Task 1

Due: 11:59pm on Friday, April 27, 2018

You will receive no credit for items you complete after the assignment is due. Grading Policy

Additional Problem 1.13

Part A

Classify each of the following as a pure substance or a mixture.

Drag the appropriate items to their respective bins.

ANSWER:

Reset   Help

pure substance

magnesium   crushed ice

mixture

rice pudding   seawater

Correct

Part B

For a mixture, indicate whether it is homogeneous or heterogeneous.

Drag the appropriate items to their respective bins.

ANSWER:

Reset   Help

homogeneous mixture

seawater

heterogeneous mixture

rice pudding

Correct

Chapter 1 Question 3 - Bimodal

Part A

If matter is uniform throughout and cannot be separated into other substances by physical processes, but can be decomposed into other substances by chemical processes, it is called a(n) _____.

ANSWER:

- ○ element
- ○ mixture of elements
- ● compound
- ○ homogeneous mixture
- ○ heterogeneous mixture

Correct

Problem 1.1

Part A

Which of the images shown represents a pure element, a mixture of two elements, a pure compound, a mixture of an element and a compound? (More than one picture might fit each description.)
1 - pure element
2 - mixture of two elements
3 - pure compound
4 - mixture of an element and a compound

Drag the items into the appropriate bins.
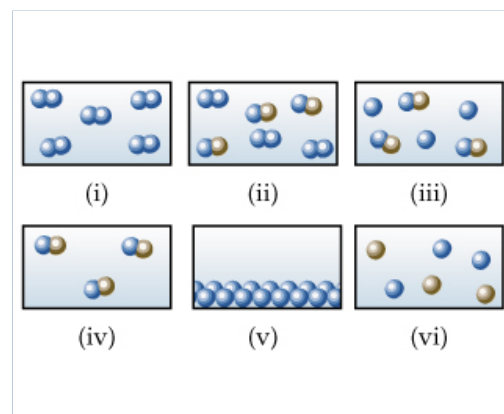
ANSWER:

Correct

Chapter 1 Question 24 - Bimodal

Part A

A certain liquid has a density of 2.67 g/cm^3. 1340 g of this liquid would occupy a volume of _____ L.

ANSWER:

- ○ 1.99×10^{-3}
- ○ 35.8
- ○ 3.58
- ● 0.502
- ○ 50.2

Correct

Problem 1.4

Part A

Identify each of the following as measurements of length, area, volume, mass, density, time, or temperature.

Drag the items into the appropriate bins.

ANSWER:

Reset | Help

length	area	volume	mass	density	time	temperature
0.88 pm	540 km^2	2 mm^3		5.5 kg/m^3	5 ns	23°C
						173 K

Correct

Chapter 1 Question 33 - Multiple Choice

Part A

Precision refers to _____.

ANSWER:

- ○ how close a measured number is to the calculated value
- ◉ how close a measured number is to other measured numbers
- ○ how close a measured number is to infinity
- ○ how close a measured number is to zero
- ○ how close a measured number is to the true value

Correct

Chapter 1 Question 34 - Multiple Choice

Part A

Accuracy refers to _____.

ANSWER:

- ● how close a measured number is to the true value
- ○ how close a measured number is to zero
- ○ how close a measured number is to infinity
- ○ how close a measured number is to other measured numbers
- ○ how close a measured number is to the calculated value

Correct

Additional Problem 1.38

Indicate the number of significant figures in each of the following measured quantities.

Part A

3.774 km

Express your answer as an integer.

ANSWER:

4	sig figs

Correct

Part B

205 m^2

Express your answer as an integer.

ANSWER:

3	sig figs

Correct

Part C

1.700 cm

Express your answer as an integer.

ANSWER:

4	sig figs

Correct

Part D

350.00 K

Express your answer as an integer.

ANSWER:

5	sig figs

Correct

Part E

307.080 g

Express your answer as an integer.

ANSWER:

6	sig figs

Correct

Part F

$1.3 \times 10^3 \, \text{m/s}$

Express your answer as an integer.

ANSWER:

2	sig figs

Correct

Chapter 1 Question 44 - Bimodal

Part A

The density of a 167.4 g sample of magnesium having a volume of 96.32 mL is _____ g/cm^3.

ANSWER:

- ○ 0.5754
- ○ 2.663
- ○ 7128
- ○ 3.625
- ● 1.738

Correct

Additional Problem 2.27

How many protons, neutrons, and electrons are in the following atoms?

Part A

^{40}Ar,

Enter your answers numerically separated by commas.

ANSWER:

$p, \, n, \, e = $ 18,22,18

Correct

Part B

^{65}Zn,

Enter your answers numerically separated by commas.

ANSWER:

$p, \, n, \, e = $ 30,35,30

Correct

Part C

^{70}Ga,

Enter your answers numerically separated by commas.

ANSWER:

$p,\ n,\ e =$ 31,39,31

Correct

Part D

^{80}Br,

Enter your answers numerically separated by commas.

ANSWER:

$p,\ n,\ e =$ 35,45,35

Correct

Part E

^{184}W,

Enter your answers numerically separated by commas.

ANSWER:

$p,\ n,\ e =$ 74,110,74

Correct

Part F

^{243}Am.

Enter your answers numerically separated by commas.

ANSWER:

$p,\ n,\ e =$ 95,148,95

Correct

Additional Problem 2.31

Write the correct symbol, with both superscript and subscript, for each of the following. Use the list of elements inside the front cover as needed:

Part A

the isotope of platinum that contains 118 neutrons

Express your answer as an isotope.

ANSWER:

$^{196}_{78}\text{Pt}$

Correct

Part B

the isotope of krypton with mass number 84

Express your answer as an isotope.

ANSWER:

$$^{84}_{36}\text{Kr}$$

Correct

Part C

the isotope of arsenic with mass number 75

Express your answer as an isotope.

ANSWER:

$$^{75}_{33}\text{As}$$

Correct

Part D

the isotope of magnesium that has an equal number of protons and neutrons

ANSWER:

$$^{24}_{12}\text{Mg}$$

Correct

Chapter 2 Question 31 - Multiple Choice

Part A

Different isotopes of a particular element contain the same number of _____.

ANSWER:

- ◯ neutrons
- ◉ protons
- ◯ subatomic particles
- ◯ protons, neutrons, and electrons
- ◯ protons and neutrons

Correct

Sample Exercise 2.1 Practice Exercise 1 with feedback

Part A - Atomic Size

Which of the following factors determines the size of an atom?

ANSWER:

○ The volume of a single electron, multiplied by the number of electrons in the atom.

○ The volume of the nucleus.

○ The total nuclear charge.

● The volume of space occupied by the electrons of the atom.

○ The total mass of the electrons surrounding the nucleus.

Correct

The size of an atom is governed by the volume of space occupied by the electrons of the atom.

Chapter 2 Question 41 - Multiple Choice

Part A

The element X has three naturally occurring isotopes. The masses (amu) and % abundances of the isotopes are given in the table below. The average atomic mass of the element is _____ amu.

Isotope	Abundance	Mass
221X	74.22	220.9
220X	12.78	220.0
218X	13.00	218.1

ANSWER:

○ 220.42

○ 219.7

○ 221.0

● 220.4

○ 218.5

Correct

Problem 2.35

Only two isotopes of copper occur naturally, ^{63}Cu (atomic mass = 62.9296 amu; abundance 69.17 %) and ^{65}Cu (atomic mass = 64.9278 amu; abundance 30.83 %).

Part A

Calculate the atomic weight (average atomic mass) of copper.

Express your answer using four significant figures.

ANSWER:

$A =$ 63.55 amu

Correct

Chapter 2 Question 7 - Bimodal

Part A

Which group in the periodic table contains only nonmetals?

ANSWER:

○ 1A

○ 2B

○ 6A

○ 2A

⦿ 8A

Correct

Chapter 2 Question 13 - Bimodal

Part A

Elements in Group 7A are known as the _____.

ANSWER:

○ chalcogens

○ noble gases

○ alkaline earth metals

⦿ halogens

○ alkali metals

Correct

Additional Problem 2.49

Write the empirical formula corresponding to each of the following molecular formulas.

Part A

Al_2Br_6,

Express your answer as a chemical formula.

ANSWER:

$AlBr_3$

Correct

Part B

C_8H_{10},

Express your answer as a chemical formula.

ANSWER:

C_4H_5

Correct

Part C

$C_4H_8O_2$,

Express your answer as a chemical formula.

ANSWER:

C_2H_4O

Correct

Part D

P_4O_{10},

Express your answer as a chemical formula.

ANSWER:

P_2O_5

Correct

Part E

$C_6H_4Cl_2$,

Express your answer as a chemical formula.

ANSWER:

C_3H_2Cl

Correct

Part F

$B_3N_3H_6$.

Express your answer as a chemical formula.

ANSWER:

BNH_2

Correct

Sample Exercise 2.6 Practice Exercise 1 with feedback

Part A - Relating Empirical and Molecular Formulas

Tetracarbon dioxide is an unstable oxide of carbon with the following molecular structure:

What are the molecular and empirical formulas of this substance?

ANSWER:

- ○ C_2O, CO_2
- ○ C_2O_2, CO_2
- ○ CO_2, CO_2
- ◉ C_4O_2, C_2O
- ○ C_4O, CO

Correct

Tetracarbon dioxide consists of four carbon atoms and two oxygen atoms, thus its molecular formula is C_4O_2. The molecular formula can be reduced by a factor of two to produce its empirical formula, C_2O.

A Formula for Formulas

Learning Goal:

To understand the strategy for writing chemical formulas.

Chemistry can be thought of as a language, and, like any language, there are rules that govern usage. In chemistry these rules are particularly strict and invariant, being governed by the properties of the elements that combine into the chemical words or formulas.

In any chemical formula, the subscripts indicate the number of each type of atom in one molecule or formula unit of the compound. For example, one molecule of $C_3H_6O_3$ contains three carbon atoms, six hydrogen atoms, and three oxygen atoms. One NF_3 molecule contains one nitrogen atom and three fluorine atoms. One formula unit of Na_2S contains two sodium atoms and one sulfur atom.

There are three main types of chemical formulas: organic, molecular inorganic, and ionic.

1. $C_3H_6O_3$ is an *organic* compound because it contains predominantly carbon and hydrogen atoms.
2. NF_3 is a *molecular inorganic* compound because it does not contain mainly carbon and it contains only nonmetal atoms.
3. Na_2S is an *ionic* compound because it is made up of both metal and nonmetal atoms.

Organic compounds

Organic formulas follow the convention of placing C first in the formula, followed by H, followed by the remaining symbols in alphabetical order.

Part A

Which of the following could be the structure of $C_3H_6O_3$?
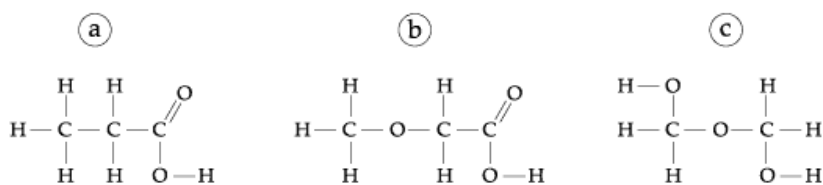
ANSWER:

- [ ] a
- [x] b
- [ ] c

Correct

Part B

Adrenaline contains 13 hydrogen atoms, 9 carbon atoms, 3 oxygen atoms, and 1 nitrogen atom. What is the chemical formula for adrenaline?

Express your answer as a chemical formula.

Hint 1. Choose a convention

Which formula convention should be used for adrenaline?

ANSWER:

- [ ] ionic
- [x] organic
- [ ] inorganic

Correct

Adrenaline is organic because it contains mostly C and H.

Hint 2. Symbol order in organic compounds

The convention for organic formulas is to put C first, followed by H, followed by the rest of the symbols in alphabetical order.

ANSWER:

$C_9H_{13}NO_3$

Correct

Molecular inorganic compounds

Molecular inorganic formulas generally follow the convention of placing elements of groups 13 to 15 first (in that order), followed by the rest of the symbols starting with those furthest to the left in the periodic table. Elements in the same column are listed alphabetically.

Part C

A certain compound is made up of two chlorine atoms, one carbon atom, and one oxygen atom. What is the chemical formula of this compound?

Express your answer as a chemical formula.

Hint 1. Choose a convention

Which formula convention should be used for this compound?

ANSWER:

- ⚪ ionic
- ⚪ organic
- 🔘 inorganic

Correct

This compound is made up of only nonmetals and is *not* predominantly C and H. Therefore we follow the inorganic formula convention in this case.

Hint 2. Symbol order in inorganic compounds

The convention for inorganic compounds is to put elements in groups 13 to 15 first, in that order, followed by the rest of the symbols starting with those furthest to the left in the periodic table. Elements in the same column are listed alphabetically.

ANSWER:

$COCl_2$

Correct

Ionic compounds

Ionic compounds are always made up of a *cation* (positive ion) and an *anion* (negative ion). The cation is always listed first in the formula.
The hard part about writing ionic formulas is determining how many of each ion is needed to make a neutral compound. In Na_2S, the cation is Na^+ and the anion is S^{2-}. Na forms a cation with a +1 charge because it must lose an electron to achieve 10 electrons like Ne, the nearest noble gas to Na in atomic number. S forms an anion with a -2 charge because it must gain two electrons to have 18 electrons like Ar, the nearest noble gas to S in atomic number.

Na^+ and S^{2-} must now be combined in such a way that the compound is neutral. Two Na^+ ions have a total charge of +2 and one S^{2-} ion has a total charge of -2. Therefore, Na_2S is a neutral compound because the total charge sums to zero.

Part D

Magnesium fluoride contains only magnesium and fluorine. What is the formula for this compound?

Express your answer as a chemical formula.

Hint 1. Choose a convention

Which formula convention should be used for magnesium fluoride?

ANSWER:

○ ionic

○ organic

○ inorganic

Hint 2. Determine the ionic charges

What are the charges on the magnesium ion and the fluoride ion?

Enter the charge on magnesium followed by the charge on fluorine separated by a comma (e.g., -5,+6).

Hint 1. How to find the charge

The atomic number of F is 9. The closest noble gas to F in atomic number is Ne (whose atomic number is 10). The atomic number of Mg is 12. Therefore, Ne is also the closest noble gas to magnesium. To find the charges on F and Mg, determine how many electrons each one must gain or lose to have 10 electrons like Ne.

ANSWER:

+2,-1

Hint 3. Symbol order in ionic compounds

By convention, ionic formulas are written with the cation first, followed by the anion.

ANSWER:

MgF_2

Correct

Additional Problem 2.58

Using the periodic table, predict the charges of the ions of the following elements.

Part A

Ga

Express your answer as an ion.

ANSWER:

Ga^{3+}

Correct

Part B

Sr

Express your answer as an ion.

ANSWER:

Sr^{2+}

Correct

Part C

As

Express your answer as an ion.

ANSWER:

$$As^{3-}$$

Correct

Part D

Br

Express your answer as an ion.

ANSWER:

$$Br^-$$

Correct

Part E

Se

Express your answer as an ion.

ANSWER:

$$Se^{2-}$$

Correct

Additional Problem 2.59

Using the periodic table to guide you, predict the chemical formula and name of the compound formed by the following elements.

Part A

Using the periodic table to guide you, predict the chemical formula of the compound formed by Ga and F.

Express your answer as a chemical formula.

ANSWER:

$$GaF_3$$

Correct

Part B

Using the periodic table to guide you, predict the name of the compound formed by Ga and F.

ANSWER:

gallium(III) fluoride

Correct

Part C

Using the periodic table to guide you, predict the chemical formula of the compound formed by Li and H.

Express your answer as a chemical formula.

ANSWER:

$$LiH$$

Correct

Part D

Using the periodic table to guide you, predict the name of the compound formed by Li and H.

ANSWER:

> lithium hydride

Correct

Part E

Using the periodic table to guide you, predict the chemical formula of the compound formed by Al and I.

Express your answer as a chemical formula.

ANSWER:

> AlI_3

Correct

Part F

Using the periodic table to guide you, predict the name of the compound formed by Al and I.

ANSWER:

> aluminium iodide

Correct

Part G

Using the periodic table to guide you, predict the chemical formula of the compound formed by K and S.

Express your answer as a chemical formula.

ANSWER:

> K_2S

Correct

Part H

Using the periodic table to guide you, predict the name of the compound formed by K and S.

ANSWER:

> potassium sulfide

Correct

Additional Problem 2.65

Part A

Predict whether each of the following compounds is molecular or ionic.

Drag the items into the appropriate bins.

ANSWER:

Reset Help

molecular

NOCl CH_3OH

NF_3 B_2H_6

ionic

CsBr Ag_2SO_4

$LiNO_3$ Sc_2O_3

Correct

Chapter 2 Question 37 - Bimodal

Part A

Predict the empirical formula of the ionic compound that forms from magnesium and fluorine.

ANSWER:

- ○ Mg_2F_3
- ○ Mg_3F_2
- ● MgF_2
- ○ MgF
- ○ Mg_2F

Correct

Chapter 2 Question 53 - Bimodal

Part A

The correct name for HBrO is _____.

ANSWER:

- ○ hydrobromic acid
- ○ perbromic acid
- ○ bromic acid
- ○ bromous acid
- ● hypobromous acid

> **Correct**

Chapter 2 Question 65 - Bimodal

Part A

The formula of the carbonate ion is _____ .

ANSWER:

- ○ $CO_2{}^{2-}$
- ○ $CO_3{}^{3-}$
- ○ $CO_2{}^-$
- ◉ $CO_3{}^{2-}$
- ○ CO^-

> **Correct**

Chapter 2 Question 67 - Bimodal

Part A

What is the correct formula for ammonium sulfide?

ANSWER:

- ○ NH_4SO_3
- ○ N_2S_3
- ○ $(NH_4)_2SO_4$
- ○ NH_3S
- ◉ $(NH_4)_2S$

> **Correct**

Additional Problem 6.61

Part A

Which of the following represent impossible combinations of n and l?

Check all that apply.

ANSWER:

- ☑ 1p
- ☐ 5f
- ☑ 2d
- ☐ 4s

> **Correct**

Chapter 6 Question 13 - Multiple Choice

Part A

Which of the subshells below do <u>not</u> exist due to the constraints upon the angular momentum quantum number?

ANSWER:

○ 2s

◉ 2d

○ 2p

○ all of the above

○ none of the above

Correct

Chapter 6 Question 19 - Multiple Choice

Part A

Which quantum number determines the energy of an electron in a hydrogen atom?

ANSWER:

○ m_l

○ E

○ l

◉ n

○ n and l

Correct

Problem 6.72

What is the maximum number of electrons in an atom that can have the following quantum numbers?

Part A

$n = 3$, $m_l = -2$

Express your answer as an integer.

ANSWER:

Number of electrons =   2

Correct

Part B

$n = 4$, $l = 3$

Express your answer as an integer.

ANSWER:

Number of electrons =   14

Correct

Part C

$n = 5$, $l = 3$, $m_l = 2$

Express your answer as an integer.

ANSWER:

Number of electrons =   2

Correct

Part D

$n = 4$, $l = 1$, $m_l = 0$

Express your answer as an integer.

ANSWER:

Number of electrons =   2

Correct

Problem 6.63

Which sketch shows the shape and orientation of the following types of orbital?

Part A

s

ANSWER:

Correct

Part B

p_z
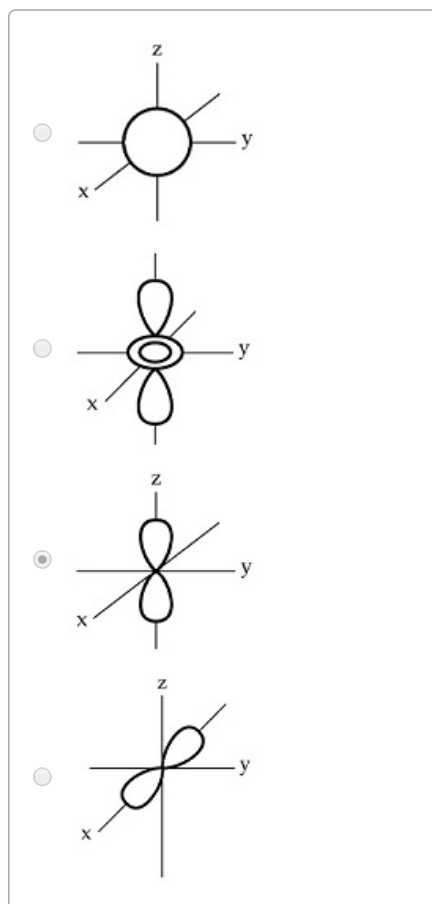
ANSWER:

Correct

Part C

d_{xy}

ANSWER:
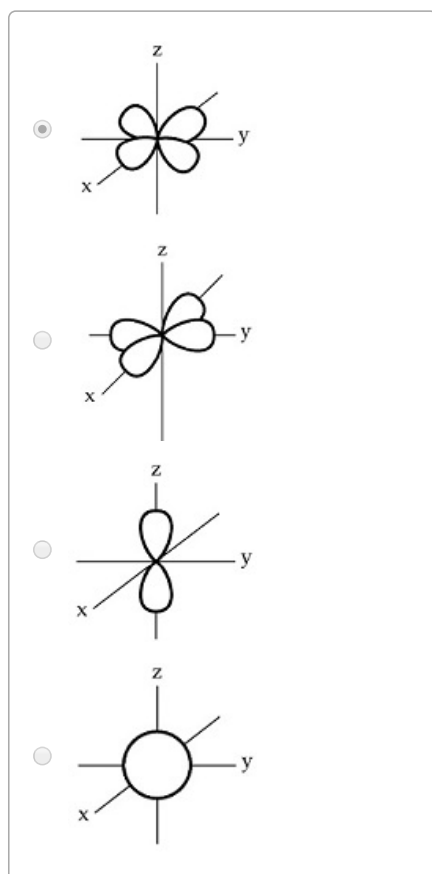
Correct

Chapter 6 Question 7 - Short Answer

Part A

The ground state electron configuration of scandium is _____.

Express your answer in condensed form, in order of increasing orbital energy. For example, $[\text{He}]2s^2 2p^2$ would be entered as [He]2s^22p^2.

ANSWER:

[Ar]4s^23d^1

Correct

Chapter 6 Question 24 - Algorithmic

Part A

There are _____ unpaired electrons in a ground state oxygen atom.

ANSWER:

- ○ 3
- ◉ 2
- ○ 1
- ○ 4
- ○ 0

Correct

Chapter 6 Question 30 - Multiple Choice

Part A

Which electron configuration represents a violation of the Pauli exclusion principle?

ANSWER:

Correct

Chapter 6 Question 31 - Multiple Choice

Part A

Which one of the following is the correct electron configuration for a ground-state nitrogen atom?

ANSWER:

○ None of the above is correct.

> **Correct**

Chapter 6 Question 76 - Bimodal

Part A

[Ne]3s^{2}3p^3 is the electron configuration of a(n) _____ atom.

ANSWER:

- ◉ P
- ○ Sn
- ○ As
- ○ Sb
- ○ V

> **Correct**


Orbital Diagrams

Learning Goal:

To understand how to draw orbital diagrams, and how they are used to write electron configurations.

The *electron configuration* of an element is the arrangment of its electrons in their atomic orbitals. Electron configurations can be used to predict most of the chemical properties of an element.

Orbital diagrams are a useful tool to aid in the derivation of the electron configuration of an element. Orbital diagrams are filled using the aufbau principle, the Pauli principle, and Hund's rule.

Aufbau is German for "building up." The *aufbau* principle simply states that electrons are added to an orbital diagram one at a time to the lowest energy orbital available, and that the orbital diagram is thus "built up." However, due to shielding of the nucleus, the energies of orbitals are not always in order of energy level (n). For example, the $4s$ orbital is lower in energy than the $3d$ orbital for elements with more than one electron. To aid in remembering the energy order of orbitals, draw a diagram with the energy levels (1 through 8) down the left of the diagram, and the subshells of each energy level across in rows, with each row offset by one (so $3s$ is below $2p$, $4p$ is below $3d$, etc). To determine the order in which orbitals fill, read the diagram from top to bottom, left to right. This results in the order $1s2s2p3s3p4s3d4p5s$, etc. This order is often called the "*aufbau* order."
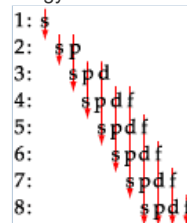
The *Pauli principle* states that no two electrons in an atom can have the same value of all four quantum numbers (n, l, m_l, and m_s). The first three quantum numbers (n, l, and m_l) specify a particular orbital, such as $1s$. The fourth quantum number (m_s) specifies the spin of the electron. Since there are only two possibly values for m_s ($+\frac{1}{2}$ and $-\frac{1}{2}$), only two electrons can occupy any given orbital. Remember that p subshells consist of three separate orbitals (p_x, p_y, and p_z), for a total of up to six electrons in a given p subshell. Similarly, d subshells consist of five separate orbitals, and f subshells consists of seven separate orbitals.

Finally, *Hund's rule* states that the lowest energy electron configuration for an atom is one having the maximum number of electrons with parallel spins in degenerate orbitals. In other words, when three electrons begin to fill a p subshell (which consists of three degenerate orbitals, meaning three orbitals with the same energy), the lowest energy configuration consists of one electron in each p orbital, all with either spin up or spin down.

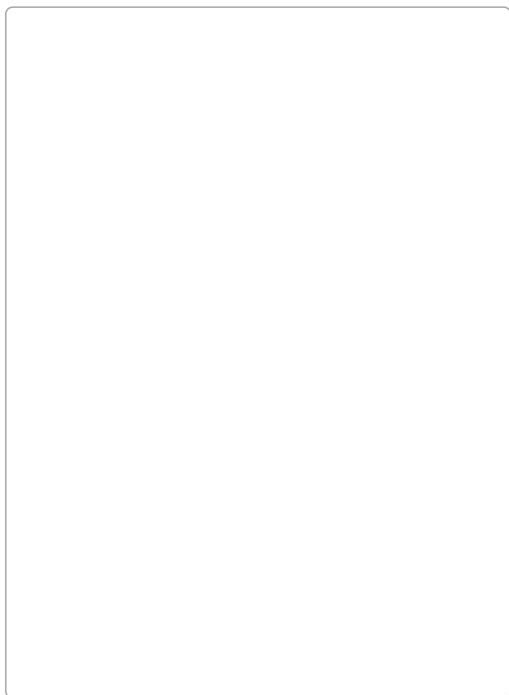
Part A

Draw an orbital diagram for boron.

Use this tool to draw the orbital diagram.

> **Hint 1.** How to approach the problem
>
> First, determine the number of electrons in an atom of boron ($Z = 5$). Next, fill the orbitals one electron at a time, from lowest energy to highest energy.

ANSWER:

Correct

Part B

Draw an orbital diagram for scandium (Sc).

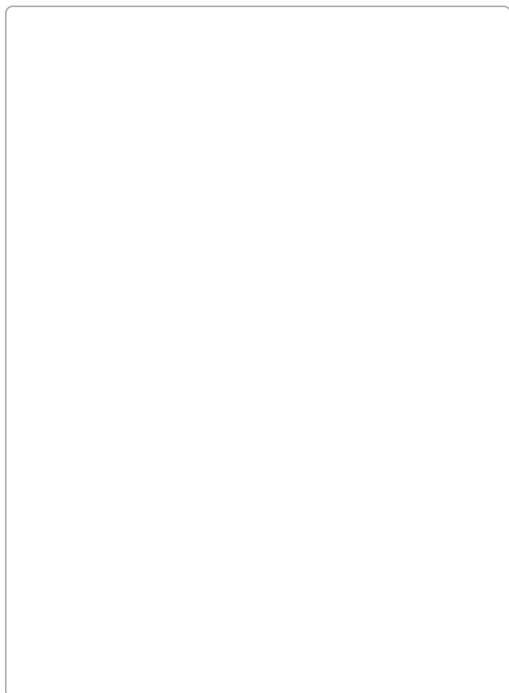**Use this tool to draw the orbital diagram.**

Hint 1. How to approach the problem

First, determine the number of electrons in an atom of scandium$(Z = 21)$. Next, fill the orbitals one electron at a time, from lowest energy to highest energy.

Hint 2. The aufbau principle

Remember that the $4s$ orbital fills before the $3d$ orbitals.

ANSWER:

Correct

Part C

Electron configurations are a shorthand form of an orbital diagram, describing which orbitals are occupied for a given element. For example, $1s^2 2s^2 2p^1$ is the electron configuration of boron.

Use this tool to generate the electron configuration of arsenic (As).

Hint 1. How to approach the problem

First, determine the number of electrons in an atom of arsenic($Z = 33$). Next, fill the orbitals one electron at a time, from lowest energy to highest energy.

Hint 2. The aufbau principle

Remember that the $4s$ orbital fills before the $3d$ orbitals.

ANSWER:

Correct

Chapter 6 Question 34 - Algorithmic

Part A

The element that has a valence configuration of 5s^2 5p^6 is _____.

ANSWER:

- ○ Ne
- ○ Rn
- ● Xe
- ○ Ar
- ○ Kr

Correct

Chapter 6 Question 82 - Bimodal

Part A

All of the _____ have a valence shell electron configuration ns^1.

ANSWER:

- ○ chalcogens
- ○ noble gases
- ⊙ alkali metals
- ○ alkaline earth metals
- ○ halogens

Correct

Score Summary:

Your score on this assignment is 98.8%.
You received 98.83 out of a possible total of 100 points.

Part A

All of the _____ have a valence shell electron configuration ns^1.

ANSWER:

- ○ chalcogens
- ○ noble gases