Name:

Unit Review: Periodic Table

1. In terms of atomic structure, explain why electronegativity increases as you go across a period on the periodic table.

2. Explain in terms of atomic structure why the atomic radius increases as you go down a group on the periodic table.

3. Explain, in terms of subatomic particles, why the radius of a chloride ion is larger than the radius of a chlorine atom.

4. Explain, in terms of atomic structure, why the noble gas neon is an unreactive element.

5. Describe *one* chemical property of Group 1 metals that results from the atoms of each metal having only one valence electron.

6. Explain, in terms of electron configuration, why selenium and sulfur have similar chemical properties.

Base your answers to questions 7 through 9 on the elements in Group 2 on the Periodic Table.

7. Explain, in terms of atomic structure, why the elements in Group 2 have similar chemical properties.

8. State, in terms of the number of electron shells, why the radius of a strontium atom in the ground state is larger than the radius of a magnesium atom in the ground state.

9. State the general trend in first ionization energy for the elements in Group 2 as these elements are considered in order from top to bottom in the group.

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10. Explain, in terms of atomic structure, why the atomic radius of iodine is greater than the atomic radius of fluorine.

11. Fluorine is a Group 17 element. Fluorine is the most electronegative and reactive of all elements. It is a pale yellow, corrosive gas, which reacts with practically all organic and inorganic substances.

a Draw the Lewis electron-dot structure for an *atom* of fluorine.

b What is the definition of the term "electronegativity".

c Explain in terms of atomic structure why the electronegativity of elements in Group 17 decreases as you go down within that group.

Base your answers to questions 12 through 16 on the information below.
The ionic radii of some Group 2 elements are given in the table below.

Ionic Radii of Some Group 2 Elements

Symbol	**Atomic Number**	**Ionic Radius** (pm)
Be	4	44
Mg	12	66
Ca	20	99
Ba	56	134

12. Explain, in terms of electrons, why the ionic radius of a Group 2 element is smaller than its atomic radius.

13. State the trend in ionic radius as the elements in Group 2 are considered in order of increasing atomic number.

14. Estimate the ionic radius of strontium.

15. On the same grid, plot the data from the data table. Circle and connect the points.

16. On the grid, mark an appropriate scale on the axis labeled "Ionic Radius (pm)."

Base your answers to questions 17 and 18 on the information below.

Densities of Group 14 Elements

Element	Density at STP (g/cm^3)
C	3.51
Si	2.33
Ge	5.32
Sn	7.31
Pb	11.35

17. Calculate the volume of a tin block that has a mass of 95.04 grams at STP. Your response must include *both* a numerical setup and the calculated result

18. Identify *one* element from this table for *each* type of element: metal, metalloid, and nonmetal.

Base your answers to questions 19 through 21 on the information below.

Elements with atomic numbers 112 and 114 have been produced and their IUPAC names are pending approval. However, an element that would be put between these two elements on the Periodic Table has not yet been produced. If produced, this element will be identified by the symbol Uut until an IUPAC name is approved.

19. Identify one element that would be chemically similar to Uut.

20. Determine the charge of an Uut nucleus. Your response must include both the numerical value and the sign of the charge.

21. Draw a Lewis electron-dot diagram for an atom of Uut.

Base your answers to questions 22 and 23 on the information below.

Two sources of copper are cuprite, which has the IUPAC name copper(I) oxide, and malachite, which has the formula $Cu_2CO_3(OH)_2$. Copper is used in home wiring and electric motors because it has good electrical conductivity. Other uses of copper not related to its electrical conductivity include coins, plumbing, roofing, and cooking pans.Aluminum is also used for cooking pans.

At room temperature, the electrical conductivity of a copper wire is 1.6 times greater than an aluminum wire with the same length and cross-sectional area. At room temperature, the heat conductivity of copper is 1.8 times greater than the heat conductivity of aluminum. At STP, the density of copper is 3.3 times greater than the density of aluminum.

22. Identify *one* physical property of aluminum that could make it a better choice than copper for a cooking pan.

23. Identify *one* physical property of copper that makes it a good choice for uses that are *not* related to electrical conductivity.

Base your answers to questions 24 and 25 on the information below.

The nucleus of one boron atom has five protons and four neutrons.

24. Determine the total charge of the boron nucleus.

25. Determine the total number of electrons in the boron atom.

Base your answers to questions 26 through 28 on the information below.

The atomic and ionic radii for sodium and chlorine are shown in the table below.

Atomic and Ionic Radii

Particle	Radius (pm)
Na atom	190.
Na^+ ion	102
Cl atom	97
Cl^- ion	181

26. Explain, in terms of atomic structure, why the radius of an Na atom is larger than the radius of an Na^+ ion.

27. Convert the radius of an Na^+ ion to meters.

28. Write the ground state electron configuration for the ion that has a radius of 181 picometers.

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

Arsenic is often obtained by heating the ore arsenopyrite, FeAsS. The decomposition of FeAsS is represented by the balanced equation below.

$$FeAsS(s) \xrightarrow{heat} FeS(s) + As(g)$$

In the solid phase, arsenic occurs in two forms. One form, yellow arsenic, has a density of 1.97 g/cm^3 at STP. The other form, gray arsenic, has a density of 5.78 g/cm^3 at STP. When arsenic is heated rapidly in air, arsenic(III) oxide is formed.

Although arsenic is toxic, it is needed by the human body in very small amounts. The body of a healthy human adult contains approximately 5 milligrams of arsenic.

Convert the mass of arsenic found in the body of a healthy human adult to grams.

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

A 4.86-gram sample of calcium reacted completely with oxygen to form 6.80 grams of calcium oxide. This reaction is represented by the balanced equation below.

$$2Ca(s) + O_2(g) \rightarrow 2CaO(s)$$

Explain, in terms of electrons, why the radius of a calcium ion is smaller than the radius of a calcium atom.

Base your answers to questions 31 through 34 on the information below, which describes the proposed discovery of element 118.

In 1999, a nuclear chemist and his team announced they had discovered a new element by crashing krypton atoms into lead. The new element, number 118, was assigned the name ununoctium and the symbol Uuo. One possible isotope of ununoctium could have been Uuo-291.

However, the discovery of Uuo was not confirmed because other scientists could not reproduce the experimental results published by the nuclear chemist and his team. In 2006, another team of scientists claimed that they produced Uuo. This claim has yet to be confirmed. Adapted from Discover January 2002

31. Explain why being able to reproduce scientific results is an important component of scientific research.

32. What would be the total number of electrons present in a theoretical atom of Uuo-291?

33. What would be the total number of neutrons present in a theoretical atom of Uuo-291?

34. Based on atomic number, in which group on the Periodic Table would element 118 be placed?

Base your answers to questions 35 through 38 on the information below.

A metal, *M*, was obtained from a compound in a rock sample. Experiments have determined that the element is a member of Group 2 on the Periodic Table of the Elements.

35. Using the symbol *M* for the element, write the chemical formula for the compound that forms when element *M* reacts with iodine.

36. Explain why the radius of a positive ion of element *M* is *smaller* than the radius of an atom of element *M*.

37. What is the phase of element *M* at STP?

38. Explain, in terms of electrons, why element *M* is a good conductor of electricity.

Base your answers to questions 39 and 40 on the table below.

First Ionization Energy of Selected Elements

Element	Atomic Number	First Ionization Energy (kJ/mol)
lithium	3	520
sodium	11	496
potassium	19	419
rubidium	37	403
cesium	55	376

39. Explain, in terms of atomic structure, why cesium has a *lower* first ionization energy than rubidium.

40. State the trend in first ionization energy for the elements in the table as the atomic number increases.

Answer Key
[New Exam]

1. Essay

2. As you down a group on the periodic table, there are more shells of electrons added which increases the shielding effect.

3. -A Cl^- ion has 18 electrons and 17 protons, so there is less attraction by the nucleus for the electron shells, allowing the electron shells to expand. -The radius of Cl^- is larger because the nucleus can't hold 18 electrons as close as it can hold 17 electrons

4. *Examples:* - Neon has atoms with a complete outer shell of electrons. - Neon has a complete octet. - Neon has eight valence electrons.

5. *Examples*: -form 1+ ions -react vigorously with water -easily lose one electron -form ionic bonds with nonmetals -form halides with the general formula *MX*

6. Examples: - An atom of each element has six electrons in its outer shell. - same number of valence electrons

7. -In the ground state, an atom of each element has two valence electrons.
-The number of electrons in the outermost shell of each atom is the same.

8. A strontium atom in the ground state has two more electron shells than a magnesium atom in the ground state.

9. as atomic number increases, first ionization energy decreases.

10. Examples: - An iodine aton has more electron shells than a fluorine atom. - A fluorine atom has fewer electron shells.

11. $:\ddot{\underset{\cdot\cdot}{F}}\cdot$

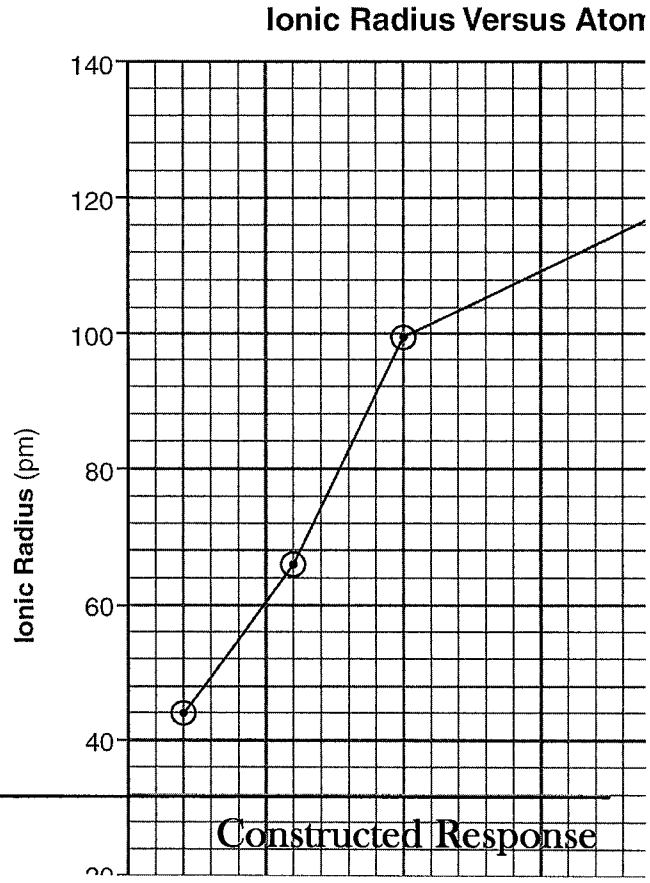
b) Electronegativity is the relative measure of how strongly the nucleus of an atom will attract electrons from another atom. c) As you go down the period the nuclear charge gets shielded by layers of more electrons and as the atom gets larger, the distance to the nuclear charge gets greater.

12. - The valence electron shell of a Group 2 atom is lost when it becomes an ion. - A Group 2 ion has two fewer electrons than the atom from which it was formed.

13. - As the atomic number of elements in Group 2 increases, the ionic radius increases. - The ionic radius increases.

14. - 117 pm ± 2 pm

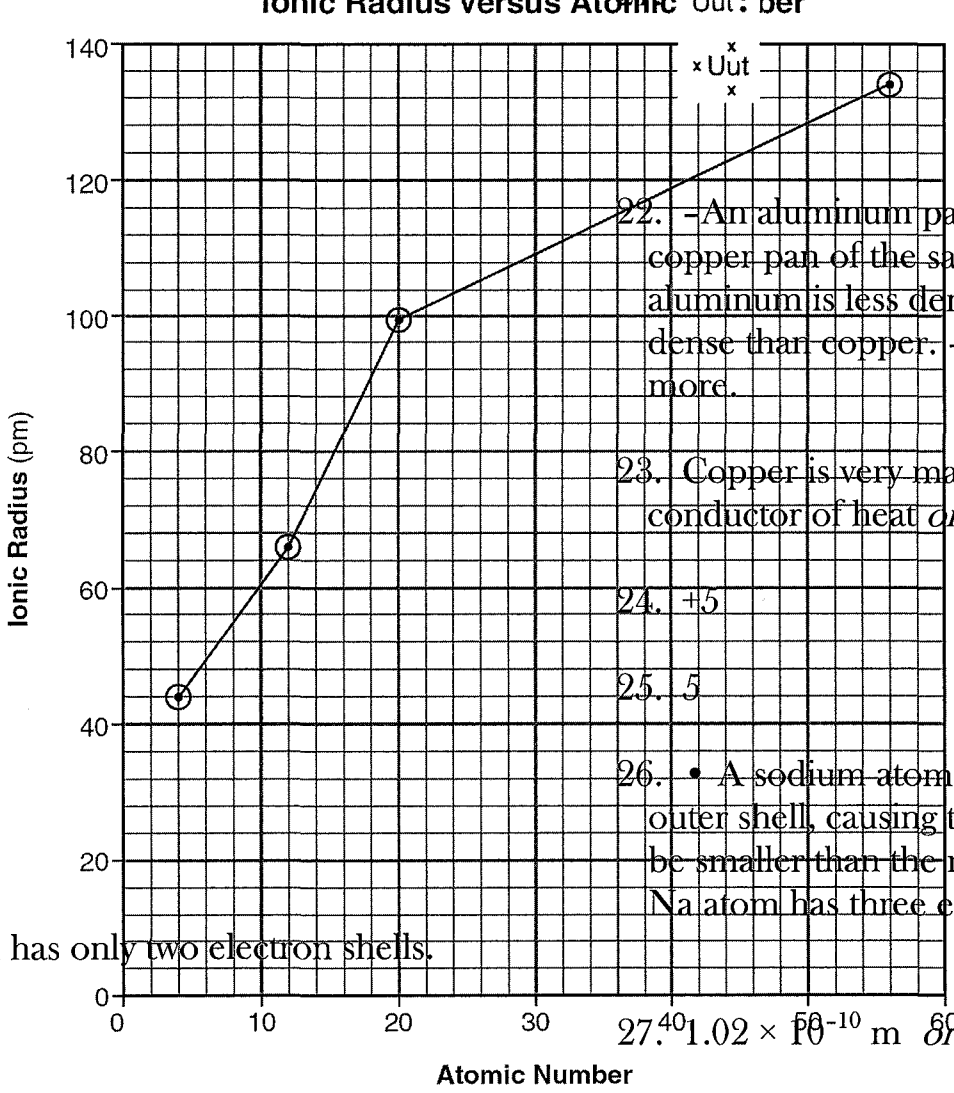
15.



Constructed Response

Answer Key
[New Exam]

16.



17. 7.31 g/cm^3 = $\frac{95.04\ g}{V}$

18. -Metal: Tin or Sn or Lead or Pb
-Metalloid: Silicon or Si or Germanium or Ge
-Nonmetal: Carbon or C

19. *Examples:* - Ti - boron

20. +113

21.

22. -An aluminum pan has less mass than a copper pan of the same size because aluminum is less dense. -Aluminum is less dense than copper. -A Cu pan would weigh more.

23. Copper is very malleable *or* a good conductor of heat *or* a high melting point

24. +5

25. 5

26. • A sodium atom loses the electron in its outer shell, causing the radius of the ion to be smaller than the radius of the atom. • An Na atom has three electron shells, but an Na^+ ion has only two electron shells.

27. 1.02×10^{-10} m *or* 0.000 000 000 102 m

28. 2-8-8

29. 5×10^{-3} g or 0.005 g

30. *Examples:* - A Ca^{2+} ion has two fewer electrons than a Ca atom, so the ion is smaller. A Ca^{2+} ion has two fewer electrons than a Ca atom, so the ion is smaller.- Ca has an electron configuration of 2-8-8-2, and Ca^{2+} has an electron configuration of 2-8-8, so the ion is smaller.Ca has an electron configuration of 2-8-8-2, and Ca^{2+} has an

electron configuration of 2-8-8, so the ion is smaller.

31. *Examples:* --Reproducing results verifies that the results are valid. --reliability of results

32. 118

33. 173

34. *Examples:* --Group 18 --noble gases

35. MI_2

36. Examples: - The ionic radius is smaller because the atom loses two electrons. - The ion has one less occupied energy level.

37. solid

38. Examples: - Metals have freely moving valence electrons. - mobile valence electrons - sea of mobile electrons - Electrons are delocalized.

39. Acceptable responses include, but are not limited to:
As atomic radius increases, valence electrons are more easily removed.
The force of attraction between the nucleus and the valence electrons decreases down the group.
cesium has more shells, easier to remove electrons

40. Acceptable responses include, but are not limited to:
As atomic number increases, first ionization energy decreases. Ionization energy decreases.