher	Higher
Cornstarch	Solid	White, fine powder	Higher	Higher
Isopropyl Alcohol	Liquid	Colorless, transparent	Lower	Higher
Cooking Oil	Liquid	Yellow, translucent	Lower	Higher

Data Table 2: Melting and Boiling Points of Solids over Time
(SAMPLE ANSWER BELOW)

Time	A. Table Salt	B. Baking Soda	C. Sugar	D. Cornstarch
1 min	No change	No change	No change	No change
2 min	No change	No change	No change	No change
3 min	No change	No change	No change	No change
4 min	No change	No change	No change	No change
5 min	No change	Melted	Slight tan color	Greenish brown color formed around edges
6 min	No change	No change	Melted	Slight tan color
7 min	Brown color across all of sample	No change	No change	
8 min	Tan color	Sample turned dark brown and began to rise	No change	No change
9 min		Tan color	Sample appeared to be burning so was removed from the oven	No change
10 min	No change		Tan color	
15	No change	No change		Tan color

min				
20 min		No change	No change	
25 min	Tan color		No change	No change
30 min		Light brown color		No change

Data Table 3: Solubility in Water
(SAMPLE ANSWER BELOW)

Substance	Observations	Solubility
Table Salt	Solid dissolved after stirring	Soluble
Baking Soda	Solid dissolved after stirring	Soluble
Sugar	Solid dissolved after stirring	Soluble
Cornstarch	Solid appeared to dissolve after stirring, but after the waiting period the particles settled at the bottom of the glass.	Insoluble
Isopropyl Alcohol	Liquid disappeared after stirring	Soluble
Cooking Oil	Mixed when stirred, then separated	Insoluble

Data Table 4: Ionic vs. Molecular Compound Properties
(SAMPLE ANSWER BELOW)

Property	Ionic Compounds	Molecular Compounds
Element Types	Metal and nonmetal	Nonmetal
State of Matter	Solid	Solid, liquid, or gas
Melting Point	High	Variable
Boiling Point	High	Variable
Solubility	Tend to be soluble	Variable

Data Table 5: Conclusions and Compound Types
(SAMPLE ANSWER BELOW)

Chemical Formula	Element Types	Properties of substance	Compound Type
Water - H ₂ O	Nonmetal	Liquid at room temperature, melting point lower than room temperature	Molecular
Table Salt - NaCl	Metal and nonmetal	Solid at room temperature, high melting and boiling point, and soluble in water	Ionic
Baking Soda - NaHCO ₃	Metal and nonmetal	Solid at room temperature, high melting and boiling point, and soluble in water	Ionic
Sugar - C ₆ H ₁₂ O ₆	Nonmetal	Solid at room temperature, low melting point, and soluble in water	Molecular
Cornstarch -	Nonmetal	Solid at room temperature, fairly low melting point, and	Molecular

$C_{27}H_{48}O_{20}$		insoluble in water	
Isopropyl Alcohol - C_3H_8O	Nonmetal	Liquid at room temperature, melting point lower than room temperature, and soluble in water	Molecular
Cooking Oil - $C_{54}H_{100}O_7$	Nonmetal	Liquid at room temperature, melting point below room temperature, and insoluble in water	Molecular

Competency Review

_____ mixtures are completely uniform.

- ☐ Heterogeneous
☒ Homogeneous

Compounds are composed of two or more chemically combined elements.

- ☒ True
☐ False

Chemical properties are the characteristics of a substance that can be observed without altering the composition of the substance.

- ☐ True
☒ False

Physical properties of a substance include the _____.

- ☐ appearance
☐ density
☐ melting point
☒ All of the above

____ compounds form when two nonmetal elements combine.

- ☐ Heterogeneous
 - ☐ Homogeneous
 - ☐ Ionic
 - ☒ Molecular
- ✓

Ionic compounds tend to be soluble in water.

- ☒ True
 - ☐ False
- ✓

Metal atoms ____ electrons and become ____ charged.

- ☐ gain; negatively
 - ☐ lose; negatively
 - ☒ lose; positively
 - ☐ gain; positively
- ✓

While ionic compounds are usually solid at room temperature, molecular compounds are ____.

- ☐ gas
 - ☐ liquid
 - ☐ solid
 - ☒ All of the above
- ✓

Molecular compounds are unique because they have a small range of melting and boiling points.

- ☐ True
 - ☒ False
- ✓

_____ is a white, crystalline solid at room temperature that is soluble in water, has low melting and boiling points, and held together through covalent bonds.

- ☐ Baking soda
- ☐ Butter
- ☒ Granulated sugar
- ☐ Table salt

✓

Table salt is an ionic compound that has high melting and boiling points and is soluble in water.

- ☒ True
- ☐ False

✓

A solid substance is tested in a lab to determine the type of compound it is. The researcher finds that the substance has a high melting and boiling point and is soluble in water. Based on this information the researcher can conclude that the substance is a(n) _____.

- ☐ heterogeneous
- ☐ homogeneous
- ☒ ionic compound
- ☐ molecular compound

✓

Extension Questions

Mixtures of hydrogen and oxygen in varying concentrations can be sparked to produce water. Define mixture and compound, and then explain the differences between a mixture of hydrogen and oxygen and the compound dihydrogen monoxide (also known as water). (SAMPLE ANSWER BELOW)

Mixtures and compounds are both made from different substances; however, the substances in a mixture are not chemically joined as they are in a compound. A mixture of hydrogen and oxygen can have a variable composition, whereas water will always contain equal amounts of hydrogen and oxygen. The atoms are not joined together in the mixture of hydrogen and oxygen, but the atoms are joined in water. Hydrogen and oxygen will retain their own separate properties in the mixture, but water will have different properties than the individual elements have. A mixture of hydrogen and oxygen can physically be separated into the two elements, but water cannot be physically separated into hydrogen and oxygen and instead has to undergo a chemical change, such as a displacement reaction.

