

## Periodic Table Review

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1. Which list of elements consists of a metal, a metalloid, and a nonmetal?
- 1) Li, Na, Rb                      **3) Sn, Si, C**  
2) Cr, Mo, W                      4) O, S, Te
2. The elements on the Periodic Table are arranged in order of increasing
- 1) atomic mass                      3) molar mass  
**2) atomic number**                      4) oxidation number
3. Which list includes elements with the most similar chemical properties?
- 1) Br, Ga, Hg                      **3) O, S, Se**  
2) Cr, Pb, Xe                      4) N, O, F
4. Compared to the atoms of nonmetals in Period 3, the atoms of metals in Period 3 have
- 1) fewer valence electrons**  
2) more valence electrons  
3) fewer electron shells  
4) more electron shells
5. Which element has chemical properties that are most similar to the chemical properties of sodium?
- 1) beryllium                      **3) lithium**  
2) calcium                      4) magnesium
6. Which statement identifies the element arsenic?
- 1) Arsenic has an atomic number of 33.**  
2) Arsenic has a melting point of 84 K.  
3) An atom of arsenic in the ground state has eight valence electrons.  
4) An atom of arsenic in the ground state has a radius of 146 pm.
7. Which quantity identifies an element?
- 1) atomic number**  
2) mass number  
3) total number of neutrons in an atom of the element  
4) total number of valence electrons in an atom of the element
8. At STP, which element is a good conductor of electricity?
- 1) chlorine                      **3) silver**  
2) iodine                      4) sulfur
9. A solid element that is malleable, a good conductor of electricity, and reacts with oxygen is classified as a
- 1) metal**                      3) noble gas  
2) metalloid                      4) nonmetal
10. Which element is a liquid at 305 K and 1.0 atmosphere?
- 1) magnesium                      **3) gallium**  
2) fluorine                      4) iodine
11. Which Group 14 element is classified as a metal?
- 1) carbon                      3) silicon  
2) germanium                      **4) tin**
12. An element that has a low first ionization energy and good conductivity of heat and electricity is classified as a
- 1) metal**                      3) nonmetal  
2) metalloid                      4) noble gas
13. Which two characteristics are associated with metals?
- 1) low first ionization energy and low electronegativity**  
2) low first ionization energy and high electronegativity  
3) high first ionization energy and low electronegativity  
4) high first ionization energy and high electronegativity
14. Which elements have the most similar chemical properties?
- 1) boron and carbon  
**2) oxygen and sulfur**  
3) aluminum and bromine  
4) argon and silicon
15. The element sulfur is classified as a
- 1) metal                      **3) nonmetal**  
2) metalloid                      4) noble gas
16. At STP, which element is solid, brittle, and a poor conductor of electricity?
- 1) Al    2) K    3) Ne    **4) S**
17. Which element is classified as a nonmetal?
- 1) Be    2) Al    3) Si    **4) Cl**
18. Which atom in the ground state has a stable electron configuration?
- 1) carbon                      **3) neon**  
2) magnesium                      4) oxygen
19. Which element is a noble gas?
- 1) krypton**                      3) antimony  
2) chlorine                      4) manganese
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20. Which Group 14 element is a metalloid?

- 1) tin                      3) lead  
2) **silicon**                4) carbon

21. Which element is a liquid at STP?

- 1) **bromine**                3) francium  
2) cesium                 4) iodine

22. Which Group 15 element exists as diatomic molecules at STP?

- 1) phosphorus            3) bismuth  
2) **nitrogen**               4) arsenic

23. Which element has the greatest density at STP?

- 1) scandium               3) silicon  
2) **selenium**               4) sodium

24. Which Lewis electron-dot diagram represents a nitrogen atom in the ground state?

- 1)  $\ddot{\text{N}}$                       3)  $\cdot\ddot{\text{N}}\cdot$   
2)  $\cdot\ddot{\text{N}}\cdot$                     4)  $\begin{array}{c} \cdot\ddot{\text{N}}\cdot \\ \cdot\ddot{\text{N}}\cdot \end{array}$

25. Which Lewis electron-dot diagram represents an atom in the ground state for a Group 13 element?

- 1)  $\begin{array}{c} \cdot\ddot{\text{X}}\cdot \\ \cdot\ddot{\text{X}}\cdot \end{array}$                     3)  $\ddot{\text{X}}\cdot$   
2)  $\text{X}:\cdot$                     4)  $\begin{array}{c} \cdot\ddot{\text{X}}\cdot \\ \cdot\ddot{\text{X}}\cdot \end{array}$

26. Which Lewis electron-dot diagram represents a boron atom in the ground state?

- 1)  $\cdot\text{B}$     2)  $\cdot\dot{\text{B}}\cdot$     3)  $:\dot{\text{B}}\cdot$     4)  $:\dot{\text{B}}\cdot$

27. The elements in Group 2 have similar chemical properties because each atom of these elements has the same

- 1) atomic number  
2) mass number  
3) number of electron shells  
4) **number of valence electrons**

28. Which set of properties is most characteristic of transition elements?

- 1) colorless ions in solution, multiple positive oxidation states  
2) colorless ions in solution, multiple negative oxidation states  
3) **colored ions in solution, multiple positive oxidation states**  
4) colored ions in solution, multiple negative oxidation states

29. Which atom has the largest atomic radius?

- 1) potassium              3) **francium**  
2) rubidium                4) cesium

30. Which ion has the *smallest* radius?

- 1)  $\text{O}^{2-}$                       3)  $\text{Se}^{2-}$   
2)  $\text{S}^{2-}$                       4)  $\text{Te}^{2-}$

31. As the elements in Period 3 are considered in order of increasing atomic number, there is a general *decrease* in

- 1) atomic mass  
2) **atomic radius**  
3) electronegativity  
4) first ionization energy

32. Which characteristics both generally *decrease* when the elements in Period 3 on the Periodic Table are considered in order from left to right?

- 1) nonmetallic properties and atomic radius  
2) nonmetallic properties and ionization energy  
3) **metallic properties and atomic radius**  
4) metallic properties and ionization energy

33. An ion of which element has a larger radius than an atom of the same element?

- 1) aluminum               3) magnesium  
2) **chlorine**                4) sodium

34. Which of the following ions has the *smallest* radius?

- 1)  $\text{F}^-$     2)  $\text{Cl}^-$     3)  $\text{K}^+$     4)  $\text{Ca}^{2+}$

35. Which general trends in first ionization energy and electronegativity values are demonstrated by Group 15 elements as they are considered in order from top to bottom?

- 1) **The first ionization energy decreases and the electronegativity decreases.**  
2) The first ionization energy increases and the electronegativity increases.  
3) The first ionization energy decreases and the electronegativity increases.  
4) The first ionization energy increases and the electronegativity decreases.

36. Which element has atoms with the strongest attraction for electrons in a chemical bond?

- 1) chlorine                3) **fluorine**  
2) nitrogen                4) oxygen

37. Which atom has the *weakest* attraction for electrons in a chemical bond?

- 1) a boron atom            3) a fluorine atom  
2) **a calcium atom**        4) a nitrogen atom

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\_\_\_\_\_ 38. Which general trend is demonstrated by the Group 17 elements as they are considered in order from top to bottom on the Periodic Table?

- 1) a decrease in atomic radius
- 2) a decrease in electronegativity**
- 3) an increase in first ionization energy
- 4) an increase in nonmetallic behavior

\_\_\_\_\_ 39. Which atom in the ground state requires the *least amount of energy to remove its valence electron*?

- 1) lithium atom      **3) rubidium atom**
- 2) potassium atom    4) sodium atom

\_\_\_\_\_ 40. In the ground state, each atom of an element has two valence electrons. This element has a lower first ionization energy than calcium. Where is this element located on the Periodic Table?

- 1) Group 1, Period 4
- 2) Group 2, Period 5**
- 3) Group 2, Period 3
- 4) Group 3, Period 4

\_\_\_\_\_ 41. Sodium atoms, potassium atoms, and cesium atoms have the same

- 1) atomic radius
- 2) first ionization energy
- 3) total number of protons
- 4) oxidation state**

Base your answers to questions **42** through **44** 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.

\_\_\_\_\_ 42. State the expected number of valence electrons in an atom of the element flerovium in the ground state.

\_\_\_\_\_ 43. 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.

\_\_\_\_\_ 44. Identify an element in Group 14 that is classified as a metalloid.

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Base your answers to questions 45 through 48 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)			

45. 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.

46. Based on Table J, identify the *least* active metal listed in Group I on Mendeleev's table.

47. Based on Mendeleev's oxide formula, what is the number of electrons lost by each atom of the elements in Group III?

48. Identify *one* characteristic used by Mendeleev to develop his classification system of the elements.

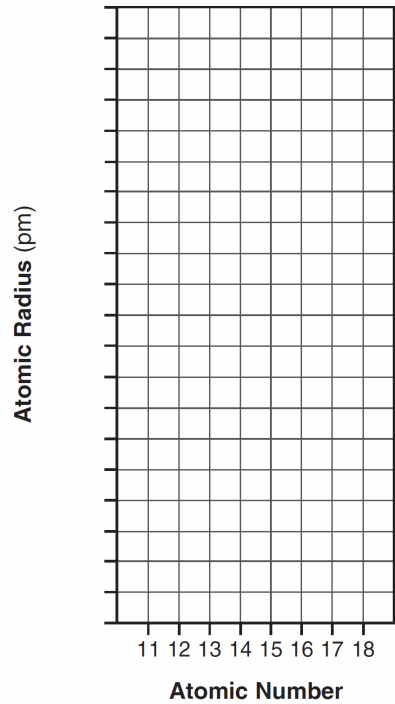
Base your answers to questions **49** and **50** on the information below.

The atomic number and corresponding atomic radius of the Period 3 elements are shown in the data table below.

**Data Table**

Atomic Number	Atomic Radius (pm)
11	160.
12	140.
13	124
14	114
15	109
16	104
17	100.
18	101

**Atomic Radius Versus Atomic Number**



\_\_\_\_\_ 49. Explain, in terms of electrons, the change in radius when a sodium atom becomes a sodium ion.

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50. State the general relationship between the atomic number and the atomic radius for the Period 3 elements.

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51. Draw a Lewis electron-dot diagram for an atom of silicon.

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Base your answers to questions **52** through **54** on the information below.

The atomic radius and the ionic radius for some Group 1 and some Group 17 elements are given in the tables below.

**Atomic and Ionic Radii of Some Elements**

**Group 1**

Particle	Radius (pm)
Li atom	130.
Li <sup>+</sup> ion	78
Na atom	160.
Na <sup>+</sup> ion	98
K atom	200.
K <sup>+</sup> ion	133
Rb atom	215
Rb <sup>+</sup> ion	148

**Group 17**

Particle	Radius (pm)
F atom	60.
F <sup>-</sup> ion	133
Cl atom	100.
Cl <sup>-</sup> ion	181
Br atom	117
Br <sup>-</sup> ion	?
I atom	136
I <sup>-</sup> ion	220.

52. State the relationship between atomic number and first ionization energy as the elements in Group 1 are considered in order of increasing atomic number.

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53. Explain, in terms of electron shells, why the radius of a K<sup>+</sup> ion is greater than the radius of an Na<sup>+</sup> ion.

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54. Estimate the radius of a Br<sup>-</sup> ion.

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Base your answers to questions **55** through **59** on the information below.

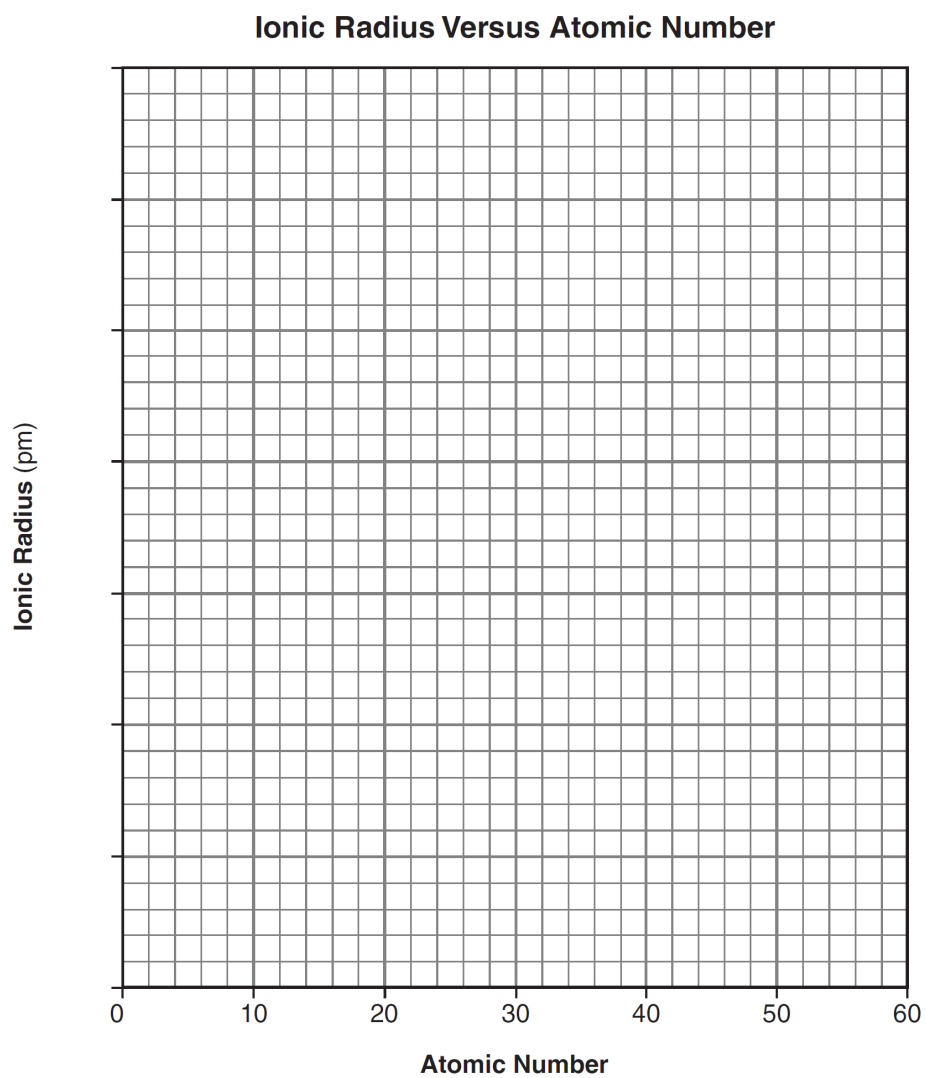
The ionic radii of some Group 2 elements are given in the table below.

**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

- \_\_\_\_\_ 55. Explain, in terms of electrons, why the ionic radius of a Group 2 element is smaller than its atomic radius.
- \_\_\_\_\_ 56. State the trend in ionic radius as the elements in Group 2 are considered in order of increasing atomic number.
- \_\_\_\_\_ 57. Estimate the ionic radius of strontium.
- \_\_\_\_\_ 58. On the same grid, plot the data from the data table. Circle and connect the points.
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59. On the grid, mark an appropriate scale on the axis labeled "Ionic Radius (pm)."





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

**Naturally Occurring Isotopes of Sulfur**

<b>Isotope</b>	<b>Atomic Mass</b> (atomic mass units, u)	<b>Natural Abundance</b> (%)
$^{32}\text{S}$	31.97	94.93
$^{33}\text{S}$	32.97	0.76
$^{34}\text{S}$	33.97	4.29
$^{36}\text{S}$	35.97	0.02

In the space below, draw a Lewis electron-dot diagram for an atom of sulfur-33.

# Answer Key

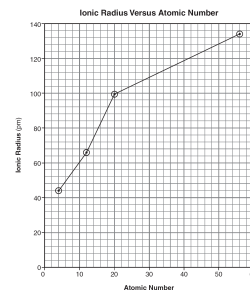
## Periodic Table Review Flipped

1. 3
2. 2
3. 3
4. 1
5. 3
6. 1
7. 1
8. 3
9. 1
10. 3
11. 4
12. 1
13. 1
14. 2
15. 3
16. 4
17. 4
18. 3
19. 1
20. 2
21. 1
22. 2
23. 2
24. 3
25. 3
26. 2
27. 4
28. 3
29. 3
30. 1
31. 2
32. 3
33. 2
34. 1
35. 1
36. 3
37. 2
38. 2
39. 3

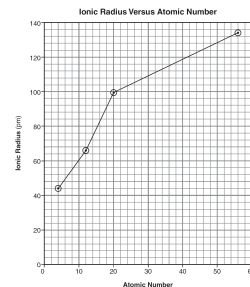
40. 2
41. 4
42. -4 -four  $-4e^-$  -four valence electrons
43. -The atomic radius of these elements increases down the group because each successive element has one more electron shell. -The number of shells per atom increases.
44. -Si -germanium  
-element 32
45. -Since the Group 18 elements tend not to react with other elements, there were no oxide compounds for Mendeleev to study. -Group 18 elements are generally unreactive.
46. -Ag -silver
47. -three electrons  
-three -3
48. -increasing atomic mass -atomic mass  
-oxide formulas
49. -The radius of a sodium ion is smaller because the sodium atom lost one electron. -An  $\text{Na}^+$  ion is smaller because it has one fewer electron shell.
50. As atomic number increases, there is a decrease in atomic radius

51.  $\cdot\ddot{\text{Si}}\cdot$   
 $\cdot\ddot{\text{Si}}\cdot$
52. As the elements in Group 1 are considered in order of increasing atomic number, first ionization energy decreases. As atomic number increases, first ionization energy decreases.
53. A  $\text{K}^+$  ion has three electron shells and an  $\text{Na}^+$  ion has only two. A sodium ion has fewer electron shells than a potassium ion.
54. ionic radius value greater than 181 pm and less than 220. pm.
55. - 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.
56. - As the atomic number of elements in Group 2 increases, the ionic radius increases. - The ionic radius increases.
57.  $-117 \text{ pm} \pm 2 \text{ pm}$

58.



59.



60.

