Name: **"In Terms Of"**

Mrs. Vandergoot **Regents Chemistry**

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1. Explain, in terms of electron configuration, why arsenic and antimony are chemically similar.

2. Base your answer to the following question on the information below and on your knowledge of chemistry.

   The radius of a lithium atom is 130 picometers, and the radius of a fluorine atom is 60 picometers. The radius of a lithium ion, Li^+, is 59 picometers, and the radius of a fluoride ion, F^-, is 133 picometers.

   Explain, in terms of subatomic particles, why the radius of a lithium ion is smaller than the radius of a lithium atom.

3. Base your answer to the following question on the information below and on your knowledge of chemistry.

   Fireworks that contain metallic salts such as sodium, strontium, and barium can generate bright colors. A technician investigates what colors are produced by the metallic salts by performing flame tests. During a flame test, a metallic salt is heated in the flame of a gas burner. Each metallic salt emits a characteristic colored light in the flame.

   Explain, in terms of electrons, how a strontium salt emits colored light.

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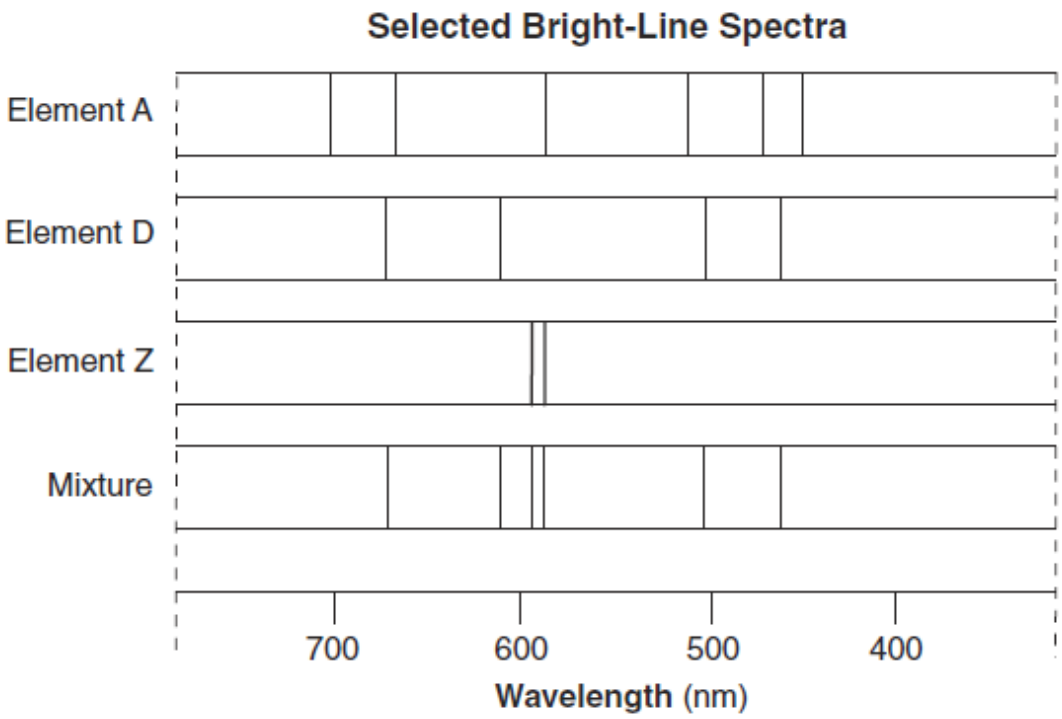
4. Base your answer to the following question on the information below and on your knowledge of chemistry.

The bright-line spectra observed in a spectroscope for three elements and a mixture of two of these elements are represented in the diagram below.



Describe, in terms of *both* electrons and energy state, how the light represented by the spectral lines is produced.

5. Base your answer to the following question on the information below and on your knowledge of chemistry.

Illuminated **EXIT** signs are used in public buildings such as schools. If the word **EXIT** is green, the sign may contain the radioisotope tritium, hydrogen-3. The tritium is a gas sealed in glass tubes. The emissions from the decay of the tritium gas cause a coating on the inside of the tubes to glow.

State, in terms of neutrons, how an atom of tritium *differs* from an atom of hydrogen-1.

6. Base your answer to the following question on the information below and on your knowledge of chemistry.

Chemical concepts are applied in candy making. A recipe for making lollipops is shown below.

Hard-Candy Lollipops Recipe

Ingredients:
414 grams of sugar
177 grams of water
158 milliliters of light corn syrup

Step 1: In a saucepan, mix the sugar and water. Heat this mixture, while stirring, until all of the sugar dissolves.
Step 2: Add the corn syrup and heat the mixture until it boils.
Step 3: Continue boiling the mixture until the temperature reaches 143°C at standards pressure.
Step 4: Remove the pan from the heat and allow it to stand until the bubbling stops. Pour the mixture into lollipop molds that have been coated with cooking oil spray.

Explain, in terms of the polarity of sugar molecules, why the sugar dissolves in water.

7. Base your answer to the following question on the information below

The element boron, a trace element in Earth's crust, is found in foods produced from plants. Boron has only two naturally occurring stable isotopes, boron-10 and boron-11.

State, in terms of subatomic particles, *one* difference between the nucleus of a carbon-11 atom and the nucleus of a boron-11 atom.

8. Explain, in terms of protons and neutrons, why U-235 and U-238 are different isotopes of uranium.

9. Base your answer to the following question on the information below.

In the gold foil experiment, a thin sheet of gold was bombarded with alpha particles. Almost all the alpha particles passed straight through the foil. Only a few alpha particles were deflected from their original paths.

Explain, in terms of charged particles, why some of the alpha particles were deflected.

10. Base your answer to the following question on the information below

An atom in an excited state has an electron configuration of 2-7-2.

Explain, in terms of subatomic particles, why this excited atom is electrically neutral.

11. Explain, in terms of atomic structure, why liquid mercury is a good electrical conductor.

12. Base your answer to the following question on the information below and your knowledge of chemistry.

Many scientists made observations of the elements that led to the modern Periodic Table. In 1829, Dobereiner found groups of three elements that have similar properties and called each of these groups a triad. Dobereiner noticed a relationship between the atomic masses of the elements in each triad. Triad 1, shown in the table below, consists of sulfur, selenium, and tellurium. The middle element, selenium, has an atomic mass that is close to the sum of the atomic masses of sulfur and tellurium, divided by 2.
For example: $\frac{32u+128u}{2} = 80u$, which is close to the 79 u value in the table.

The other triads shown in the table below demonstrate the same mathematical relationship.

Dobereiner's Triads

Triad	Triad	Dobereiner's Atomic Masses (u)
1	sulfur selenium tellurium	32 79 128
2	calcium strontium barium	40. 88 137
3	chlorine bromine iodine	35.5 80. 127
4	lithium sodium potassium	7 23 39

Explain, in terms of electrons, why the elements in triad 2 have similar chemical properties.

Base your answers to questions **13** and **14** on the information below and on your knowledge of chemistry.

The Lewis electron-dot diagrams for three substances are shown below.

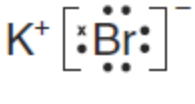


Diagram 1

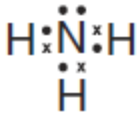


Diagram 2

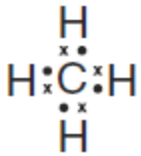


Diagram 3

13. Explain, in terms of distribution of charge, why a molecule of the substance represented in diagram 3 is nonpolar.

14. Describe, in terms of valence electrons, how the chemical bonds form in the substance represented in diagram 1.

15. Explain, in terms of element classification, why K_2O is an ionic compound.

16. Base your answer to the following question on the information below and on your knowledge of chemistry.

There are six elements in Group 14 on the Periodic Table. One of these elements has the symbol Uuq, which is a temporary, systematic symbol. This element is now known as flerovium.

Explain, in terms of electron shells, why each successive element in Group 14 has a larger atomic radius, as the elements are considered in order of increasing atomic number.

17. Explain, in terms of atomic structure, why Group 18 elements on the Periodic Table rarely form compounds.

18. Base your answer to the following question on the information below and on your knowledge of chemistry.

Before atomic numbers were known, Mendeleev developed a classification system for the 63 elements known in 1872, using oxide formulas and atomic masses. He used an R in the oxide formulas to represent any element in each group. The atomic mass was listed in parentheses after the symbol of each element. A modified version of Mendeleev's classification system is shown in the table below.

Modified Version of Mendeleev's Table

Group →		I	II	III	IV	V	VI	VII
Oxide formulas		R_2O	RO	R_2O_3	RO_2	R_2O_5	RO_3	R_2O_7
Series	1	H(1)						
	2	Li(7)	Be(9.4)	B(11)	C(12)	N(14)	O(16)	F(19)
	3	Na(23)	Mg(24)	Al(27.3)	Si(28)	P(31)	S(32)	Cl(35.5)
	4	K(39)	Ca(40)		Ti(48)	V(51)	Cr(52)	Mn(55)
	5	Cu(63)	Zn(65)			As(75)	Se(78)	Br(80)
	6	Rb(85)	Sr(87)	Yt(88)	Zr(90)	Nb(94)	Mo(96)	
	7	Ag(108)	Cd(112)	In(113)	Sn(118)	Sb(122)	Te(125)	I(127)
	8	Cs(133)	Ba(137)	Di(138)	Ce(140)			

Explain , in terms of chemical reactivity, why the elements in Group 18 on the modern Periodic Table were *not* identified by Mendeleev at that time.

19. Base your answer to the following question on the information below and on your knowledge of chemistry.

Wood is mainly cellulose, a polymer produced by plants. One use of wood is as a fuel in campfires, fireplaces, and wood furnaces. The molecules of cellulose are long chains of repeating units. Each unit of the chain can be represented as $C_6H_{10}O_5$. The balanced equation below represents a reaction that occurs when $C_6H_{10}O_5$ is burned in air.

$$C_6H_{10}O_5 + 6O_2 \rightarrow 6CO_2 + 5H_2O + \text{heat}$$

Explain, in terms of substances in the reaction, why the equation represents a chemical change.

20. Base your answer to the following question on the information below and on your knowledge of chemistry.

At STP, Cl_2 is a gas and I_2 is a solid. When hydrogen reacts with chlorine, the compound hydrogen chloride is formed. When hydrogen reacts with iodine, the compound hydrogen iodide is formed.

Explain, in terms of intermolecular forces, why iodine is a solid at STP but chlorine is a gas at STP.

21. Base your answer to the following question on the information below and on your knowledge of chemistry.

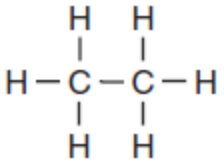
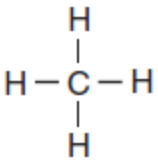
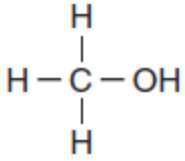
A student made a copper bracelet by hammering a small copper bar into the desired shape. The bracelet has a mass of 30.1 grams and was at a temperature of 21°C in the classroom. After the student wore the bracelet, the bracelet reached a temperature of 33°C. Later, the student removed the bracelet and placed it on a desk at home, where it cooled from 33°C to 19°C. The specific heat capacity of copper is 0.385 J/g• K.

Explain, in terms of heat flow, the change in the temperature of the bracelet when the student wore the bracelet.

22. Base your answer to the following question on the information below and on your knowledge of chemistry.

The formulas and the boiling points at standard pressure for ethane, methane, methanol, and water are shown in the table below.

Information for Four Compounds

Name	Formula	Boiling Point (°C)
ethane		–88.6
methane		–161.5
methanol		64.6
water		100.0

Explain, in terms of molecular polarity, why the solubility of methanol in water is greater than the solubility of methane in water.

23. Base your answer to the following question on the information below and on your knowledge of chemistry.

Rubbing alcohol is a product available at most pharmacies and supermarkets. One rubbing alcohol solution contains 2-propanol and water. The boiling point of 2-propanol is 82.3°C at standard pressure.

Explain in terms of electronegativity differences, why a C–O bond is more polar than a C–H bond.

24. Base your answer to the following question on the information below and on your knowledge of chemistry.

The balanced equation below represents a reaction.

$$O_2(g) + \text{energy} \rightarrow O(g) + O(g)$$

Explain, in terms of bonds, why energy is absorbed during this reaction.

25. Base your answer to the following question on the information below and on your knowledge of chemistry.

The table below contains selected information about chlorine and two compounds containing chlorine. One piece of information is missing for each of the substances in the table.

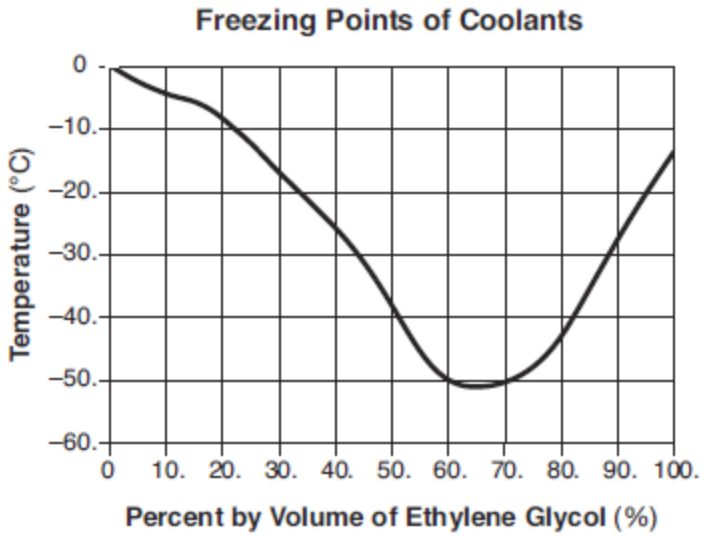
Chlorine and Two Compounds Containing Chlorine

Name	Formula	Molar Mass (g/mol)	Phase at STP
chlorine	Cl_2	71	?
calcium chloride	$CaCl_2$	?	solid
1,2-dichloroethene	?	97	liquid

Explain, in terms of electrons, why the compound containing calcium and chlorine is classified as an ionic compound.

26. Base your answer to the following question on the information below and on your knowledge of chemistry.

A solution of ethylene glycol and water can be used as the coolant in an engine-cooling system. The ethylene glycol concentration in a coolant solution is often given as percent by volume. For example, 100. mL of a coolant solution that is 40.% ethylene glycol by volume contains 40. mL of ethylene glycol diluted with enough water to produce a total volume of 100. mL. The graph below shows the freezing point of coolants that have different ethylene glycol concentrations.



Explain, in terms of particle distribution, why a coolant solution is a homogeneous mixture.

27. Base your answer to the following question on the information below.

Nitrogen gas and oxygen gas make up about 99% of Earth's atmosphere. Other atmospheric gases include argon, carbon dioxide, methane, ozone, hydrogen, etc.
The amount of carbon dioxide in the atmosphere can vary. Data for the concentration of $CO_2(g)$ from 1960 to 2000 are shown in the table below.

Atmospheric Concentration of $CO_2(g)$

Year	Concentration (ppm)
1960	316.9
1980	338.7
2000	369.4

Explain, in terms of types of matter, why methane can be broken down by chemical means, but argon can *not* be broken down by chemical means. Your response must include *both methane and argon.*

Answer Key
in terms of

1. – Arsenic atoms and antimony atoms each have 5 valence electrons. – An As atom and a Sb atom both have five outermost electrons. – same number of valence e^-

2. — A lithium atom loses its second-shell electron, so the lithium ion has only one shell of electrons. — A lithium ion has one fewer electron. — The Li atom has 3 electrons and the Li^+ ion has 2 electrons. — A Li^+ ion has one less electron.

3. — When strontium electrons in an excited state move to a lower energy state, specific amounts of energy are emitted. — Energy is emitted when electrons in higher electron shells move to lower electron shells. — Light of specific wavelengths is emitted when electrons fall to lower energy levels. — Electrons move from higher shells to lower shells.

4. —Different colors of light are produced when electrons return from higher energy states to lower energy states. —Light energy can be emitted when electrons in excited atoms return to lower shells. —Electrons release energy as they move toward the ground state.

5. — A tritium atom has two neutrons and an H-1 atom has no neutrons. — Only the tritium atom has neutrons. — H-1 has no neutrons.

6. –The polarity of sugar molecules is similar to the polarity of water molecules. –Both substances consists of polar molecules.

7. –The carbon-11 nucleus has one more proton than the nucleus of boron-11. –A B-11 atom has a different number of neutrons than a C-11 atom.

8. – A U-235 atom has 92 protons and 143 neutrons, and a U-238 atom has 92 protons and 146 neutrons. – A U-235 atom and a U-238 atom have the same number of protons but a different number of neutrons.

9. –Alpha particles are positive and are repelled by the nucleus that is also positive. –Both protons and alpha particles are positively charged so they repel each other. –Protons and alpha particles have the same charge.

10. The number of protons equals the number of electrons. *or* The atom has 11 protons and 11 electrons.

11. Examples: – Electrons in liquid mercury are mobile. – valence electrons free to move and conduct electric current

12. In the ground state, an atom of each of the elements has two valence electrons. An atom of each element has the same number of electrons in the outermost shell.

13. —Charge is symmetrically distributed. —The molecule has uniform charge distribution. —The centers of positive charge and negative charge coincide.

14. —Valence electrons are lost by potassium and gained by bromine. —The ions form as a result of a transfer of electrons between the atoms.

15. —A metal reacts with a nonmetal to produce an ionic compound. —Potassium is a metal and oxygen is a nonmetal.

16. — The atomic radius of these elements increases down the group because each successive element has one more electron shell. — The number of shells per atom increases.

Answer Key
in terms of

17. — Group 18 elements rarely form compounds because their atoms have stable electron configurations. — Their valence shells are completely filled. — All the elements have maximum numbers of valence electrons. — Atoms of Group 18 have a stable octet except He, which is stable with two electrons.

18. –Since the Group 18 elements tend not to react with other elements, there were no oxide compounds for Mendeleev to study. –Group 18 elements are generally unreactive.

19. — The products of the reaction are different substances than the reactants. — The chemical properties of the reactants and the products are different. — Bonds are broken in the reactants and new bonds are formed in the products. — Different substances are formed.

20. —Iodine has stronger intermolecular forces than chlorine. — The forces between Cl_2 molecules are weaker. — Dispersion forces are stronger in I_2. — The molecules of I_2 attract each other more.

21. —The bracelet temperature increased because heat flowed from the body to the copper. — Energy is transferred from the student to the bracelet. — Heat is absorbed by the bracelet.

22. — Methanol and water molecules are polar, but methane molecule are nonpolar. — The compounds methanol and water have similar polarities.

23. – There is a greater electronegativity difference in a CO bond than in a CH bond. – The CO bond is more polar because the electronegativity difference for a CO bond is 0.8, and the electronegativity difference for a CH bond is 0.4. – The CH bond has a smaller difference. – The CO is .8 and the CH is .4

24. –Energy is needed to break the bonds in O_2.

25. Electrons are transferred from the metal to the nonmetal. Calcium loses electrons and chlorine gains electrons. Electrons were transferred.

26. – The particles are distributed uniformly throughout the coolant mixture. – There is an even distribution of molecules in the solution. – The water and ethylene glycol molecules mix uniformly. – All particles are evenly dispersed.

27. –Methane is a compound consisting of two elements, so it can be broken down by chemical means, but argon is an element, which cannot be broken down. –Methane is a compound and argon is an element.