Final Study Guide

First Semester Examination

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Subject: Chemistry

Grade 9

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Please study the material listed in the table above with a focus on the points below.

Storyline 1: Atoms, Elements, and Molecules

Investigation 1: Atomic Structure

Lesson 1: The Particle Nature of Matter

- Investigate and compare various properties of elements.
- Develop models to describe the atomic composition of simple molecules.
- Use particle-level models to explain interactions of energy and matter within a system.
- Use evidence to determine whether a physical or chemical change has occurred.

Lesson 2: Modeling Atoms

- Describe atomic structure using a model of the atom that includes protons, neutrons, and electrons.
- Compare and contrast atoms of different elements and isotopes of the same element.
- Calculate the atomic mass of an element given isotope data.

Lesson 3: Atomic Emission Spectra and the Bohr Model

- Develop and use Bohr models for atoms, illustrating electron energy levels and the placement of electrons within those levels.
- Use the Bohr model to explain why elements have unique atomic emission spectra.
- Relate the spectra of elements to the structure of their atoms, particularly the patterns of electrons and changes in their energy.

Lesson 4: Modern Atomic Theory

- Investigate how the quantum mechanical nature of the electron gave rise to modern atomic orbital theory.
- Evaluate how the quantum mechanical nature of the electron can be used to refine models of the atom.

Lesson 5: Electrons in Atoms

- Predict the electron configuration of atoms using the periodic table as a model.
- Use electron dot structures to represent an atom's valence electrons.

Investigation 2: The Periodic Table

Lesson 1: The Periodic Table: An Overview

- Describe how elements in the periodic table are arranged by the numbers of protons in atoms.
- Identify how the arrangement of the main groups of the periodic table reflects the patterns of outermost electrons.
- Explain how the position of an element in the table can be used to predict some of its chemical properties.

Lesson 2: The Periodic Table and Atomic Structure

- Describe how electron configuration gives rise to trends in the periodic table.
- Explain how the periodic table can be used to predict electron configuration of an element.
- Use Coulomb's law to explain effective nuclear charge and why the positive charge exerted by an atomic nucleus is not equal to the charge of its protons.
- Explain patterns of effective nuclear charge across a period of main group elements.

Lesson 3: Periodic Trends

- Investigate and explain reactivity patterns in the periodic table using concepts of ionization energy, net effective charge, and atomic radius.
- Use models of elements to explain the formation of ions.
- Use periodic trends to explain some chemical properties of elements.

Investigation 3: Chemical Bonding

Lesson 1: Ionic Bonds

- Explore the octet rule and how the electrostatic attractions between cations and anions form ions bonds.
- Describe how the structure of ionic compounds affect their properties.

Lesson 2: Metallic Bonds

- Explain how the bonding in metals and alloys affects their properties.
- Describe the sea of electrons model, and they compare ionic and metallic bonds.

Lesson 3: Covalent Bonds

- Investigate covalent bonding, including molecular geometry and polarity.
- Estimate the difference in electronegativities between two elements to determine bond polarity.

Lesson 4: Intermolecular Forces

- Explore hydrogen bonds and draw models showing dispersion forces.
- Explain how intermolecular attractions between molecules affect the properties of a substance.

Lesson 5: Names and Formulas of Compounds

- Explain the rules for naming compounds and acids, including how to name a compound when given its formula.
- Predict bond types in a compound based on its name or formula.

Atomic Structure

The Particle Nature of Matter

Lesson 1

1. A chemist is conducting an experiment on a system. At the beginning of the experiment, the chemist wants to determine the temperature of the system. The system has a definite volume but no definite shape. Which of the following is most likely also true for the system?

    a. The molecules in the system have less kinetic energy than a solid.

    b. The molecules in the system have more kinetic energy than a solid.

    c. The molecules are held together by stronger attractive forces than a solid.

    d. Heat flow into the system would eventually cause it to have a definite shape.

2. Which of the following provides the best scientific explanation as to why the things classified as energy are not also classified as matter?

    a. The things classified as matter are only used to generate energy.

    b. Energy makes matter move, and the things classified as energy only make matter move.

c. You cannot hold the things classified as energy, so that must mean they cannot be classified as matter.

d. All matter has mass and occupies space, and the things classified as energy do not have mass and do not take up space.

Modeling Atoms

Lesson 2

1. How many neutrons are there in 226Ra?

   a. 88
   c. 226
   b. 138
   d. 314

2. Which of the following represents a pair of isotopes?

   a. Ca+2 ,Be+2
   c. Fe+2 , Fe+3
   b. 12C, 14C
   d. 7N, 8O

Atomic Emission Spectra and the Bohr Model

Lesson 3

1. If the hydrogen atom emits red, blue-green, blue, and violet light, how many energy levels does it have in the visible region of the spectrum?

   a. 3
   c. 5
   b. 4
   d. 6

2. What is the **lowest** possible energy level that an electron can occupy?

   a. Excited State
   b. Fundamental State
   c. Ground State
   d. Outermost State

Modern Atomic Theory

Lesson 4

1. Which atomic model uses atomic orbitals to describe the probable location of any electron in a three-dimensional space?

a. The cubic model

b. The plum-pudding model

c. The planetary model

d. The quantum mechanical model

2. The electron shell model of an atom has three main components: the energy shell, the subshell, and the orbital. Which of the following represent the correct arrangement from the lowest to highest maximum capacity to hold electrons?

a. orbitals < energy shell < subshell

b. energy shell < orbitals < subshell

c. subshell < orbitals < energy shell

d. orbitals < subshell < energy shell

Electrons in Atoms

Lesson 5

1. The atomic number of an element is 15. What is the likely arrangement of the valence and core electrons in a neutral atom of this element?

a. There are 3 valence electrons and 12 core electrons.

b. There are 4 valence electrons and 11 core electrons.

c. There are 5 valence electrons and 10 core electrons.

d. There are 6 valence electrons and 9 core electrons.

2. Which of the following descriptions of the electron dot structure corresponds to an element in the s block?

a. Has three unpaired dots

b. Has an unpaired dot

c. Has two pairs of dots and two unpaired dots

d. Has three pairs of dots and an unpaired dot

The Periodic Table

The Periodic Table: An Overview

Lesson 1

1. In the periodic table hydrogen is placed and Group 1A and helium is placed in Group 8A. The most likely reason for this is:

a. Hydrogen has one outer shell electron and helium has a full outer shell of electrons.

b. Hydrogen has one outer shell electron and helium has 8 electrons in its outer shell.

c. Hydrogen and helium are both metals.

d. Hydrogen and helium are both gasses.

2. The periodic law states that:

a. The periodic table arranges elements into periods and groups.

b. The properties of elements recur periodically based on their metallic qualities.

c. The properties of elements recur periodically when arranged by increasing atomic mass.

d. The properties of elements recur periodically when arranged by increasing atomic number.

The Periodic Table and Atomic Structure

Lesson 2

1. Which statements are true concerning elements in the same group of the periodic table? Select **all** that apply.

a. They have similar periodic properties.

b. They are all metals or nonmetals, but not both.

c. They are either all solids or all liquids or all gasses.

d. They have the same number of shells of electrons.

e. They have the same number of inner core electrons.

f. They have the same outer shell electron configuration.

2. The valence electrons of an atom do not experience the full attractive force of protons in the atom's nucleus due to the presence of inner core electrons. The reduction in nuclear charge experienced by valence electrons due to inner core electrons is called the

a. Ionization energy effect.

b. Nuclear charge effect.

c. Periodic law effect.

d. Shielding effect.

Periodic Trends

Lesson 3

1. Which of the following correctly completes the statement:

   Cations are always _____ than the parent atom and anions are always _____ than the parent atom.

   a. smaller; smaller
   c. smaller; larger
   b. larger; smaller
   d. larger; larger

2. Based on their definitions, electron affinity could be considered the opposite of

   a. Shielding effect.
   b. Ionization energy.
   c. Nonmetallic character.
   d. Effective nuclear charge.

Ionic Bonds

Lesson 1

1. An atom X has three electrons in its outermost shell. Which ion will **most likely** be formed by X?

   a. X^{-2}
   c. X^{+2}
   b. X^{-3}
   d. X^{+3}

2. Which of the following metals (M) will form an ionic compound with nitrogen with the general formula M_3N_2?
   a. lithium (Li)
   b. aluminum (Al)
   c. sodium (Na)
   d. beryllium (Be)

Metallic Bonds

Lesson 2

1. Which statement **best** compares the melting points of magnesium and sodium?

a. Magnesium has a higher melting point because it contributes one additional electron per atom than sodium in the electron sea.

b. Magnesium has a higher melting point because it contributes two additional electrons per atom than sodium in the electron sea.

c. Sodium has a higher melting point because it contributes one fewer electron per atom than magnesium in the electron sea.

d. Sodium has a higher melting point because it contributes two fewer electrons per atom than magnesium in the electron sea.

2. If you wanted to make a crucible for melting sodium (Na), which metal would be **most** suitable for that purpose?

a. calcium (Ca)

b. rubidium (Rb)

c. lithium (Li)

d. potassium (K)

Covalent Bonds

Lesson 3

1. Which of the following chemical substances has a triple covalent bond?

a. carbon dioxide (CO_2)

b. oxygen (O_2)

c. carbon monoxide (CO)

d. water (H_2O)

2. If you wanted to change the polarity of hydrogen bromide (HBr) by substituting the bromine by a different atom. Which atom would increase the polarity of the molecule?

a. chlorine (Cl)

b. iodine (I)

c. sulfur (S)

d. hydrogen (H)

Intermolecular Attractions

Lesson 4

1. Which of the following bulk properties of substances are affected by intermolecular forces? Select **all** that apply.

a. ductility

b. boiling point

c. volatility

d. malleability

e. melting point

2. Which of the following options correctly ranks solid iodine, liquid bromine and chlorine gas in the order of increasing intermolecular force strength?

a. solid iodine < liquid bromine < chlorine gas

b. solid iodine < chlorine gas < liquid bromine

c. chlorine gas < liquid bromine < solid iodine

d. liquid bromine < solid iodine < chlorine gas

Names and Formulas of Compounds

Lesson 5

1. Calcium bromide is the product of calcium and bromide ions. What is the formula for calcium bromide?

   a. CaBr

   b. $CaBr_2$

   c. Ca_2Br

   d. Ca_2Br_2

2. What is the name of the chemical with the formula SF6?

   a. sulfur (VI) fluoride

   b. sulfur hexafluoride

   c. sulfur heptafluoride

   d. sulfur (6) fluoride