Chapter 2 Atoms and the Periodic Table

Solutions to In-Chapter Problems

2.1 Each element is identified by a one- or two-letter symbol. Use the periodic table to find the symbol for each element.

a. Ca b. Rn c. N d. Au

2.2 Use the periodic table to find the symbol for each element.

a. Cu and Zn b. Cu and Sn c. Sn, Sb, and Pb

2.3 Use the periodic table to find the element corresponding to each symbol.

a. neon b. sulfur c. iodine d. silicon e. boron f. mercury

2.4 *Metals* are shiny materials that are good conductors of heat and electricity. *Nonmetals* do not have a shiny appearance, and they are generally poor conductors of heat and electricity. *Metalloids* have properties intermediate between metals and nonmetals.

a, d, f, h: metals b, c, g: nonmetals e: metalloid

2.5 Use Figure 2.1 and the definitions in Answer 2.4 to determine if the micronutrients are metals, nonmetals, or metalloids.

As, B, Si: metalloids Cr, Co, Cu, Fe, Mn, Mo, Ni, Zn: metals F, I, Se: nonmetals

2.6 Use Figure 2.3 to determine which elements are represented in the molecular art.

a. 4 hydrogens, 1 carbon b. 3 hydrogens, 1 nitrogen c. 6 hydrogens, 2 carbons, 1 oxygen

2.7 The subscript tells how many atoms of a given element are in each chemical formula.

a. NaCN (sodium cyanide) = 1 sodium, 1 carbon, 1 nitrogen
b. H_2S (hydrogen sulfide) = 2 hydrogens, 1 sulfur
c. C_2H_6 (ethane) = 2 carbons, 6 hydrogens
d. SnF_2 (stannous fluoride) = 1 tin, 2 fluorines
e. CO (carbon monoxide) = 1 carbon, 1 oxygen
f. $C_3H_8O_3$ (glycerol) = 3 carbons, 8 hydrogens, 3 oxygens

2.8 Use Figure 2.3 to determine which elements are represented in the molecular art.

Halothane contains 2 carbons, 1 hydrogen, 3 fluorines, 1 bromine, and 1 chlorine atom.

2.9

a. In a neutral atom, the number of protons and electrons is equal; 9 protons = 9 electrons.
b. The atomic number = the number of protons = 9.
c. This element is fluorine.

2.10 The atomic number is unique to an element and tells the number of protons in the nucleus and the number of electrons in the electron cloud.

Atomic Number	Element	Protons	Electrons
a. 2	Helium	2	2
b. 11	Sodium	11	11
c. 20	Calcium	20	20
d. 47	Silver	47	47
e. 78	Platinum	78	78

2.11 Answer the question as in Sample Problem 2.4.

a. There are 4 protons and 5 neutrons.

b. The atomic number = the number of protons = 4.
The mass number = the number of protons + the number of neutrons = 4 + 5 = 9.

c. The element is beryllium.

2.12 In a neutral atom, the atomic number (*Z*) = the number of protons = the number of electrons. The mass number (*A*) = the number of protons + the number of neutrons.

	Protons	Neutrons (*A* – *Z*)	Electrons
a.	17	18 (35 – 17)	17
b.	14	14 (28 – 14)	14
c.	92	146 (238 – 92)	92

2.13 The mass number (*A*) = the number of protons + the number of neutrons.

a. 42 protons, 42 electrons, 53 neutrons
42 + 53 = **95**

b. 24 protons, 24 electrons, 28 neutrons
24 + 28 = **52**

2.14 The superscript gives the mass number and the subscript gives the atomic number for each element.
The atomic number = the number of protons = the number of electrons in a neutral atom.
The mass number = the number of protons + the number of neutrons.

	Atomic Number	Mass Number	Protons	Neutrons	Electrons
a. $^{13}_{6}C$	6	13	6	7	6
b. $^{121}_{51}Sb$	51	121	51	70	51

2.15 The identity of the element tells us the atomic number.
The mass number = the number of protons + the number of neutrons.

		Protons	Electrons	Atomic Number	Mass Number
With 12 neutrons:	$^{24}_{12}Mg$	12	12	12	12 + 12 = 24
With 13 neutrons:	$^{25}_{12}Mg$	12	12	12	12 + 13 = 25
With 14 neutrons:	$^{26}_{12}Mg$	12	12	12	12 + 14 = 26

2.16 Multiply the isotopic abundance by the mass of each isotope, and add up the products to give the atomic weight for the element.

a. Magnesium

Mass due to Mg-24:	0.7899×23.99 amu	= 18.9497 amu
Mass due to Mg-25:	0.1000×24.99 amu	= 2.499 amu
Mass due to Mg-26:	0.1101×25.98 amu	= 2.8604 amu
	Atomic weight	= 24.3091 amu rounded to 24.31 amu **Answer**

b. Vanadium

Mass due to V-50:	0.00250×49.95 amu	= 0.12488 amu
Mass due to V-51:	0.99750×50.94 amu	= 50.8127 amu
	Atomic weight	= 50.93758 amu rounded to 50.94 amu **Answer**

2.17 Use the element symbol to locate an element in the periodic table. Count down the rows of elements to determine the period. The group number is located at the top of each column.

Element	Period	Group
a. Oxygen	2	6A (or 16)
b. Calcium	4	2A (or 2)
c. Phosphorus	3	5A (or 15)
d. Platinum	6	8B (or 10)
e. Iodine	5	7A (or 17)

2.18 Use the definitions from Section 2.4 to identify the element fitting each description.

a. K
b. F
c. Ar
d. Sr
e. Zn
f. Nb

2.19

a. titanium, Ti, group 4B (or 4), period 4, transition metal
b. phosphorus, P, group 5A (or 15), period 3, main group element
c. dysprosium, Dy, no group number, period 6, inner transition element

2.20 Use Table 2.4 to tell how many electrons are present in each shell, subshell, or orbital.

a. a 2*p* orbital = 2 electrons
b. the 3*d* subshell = 10 electrons
c. a 3*d* orbital = 2 electrons
d. the third shell = 18 electrons

2.21 The **electronic configuration** of an individual atom is how the electrons are arranged in an atom's orbitals.

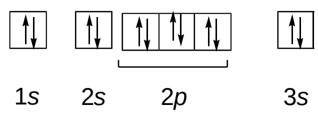
a. $1s^22s^22p^63s^23p^2$ = silicon
b. $[Ne]3s^23p^4$ = sulfur
c. $1s^22s^22p^63s^23p^64s^23d^1$ = scandium
d. $[Ar]4s^23d^{10}$ = zinc

2.22 The **electronic configuration** of an individual atom shows how the electrons are arranged in an atom's orbitals.

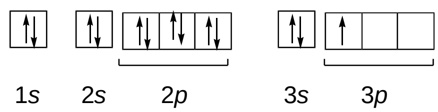
a. lithium
b. beryllium, boron, carbon, nitrogen, oxygen, fluorine, neon
c. fluorine
d. oxygen

2.23 Use Example 2.5 to help draw the orbital diagram for each element.
[1] Use the atomic number to determine the number of electrons.
[2] Place electrons two at a time into the lowest energy orbitals, using Figure 2.8. When orbitals have the same energy, place electrons one at a time in the orbitals until they are half-filled.

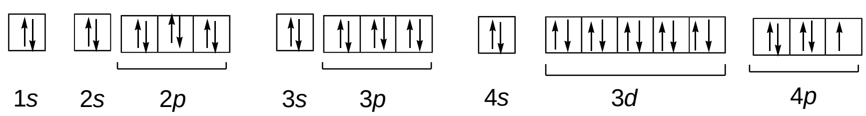
a. magnesium



b. aluminum



c. bromine



2.24 To convert the electronic configuration to noble gas notation, replace the electronic configuration corresponding to the noble gas in the preceding row by the element symbol for the noble gas in brackets.

a. sodium: $1s^22s^22p^63s^1$
[Ne]$3s^1$

b. silicon: $1s^22s^22p^63s^23p^2$
[Ne]$3s^23p^2$

c. iodine: $1s^22s^22p^63s^23p^64s^23d^{10}4p^65s^24d^{10}5p^5$
[Kr]$5s^24d^{10}5p^5$

2.25 To obtain the total number of electrons, add up the superscripts. This gives the atomic number and identifies the element. To determine the number of valence electrons, add up the number of electrons in the shell with the highest number.

a. $1s^22s^22p^63s^2$
12 electrons, 2 valence electrons in the 3*s* orbital, magnesium

b. $1s^22s^22p^63s^23p^3$
15 electrons, 5 valence electrons in the 3*s* and 3*p* orbitals, phosphorus

c. $1s^22s^22p^63s^23p^64s^23d^{10}4p^65s^24d^2$
40 electrons, 2 valence electrons in the 5*s* orbital, zirconium

d. [Ar]$4s^23d^6$
26 electrons, 2 valence electrons in the 4*s* orbital, iron

2.26 The group number of a main group element = the number of valence electrons. Use the general electronic configurations in Table 2.6 to write the configuration of the valence electrons.

a. fluorine = 7 valence electrons: $2s^22p^5$
b. krypton = 8 valence electrons: $4s^24p^6$
c. magnesium = 2 valence electrons: $3s^2$
d. germanium = 4 valence electrons: $4s^24p^2$

2.27

Se, selenium: $4s^24p^4$
Te, tellurium: $5s^25p^4$
Po, polonium: $6s^26p^4$

2.28 Write the symbol for each element and use the group number to determine the number of valence electrons for a main group element. Represent each valence electron with a dot.

a. Br　　c. Al　　e. Ne
b. Li　　d. S

2.29 The size of atoms increases down a column of the periodic table because the valence electrons are farther from the nucleus. The size of atoms decreases across a row of the periodic table because the number of protons in the nucleus increases.

a. neon, carbon, boron
b. beryllium, magnesium, calcium
c. sulfur, silicon, magnesium
d. neon, krypton, xenon
e. oxygen, sulfur, silicon
f. fluorine, sulfur, aluminum

2.30 Ionization energies decrease down a column of the periodic table because the valence electrons move farther from the positively charged nucleus. Ionization energies generally increase across a row of the periodic table because the number of protons in the nucleus increases.

a. silicon, phosphorus, sulfur
b. calcium, magnesium, beryllium
c. beryllium, carbon, fluorine
d. krypton, argon, neon
e. tin, silicon, sulfur
f. calcium, aluminum, nitrogen

Solutions to End-of-Chapter Problems

2.31 Use Figure 2.3 to determine which elements are represented in the molecular art.
a. carbon (black) and oxygen (red)
b. carbon (black), hydrogen (gray), and chlorine (green)

2.32 Use Figure 2.3 to determine which elements are represented in the molecular art.
a. Cl_2
b. CH_3Br
c. $C_2H_6O_2$

2.33 Use the periodic table to find the element corresponding to each symbol.

a. Au = gold, At = astatine, Ag = silver
b. N = nitrogen, Na = sodium, Ni = nickel
c. S = sulfur, Si = silicon, Sn = tin
d. Ca = calcium, Cr = chromium, Cl = chlorine
e. P = phosphorus, Pb = lead, Pt = platinum
f. Ti = titanium, Ta = tantalum, Tl = thallium

2.34 Use the periodic table to find the element corresponding to each symbol.

a. CU is made of C (carbon) and U (uranium); Cu = copper.
b. Os = osmium; OS is made of O (oxygen) and S (sulfur).
c. Ni = nickel; NI is made of N (nitrogen) and I (iodine).
d. BIN is made of B (boron), I (iodine) and N (nitrogen); BiN is made of Bi (bismuth).
and N (nitrogen); BIn is made of B (boron) and In (indium).

2.35 An *element* is a pure substance that cannot be broken down into simpler substances by a chemical reaction. A *compound* is a pure substance formed by combining two or more elements together.

a. H_2 = element
b. H_2O_2 = compound
c. S_8 = element
d. Na_2CO_3 = compound
e. C_{60} = element

2.36 Use the periodic table to find the element corresponding to each symbol.

a. $K_2Cr_2O_7$ is made up of 2 atoms of K (potassium), 2 atoms of Cr (chromium) and 7 atoms of O (oxygen).
b. $C_5H_8NNaO_4$ is made up of 5 atoms of C (carbon), 8 atoms of H (hydrogen), 1 atom of N (nitrogen), 1 atom of Na (sodium) and 4 atoms of O (oxygen).
c. $C_{10}H_{16}N_2O_3S$ is made up of 10 atoms of C (carbon), 16 atoms of H (hydrogen), 2 atoms of N (nitrogen), 3 atoms of O (oxygen) and 1 atom of S (sulfur).

2.37

a. cesium
b. ruthenium
c. chlorine
d. beryllium
e. fluorine
f. cerium

2.38

a. sodium
b. radon
c. phosphorus
d. copper
e. lawrencium
f. platinum

2.39

a. sodium: metal, alkali metal, main group element
b. silver: metal, transition metal
c. xenon: nonmetal, noble gas, main group element
d. platinum: metal, transition metal
e. uranium: metal, inner transition metal
f. tellurium: metalloid, main group element

2.40

a. bromine: nonmetal, halogen, main group element
b. silicon: nonmetal, main group element
c. cesium: metal, alkali metal, main group element
d. gold: metal, transition metal
e. calcium: metal, alkaline earth metal, main group element
f. chromium: metal, transition metal

2.41

a. 5 protons and 6 neutrons
b. The atomic number = the number of protons = 5.
c. The mass number = the number of protons + the number of neutrons = 5 + 6 = 11.
d. The number of electrons = the number of protons = 5.
e. element symbol: B

2.42

a. 7 protons and 7 neutrons
b. The atomic number = the number of protons = 7.
c. The mass number = the number of protons + the number of neutrons = 7 + 7 = 14.
d. The number of electrons = the number of protons = 7.
e. element symbol: N

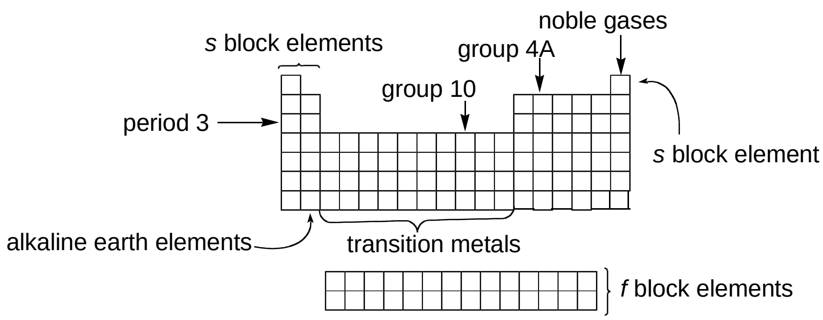
2.43

	Element Symbol	Atomic Number	Mass Number	Number of Protons	Number of Neutrons	Number of Electrons
a.	C	6	12	6	6	6
b.	P	15	31	15	16	15
c.	Zn	30	65	30	35	30
d.	Mg	12	24	12	12	12
e.	I	53	127	53	74	53
f.	Be	4	9	4	5	4
g.	Zr	40	91	40	51	40
h.	S	16	32	16	16	16

2.44

a. neon, Ne, 10 protons, 10 neutrons, 10 electrons
b. aluminum, Al, 13 protons, 14 neutrons, 13 electrons
c. strontium, Sr, 38 protons, 50 neutrons, 38 electrons
d. cesium, Cs, 55 protons, 78 neutrons, 55 electrons
e. nickel, Ni, 28 protons, 31 neutrons, 28 electrons
f. gold, Au, 79 protons, 118 neutrons, 79 electrons

2.45



2.46

a. palladium, Pd, group number = 10, period = 5, transition metal
b. carbon, C, group number = 14, period = 2, main group element
c. protactinium, Pa, group number = 5, period = 7, inner transition metal
d. argon, Ar, group number = 18, period = 3, main group element
e. arsenic, As, group number = 15, period = 4, main group element

2.47 Hydrogen is located in group 1A but is not an alkali metal.

2.48 Helium is an *s* block element but is located in group 8A instead of group 1A or 2A.

2.49 Use Figure 2.1 and the definitions in Answer 2.4 to classify each element in the fourth row of the periodic table as a metal, nonmetal, or metalloid.

K, Ca, Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga: metals
Ge, As: metalloids
Se, Br, Kr: nonmetals

2.50 Rb is an alkali metal and main group element. Sr is an alkaline earth metal and main group element. Elements Y, Zr, Nb, Mo, Tc, Ru, Rh, Pd, Ag, and Cd are transition metals. Elements In, Sn, Sb, Te, I and Xe are main group elements.

2.51 Group 8A in the periodic table contains only nonmetals.

2.52 Groups 4A, 5A and 6A contain nonmetals, metalloids and metals.

2.53 The atomic number = the number of protons = the number of electrons.
The mass number = the number of protons + the number of neutrons.

Mass	Protons	Neutrons	Electrons	Group	Symbol
16	8	8	8	6A	$^{16}_{8}O$
17	8	9	8	6A	$^{17}_{8}O$
18	8	10	8	6A	$^{18}_{8}O$

2.54 The atomic number = the number of protons = the number of electrons.
The mass number = the number of protons + the number of neutrons.

Mass	Protons	Neutrons	Electrons	Group	Symbol
116	50	66	50	4A	$^{116}_{50}Sn$
118	50	68	50	4A	$^{118}_{50}Sn$
120	50	70	50	4A	$^{120}_{50}Sn$

2.55 The identity of the element tells us the atomic number.
The number of neutrons = mass number – atomic number.

	Symbol	Protons	Neutrons	Electrons
a.	$^{27}_{13}Al$	13	27 – 13 =14	13
b.	$^{35}_{17}Cl$	17	35 – 17 =18	17
c.	$^{34}_{16}S$	16	34 – 16 =18	16

2.56 The identity of the element tells us the atomic number.
The number of neutrons = mass number – atomic number.

	Symbol	Protons	Neutrons	Electrons
a.	$^{115}_{47}Ag$	47	115 – 47 =68	47
b.	$^{197}_{79}Au$	79	197 – 79 =118	79
c.	$^{222}_{86}Rn$	86	222 – 86 =136	86
d.	$^{192}_{76}Os$	76	192 – 76 = 116	76

2.57

a. $^{127}_{53}I$ b. $^{79}_{35}Br$ c. $^{107}_{47}Ag$

2.58

a. $^{22}_{10}Ne$ b. $^{52}_{24}Cr$ c. $^{20}_{10}Ne$

2.59 Multiply the isotopic abundance by the mass of each isotope, and add up the products to give the atomic weight for the element.

Silver

Mass due to Ag-107: 0.5184×106.91 amu = 55.4221 amu
Mass due to Ag-109: 0.4816×108.90 amu = 52.4462 amu

Atomic weight = 107.8683 amu rounded to 107.9 amu **Answer**

2.60 Multiply the isotopic abundance by the mass of each isotope, and add up the products to give the atomic weight for the element.

Antimony

Mass due to Sb-121: 0.5721×120.90 amu = 69.1669 amu
Mass due to Sb-123: 0.4279×122.90 amu = 52.5889 amu

Atomic weight = 121.7558 amu rounded to 121.8 amu **Answer**

2.61 No, the neutral atoms of two different elements cannot have the same number of electrons. Two different elements must have a different number of protons, so in the neutral atoms, they must have a different number of electrons.

2.62 Yes, the neutral atoms of two different elements can have the same number of neutrons. For example O-18 has 8 protons, 8 electrons, and 10 neutrons. F-19 has 9 protons, 9 electrons and 10 neutrons. The number of neutrons are the same, but the number of protons and electrons are different.

2.63

a. first shell (n = 1) = 1 orbital (1s)

b. second shell (n = 2) = 4 orbitals (2s, three 2p)

c. third shell (n = 3) = 9 orbitals (3s, three 3p, five 3d)

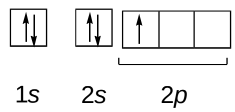
d. fourth shell (n = 4) = 16 orbitals (4s, three 4p, five 4d, seven 4f)

2.64

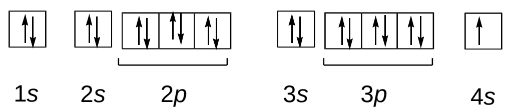
a. second shell (n = 2) = 8 electrons
b. 3s orbital: 2 electrons
c. 3p subshell: 6 electrons
d. 4f orbital: 2 electrons
e. fourth shell (n = 4) = 32 electrons
f. 5p orbital: 2 electrons

2.65 Use Example 2.5 to help draw the orbital diagram for each element.

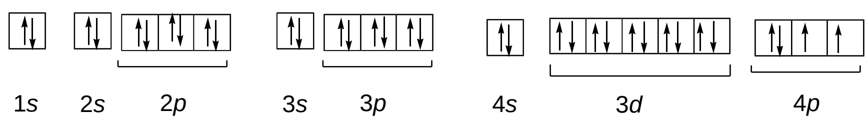
a. B



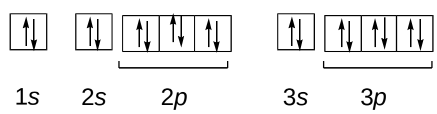
b. K



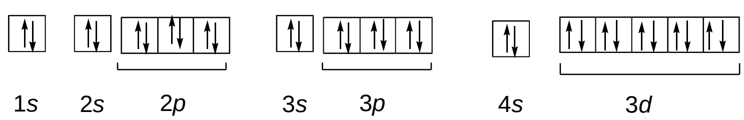
c. Se



d. Ar

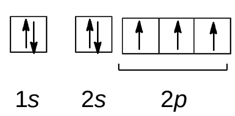


e. Zn

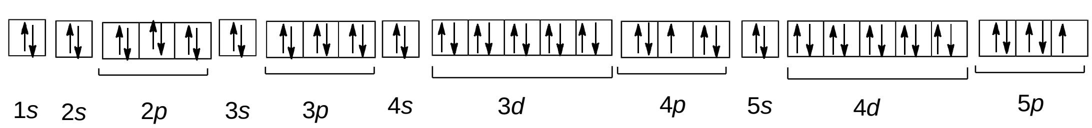


2.66 Use Example 2.5 to help draw the orbital diagram for each element.

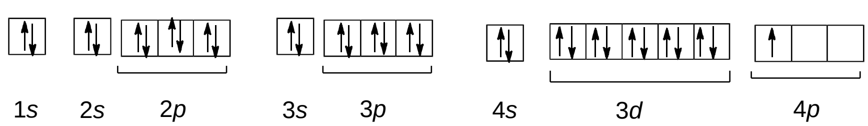
a. N



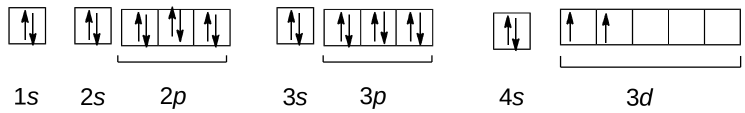
b. I



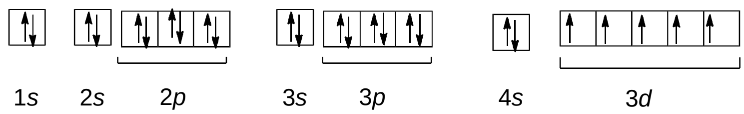
c. Ga



d. Ti



e. Mn



2.67 To convert the electronic configuration to noble gas notation, replace the electronic configuration corresponding to the noble gas in the preceding row by the symbol for the noble gas in brackets, as in Answer 2.24.

a. B: $1s^22s^22p^1$ or $[He]2s^22p^1$

b. K: $1s^22s^22p^63s^23p^64s^1$ or $[Ar]4s^1$

c. Se: $1s^22s^22p^63s^23p^64s^23d^{10}4p^4$ or $[Ar]4s^23d^{10}4p^4$

d. Ar: $1s^22s^22p^63s^23p^6$ or [Ar]

e. Zn: $1s^22s^22p^63s^23p^64s^23d^{10}$ or $[Ar]4s^23d^{10}$

2.68 To convert the electronic configuration to noble gas notation, replace the electronic configuration corresponding to the noble gas in the preceding row by the symbol for the noble gas in brackets, as in Answer 2.24.

a. N: $1s^22s^22p^3$ or $[He]2s^22p^3$

b. I: $1s^22s^22p^63s^23p^64s^23d^{10}4p^65s^24d^{10}5p^5$ or $[Kr]5s^24d^{10}5p^5$

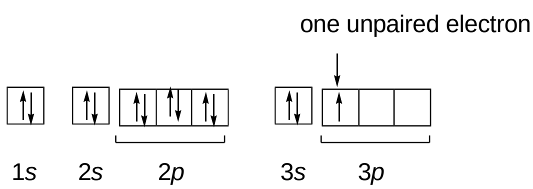
c. Ga: $1s^22s^22p^63s^23p^64s^23d^{10}4p^1$ or $[Ar]4s^23d^{10}4p^1$

d. Ti: $1s^22s^22p^63s^23p^64s^23d^2$ or $[Ar]4s^23d^2$

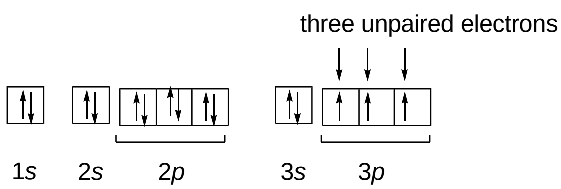
e. Mn: $1s^22s^22p^63s^23p^64s^23d^5$ or $[Ar]4s^23d^5$

2.69 To find the number of unpaired electrons, draw the orbital diagram for each element.

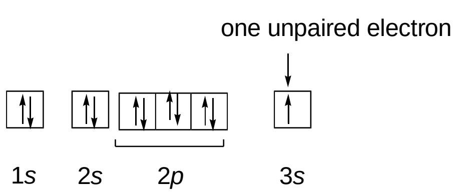
a. Al



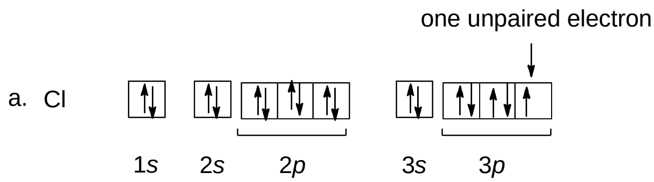
b. P

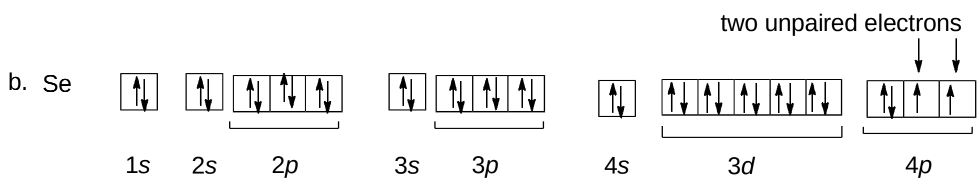


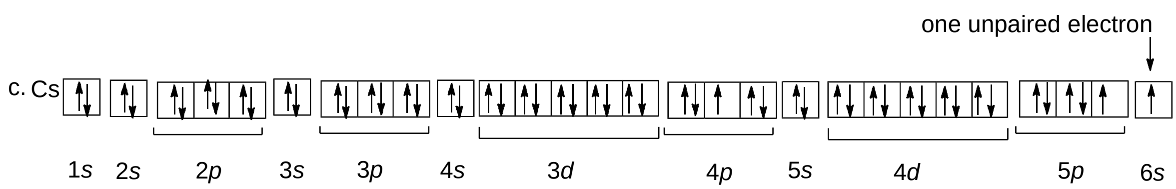
c. Na



2.70 To find the number of unpaired electrons, draw the orbital diagram for each element.







2.71

a. $1s^22s^22p^63s^23p^64s^23d^{10}4p^65s^2$ = 38 electrons, 2 valence electrons in the 5*s* orbital, strontium

b. $1s^22s^22p^63s^23p^4$= 16 electrons, 6 valence electrons in the 3*s* and the 3*p* orbitals, sulfur

c. $1s^22s^22p^63s^1$= 11 electrons, 1 valence electron in the 3*s* orbital, sodium

d. $[Ne]3s^23p^5$= 17 electrons, 7 valence electrons in the 3*s* and 3*p* orbitals, chlorine

2.72

a. $1s^22s^22p^63s^23p^6$ = 18 electrons, 8 valence electrons in the 3*s* and 3*p* orbitals, argon

b. $1s^22s^22p^63s^23p^64s^23d^7$= 27 electrons, 2 valence electrons in the 4*s* orbital, cobalt

c. $1s^22s^22p^3$= 7 electrons, 5 valence electrons in the 2*s* and 2*p* orbitals, nitrogen

d. $[Kr]5s^24d^{10}5p^2$= 50 electrons, 4 valence electrons in the 5*s* and 5*p* orbitals, tin

2.73 An alkali metal has one valence electron and an alkaline earth element has two valence electrons.

2.74 A halogen has seven valence electrons and a noble gas has eight valence electrons.

2.75

	Electrons	Group Number	Valence Electrons	Period	Valence Shell
a. Carbon	6	4A	4	2	2
b. Calcium	20	2A	2	4	4
c. Krypton	36	8A	8	4	4

2.76

	Electrons	Group Number	Valence Electrons	Period	Valence Shell
a. Oxygen	8	6A	6	2	2
b. Sodium	11	1A	1	3	3
c. Phosphorus	15	5A	5	3	3

2.77

a. carbon: $1s^22s^22p^2$; valence electrons $2s^22p^2$
b. calcium: $1s^22s^22p^63s^23p^64s^2$; valence electrons $4s^2$
c. krypton: $1s^22s^22p^63s^23p^64s^23d^{10}4p^6$; valence electrons $4s^24p^6$

2.78

a. oxygen: $1s^22s^22p^4$; valence electrons $2s^22p^4$
b. sodium: $1s^22s^22p^63s^1$; valence electrons $3s^1$
c. phosphorus: $1s^22s^22p^63s^23p^3$; valence electrons $3s^23p^3$

2.79 The group number of a main group element = the number of valence electrons.

a. 2A = 2 valence electrons b. 4A = 4 valence electrons c. 7A = 7 valence electrons

2.80

a. shell = 2 b. shell = 3 c. shell =4 d. shell =5

2.81

a. sulfur: 6, $3s^23p^4$
b. chlorine: 7, $3s^23p^5$
c. barium: 2, $6s^2$
d. titanium: 2, $4s^2$
e. tin: 4, $5s^25p^2$

2.82

a. neon: 8, $2s^22p^6$
b. rubidium: 1, $5s^1$
c. aluminum: 3, $3s^23p^1$
d. manganese: 2, $4s^2$
e. zirconium: 2, $5s^2$

2.83 Write the element symbol for each element and use the group number to determine the number of valence electrons for a main group element. Represent each valence electron with a dot.

a. beryllium	b. silicon	c. iodine	d. magnesium	e. argon
Be·	·Si·	·I:	·Mg·	:Ar:

2.84 Write the element symbol for each element and use the group number to determine the number of valence electrons for a main group element. Represent each valence electron with a dot.

a. potassium	b. boron	c. fluorine	d. calcium	e. selenium
K·	·B·	·F:	·Ca·	·Se·

2.85 Use the size rules from Answer 2.29.

a. iodine b. carbon c. potassium d. selenium

2.86 Use the size rules from Answer 2.29.

a. sodium b. carbon c. krypton d. bromine

2.87 Use the rules from Answer 2.30 to decide which has the higher ionization energy.

a. bromine b. nitrogen c. silicon d. chlorine

2.88 Use the rules from Answer 2.30 to decide which has the lower ionization energy.

a. sodium b. carbon c. krypton d. bromine

2.89 Use the size rules from Answer 2.29.

fluorine, oxygen, sulfur, silicon, magnesium

2.90 Use the size rules from Answer 2.29.

oxygen, nitrogen, phosphorus, aluminum potassium

2.91 Use the rules from Answer 2.30 to rank the elements in order of increasing ionization energy.

sodium, magnesium, phosphorus, nitrogen, fluorine

2.92 Use the rules from Answer 2.30 to rank the elements in order of decreasing ionization energy.

Oxygen, carbon, silicon, magnesium, calcium

2.93

	a. Type	b. Block	c,d: Radius	e,f: Ionization Energy	g. Valence Electrons
Sodium	Metal	*s*			1
Potassium	Metal	*s*	Largest	Lowest	1
Chlorine	Nonmetal	*p*	Smallest	Highest	7

2.94

a. Pt
b. group number = 10; period = 6
c. 78
d. transition metal
e. *d*
f. all of the valence shells are partially filled

2.95

Carbon-11 has the same number of protons and electrons as carbon-12; that is, six. Carbon-11 has only five neutrons, whereas carbon-12 has six neutrons. The symbol for carbon-11 is ${}^{11}_{6}C$.

2.96

	a. Type	b. Block	c,d: Radius	e,f: Ionization Energy	g. Valence Electrons
Calcium	Metal	*s*	Largest	Lowest	2
Magnesium	Metal	*s*			2
Sulfur	Nonmetal	*p*	Smallest	Highest	6

2.97 The electron configuration of copper ($1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^{10}$) is unusual because electrons have been added to higher-energy 3*d* orbitals even though there is only one 4*s* electron.

2.98 Strontium is an alkaline earth metal and thus has similar chemical properties as calcium. Therefore it can be incorporated into bones, just like calcium. Radioactive isotopes emit particles or energy as some form of radiation. Depending on the level of radiation emitted, illnesses such as cancer and leukemia can occur.