

- Chapter 6 Assessment Problems pp. 174-175 #41, 42, 43, 44, 46, 48, 52, 55, 56, 57, 59, 60, 61, 63, 64, 65, 66, 67.
41. Why do the elements chlorine and iodine have similar chemical properties?  
Because they have the same number (7) and configuration ( $s^2p^5$ ) of valence electrons.
  42. How are the numbers of valence electrons of the group A elements related to the group number?  
They are identical.
  43. How is the energy level of an atom's valence electrons related to the period it is in on the periodic table?  
The energy level of its valence electrons is equal to its period.
  44. How many valence electrons do each of the noble gases have?  
He has 2 and all the others have 8.
  46. In general, what electron configuration has the greatest stability?  
 $ns^2 np^6$  in any energy level ( $s^2$  in the 1st energy level)
  48. Categorize each of the elements in problem 47 as a representative element or a transition metal:  
a.  $[\text{Kr}]5s^24d^1$                       c.  $[\text{He}]2s^22p^6$   
b.  $[\text{Ar}]4s^23d^{10}4p^3$                   d.  $[\text{Ne}]3s^23p^1$   
(a) is a transition metal since it ends in the d block, all of the others are representative elements.
  49. Explain how an atom's valence electron configuration determines its place on the periodic table.  
The number of valence electrons determines its column, the energy level its row.
  52. Given any two elements within a group, is the element with the larger atomic number likely to have a larger or smaller atomic radius than the other element?  
Larger.
  55. An element forms a negative ion when ionized. On what side of the periodic table is the element located?  
The right side (it is a non-metal).
  56. Of the elements magnesium, calcium, and barium, which forms the ion with the largest radius? The smallest? What periodic trend explains this?  
Largest:  $\text{Ba}^{2+}$ . Smallest:  $\text{Mg}^{2+}$ . Increasing ionic radius down a group.
  57. What is ionization energy?  
The energy needed to remove an electron from a neutral atom in its gaseous state.
  59. Which group has the highest ionization energies? Explain why.  
The noble gases, because they have stable electron configurations and their electrons are held the closest of the atoms in each row.
  60. Define an ion.  
An ion is an atom or a bonded group of atoms with a positive or negative charge.

61. How does the ionic radius of a nonmetal compare with its atomic radius? Explain why the change in radius occurs.

The ionic radius of a nonmetal is larger than its neutral atom because nonmetals tend to gain electrons in the atom's current energy level. These additional electrons repel each other and increase the size of the atom.

63. Which element in each pair has the larger ionization energy?

- a. Li, N                      N (further right)
- b. Kr, Ne                     Ne (highest)
- c. Cs, Li                      Li (highest)

64. Explain the octet rule.

An atom with an electron configuration of  $s^2p^6$ , an octet, has the lowest energy and is the most stable. Atoms will gain, lose, or share electrons to attain an octet as their outermost electron orbital.

65. Use the illustration of spheres A and B to answer each of the following questions. Explain your reasoning for each answer.



(a) If A is an ion and B is an atom of the same element is the ion a positive or negative ion?

The ion is negative since it is larger than the neutral atom.

(b) If A and B represent the atomic radii of two elements in the same period, what is their correct order (left-to-right)?

A, B. Since atomic radii decrease moving to the right, larger A is to the left of B.

(c) If A and B represent the ionic radii of two elements in the same group, what is their correct order (top-to-bottom)?

B, A. Since atomic radii increase moving down a group, larger A is below B.

66. How many valence electrons do elements in each of the following groups have?

- a. group 8A 8
- b. group 3A 3
- c. group 1A 1

67.  $\text{Na}^+$  and  $\text{Mg}^{2+}$  ions each have ten electrons surrounding their nuclei. Which ion would you expect to have the larger radius? Why?

$\text{Na}^+$  because it has a smaller nuclear charge with identical shielding and number of electrons.

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28. Which groups have representative elements?

Groups 1A through 8A (1, 2, 13 through 18)

30. What happens when hydrogen reacts with a nonmetal element?

It loses an electron and forms an ion with a 1+ charge.

32. What is the charge on alkali metal ions? Alkaline earth metal ions?

Alkali metal ions (Group 1, IA): 1+; Alkaline earth metal ions (Group 2, IIA): 2+.

35. Explain why cesium is a more reactive alkali metal than sodium.  
Sodium has a smaller atomic radius and higher ionization energy than cesium; cesium has a larger radius and lower ionization energy due to the increased shielding of its inner electrons, so its valence electron is more easily lost.
36. Use their electron configurations to explain why calcium is less reactive than potassium.  
Calcium has two valence electrons, and it takes more energy to remove two valence electrons than one. Potassium has only one valence electron and is larger than calcium, therefore it takes less energy to remove its lone valence electron.
39. Explain why the halogens are extremely reactive non-metals.  
With seven valence electrons, halogens need only one electron to achieve a stable noble gas electron configuration.
40. Explain why most carbon compounds are classified as organic compounds.  
Many carbon compounds play key roles in the chemistry of living organisms.
41. What is the charge on halogen ions?  
Halogens gain 1 electron and form ions with a 1- charge.
42. Argon has only one more proton than chlorine. Explain why these two gases have such different chemical properties.  
Because argon has 8 valence electrons, making it a stable, closed shell of a noble gas, while chlorine has only 7 valence electrons, and must gain one electron to achieve the noble gas configuration.
48. Explain why iodine can be substituted for bromine in some compounds.  
Iodine and bromine are both halogens and have similar chemical properties (same number of valence electrons).
49. Explain why fluorine reacts with all elements except helium, neon, and argon.  
Fluorine is the most electronegative element, and therefore the most reactive.
53. How do transition metals differ from inner transition metals in their electron configurations?  
Transition metals have their final electron entering a d orbital while inner transition metals have their final electron entering an f orbital.
54. Explain why compounds of zinc are white but compounds containing copper have a color.  
Zinc has no unpaired electrons and a full d sublevel so has no absorption in the visible region of the spectrum; copper has an unpaired electron in its d sublevel (in the 2+ state) and so can absorb light in the visible region.

#### Additional Problems

1. For each of the following main group elements, indicate the symbol, with charge, of its most stable ion and the electron configuration of the ion:

Element	Symbol	e <sup>-</sup> Config of Ion	Element	Symbol	e <sup>-</sup> Config of Ion
a. Al	Al <sup>3+</sup>	[Ne]	b. S	S <sup>2-</sup>	[Ne] 3s <sup>2</sup> 3p <sup>6</sup> or [Ar]
c. As	As <sup>3-</sup>	[Ne] 3s <sup>2</sup> 3p <sup>6</sup> or [Ar]	d. Ca	Ca <sup>2+</sup>	[Ne]

2. For the following transition metal ion, indicate the electron configuration of the element and of the ion:

Ion	Electron Configuration of Element	# e <sup>-</sup> lost	Electron Configuration of Ion
Co <sup>2+</sup>	[Ar] 4s <sup>2</sup> 3d <sup>7</sup>	2	[Ar] 3d <sup>7</sup>
Nb <sup>4+</sup>	[Kr] 5s <sup>2</sup> 4d <sup>3</sup>	4	[Kr] 4d <sup>1</sup>
V <sup>3+</sup>	[Ar] 4s <sup>2</sup> 3d <sup>3</sup>	3	[Ar] 3d <sup>2</sup>

3. Given the following transition metal and the electron configuration of its ion, indicate the electron configuration of the *neutral element* and determine the ion and its charge:

Element	Electron Config of Element	Electron Config of Ion	# e <sup>-</sup> lost	Symbol w/Charge
Ni	[Ar] 4s <sup>2</sup> 3d <sup>8</sup>	[Ar] 3d <sup>6</sup>	4	Ni <sup>4+</sup>
Zr	[Kr] 5s <sup>2</sup> 4d <sup>2</sup>	[Kr]	4	Zr <sup>4+</sup>
Tc	[Kr] 5s <sup>2</sup> 4d <sup>5</sup>	[Kr] 4d <sup>2</sup>	5	Tc <sup>5+</sup>