Chapter 5- Electrons in Atoms
Packet o' Problems
+
Study Guide

(Key)

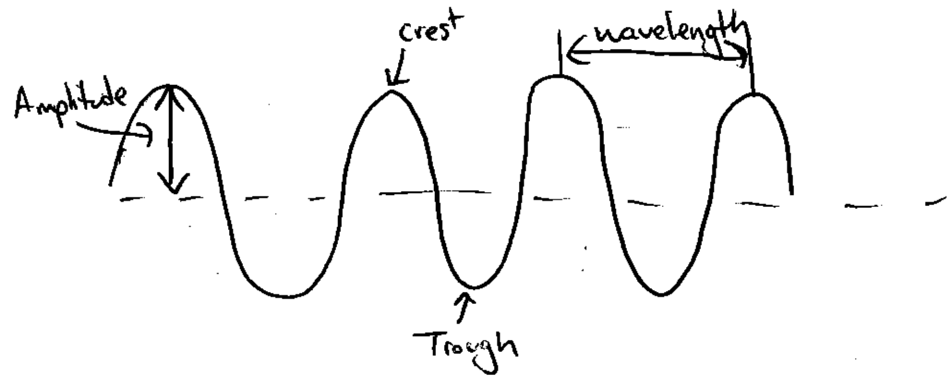
Scientific Notation
$c = \lambda \upsilon$
$E = h\upsilon$
Electron Configuration

Forms of radiation

- Radio Waves
- Microwaves
- Infrared
- Visible Light
- Ultraviolet
- X-Rays
- Gamma Rays

Electromagnetic Waves

- All travel at the speed of light ($c = 3 \times 10^8$ m/s)



wavelength (λ) - the distance between 2 successive crests or troughs. Measured in meters.

Frequency (ν) - the # of waves to pass a point in 1 second. Measured in Hertz (Hz). 1 Hz = 1 $\frac{\text{wave}}{\text{sec}}$

wave speed (c) = wavelength × frequency

$c = \lambda \cdot \nu$ measured in $\frac{\text{meters}}{\text{second}}$.

Name ______________________ Date ____________ Class ____________

Electrons in Atoms

Section 5.1 Light and Quantized Energy

In your textbook, read about the wave nature of light.

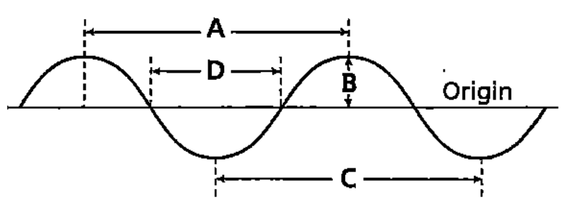
Use each of the terms below just once to complete the passage.

~~amplitude~~	~~energy~~	~~frequency~~	~~hertz~~
~~light~~	~~wave~~	~~wavelength~~	~~speed~~

Electromagnetic radiation is a kind of **(1)** energy that behaves like a(n) **(2)** wave as it travels through space. **(3)** Light is one type of electromagnetic radiation. Other examples include X rays, radio waves, and microwaves.

All waves can be characterized by their wavelength, amplitude, frequency, and **(4)** speed. The shortest distance between equivalent points on a continuous wave is called a(n) **(5)** wavelength. The height of a wave from the origin to a crest or from the origin to a trough is the **(6)** amplitude. **(7)** frequency is the number of waves that pass a given point in one second. The SI unit for frequency is the **(8)** hertz, which is equivalent to one wave per second.

Use the figure to answer the following questions.



9. Which letter(s) represent one wavelength? A, C

10. Which letter(s) represent the amplitude? B

11. If twice the length of A passes a stationary point every second, what is the frequency of the wave?

A = 2 wave crests 4 waves/sec = 4 Hz

2A = 4 wave crests

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Section 5.1 *continued*

In your textbook, read about the particle nature of light.

Circle the letter of the choice that best completes the statement or answers the question.

12. A(n) __C__ is the minimum amount of energy that can be lost or gained by an atom.

a. valence electron **b.** electron **(c.)** quantum **d.** Planck's constant

13. According to Planck's theory, for a given frequency, ν, matter can emit or absorb energy only in

a. units of hertz. **c.** entire wavelengths.

(b.) whole-number multiples of $h\nu$. **d.** multiples of $\frac{1}{2}h\nu$, $\frac{1}{4}h\nu$, and so on.

14. The ______ is the phenomenon in which electrons are emitted from a metal's surface when light of a certain frequency shines on it.

a. quantum **b.** Planck concept **c.** photon effect **(d.)** photoelectric effect

15. Which equation would you use to calculate the energy of a photon?

a. $E_{photon} = h\nu \times$ Planck's constant **c.** $E_{photon} = \frac{1}{2}h\nu$

(b.) $E_{photon} = h\nu$ **d.** $c = \lambda\nu$

In your textbook, read about atomic emission spectra.

For each statement below, write *true* or *false*.

__False__ **16.** Like the visible spectrum, an atomic emission spectrum is a continuous range of colors.

__True__ **17.** Each element has a unique atomic emission spectrum.

__True__ **18.** A flame test can be used to identify the presence of certain elements in a compound.

__True__ **19.** The fact that only certain colors appear in an element's atomic emission spectrum indicates that only certain frequencies of light are emitted.

__False__ **20.** Atomic emission spectra can be explained by the wave model of light.

__False__ **21.** The neon atoms in a neon sign emit their characteristic color of light as they absorb energy. (absorb should say release)

__True__ **22.** When an atom emits light, photons having certain specific energies are being emitted.

$E = h\nu$ diff frequencies correspond to different energies.

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CHAPTER 5 STUDY GUIDE

Section 5.2 Quantum Theory and the Atom

In your textbook, read about the Bohr model of the atom.

Use each of the terms below to complete the statements.

atomic emission spectrum	electron	frequencies	ground state
higher	energy levels	lower	

1. The lowest allowable energy state of an atom is called its ground state.
2. Bohr's model of the atom predicted the frequencies of the lines in hydrogen's atomic emission spectrum.
3. According to Bohr's atomic model, the smaller an electron's orbit, the lower the atom's energy level.
4. According to Bohr's atomic model, the larger an electron's orbit, the higher the atom's energy level.
5. Bohr proposed that when energy is added to a hydrogen atom, its electron moves to a higher-energy orbit.
6. According to Bohr's atomic model, the hydrogen atom emits a photon corresponding to the difference between the energy levels associated with the two orbits it transitions between.
7. Bohr's atomic model failed to explain the Atomic Emission Spectrum of elements other than hydrogen.

In your textbook, read about the quantum mechanical model of the atom.

Answer the following questions.

8. If you looked closely, could you see the wavelength of a fast-moving car? Explain your answer.

No. A 2,000 lb car ($\approx$ 910 kg) moving at 60 mph ($\approx$ 27 m/s) would have a wavelength of $\lambda = \frac{h}{mv} = \frac{6.626\times10^{-34}}{(910 kg)(27 m/s)} = 2.70\times10^{-38}$ m. Too small of a wavelength for humans to see (between 4×10^{-7} and 7×10^{-7} m)

9. Using de Broglie's equation, $\lambda = \frac{h}{mv}$ which would have the larger wavelength, a slow-moving proton or a fast-moving golf ball? Explain your answer.

Proton: $\lambda = \frac{h}{mv} = \frac{6.626\times10^{-34} J\cdot s}{(1.66\times10^{-27} kg)(5 m/s)} = 7.98\times10^{-14}$ m Golf Ball $\lambda = \frac{6.626\times10^{-34}}{(.0459 kg)(25 m/s)}$ 5.77×10^{-34} m

The proton has a much smaller mass than a golf ball, but a greater λ.

③

Name ____________ Date ________ Class ________

Section 5.2 *continued*

In your textbook, read about the Heisenberg uncertainty principle.

For each item in Column A, write the letter of the matching item in Column B.

Column A

C 10. The modern model of the atom that treats electrons as waves

A 11. States that it is impossible to know both the velocity and the position of a particle at the same time

D 12. A three-dimensional region around the nucleus representing the probability of finding an electron

B 13. Originally applied to the hydrogen atom, it led to the quantum mechanical model of the atom

Column B

a. Heisenberg uncertainty principle

b. Schrödinger wave equation

c. quantum mechanical model of the atom

d. atomic orbital

Answer the following question.

14. How do the Bohr model and the quantum mechanical model of the atom differ in how they describe electrons?

Bohr - electrons move in certain energy levels - only certain allowable orbits.
Bohr - only worked for hydrogen + electrons don't follow orbits
Quantum Mech Model - predicts the probability of finding an electron at a specific location in the atom.

In your textbook, read about hydrogen's atomic orbitals.

In the space at the left, write the term in parentheses that correctly completes the statement.

do not **15.** Atomic orbitals (do, do not) have an exactly defined size.

two **16.** Each orbital may contain at most (two, four) electrons.

spherically shaped **17.** All s orbitals are (spherically shaped, dumbbell shaped).

n^2 **18.** A principal energy has (n, n^2) energy sublevels.

electrons **19.** The maximum number of (electrons, orbitals) related to each principal energy level equals $2n^2$.

three **20.** There are (three, five) equal energy p orbitals.

2s and 2p **21.** Hydrogen's principal energy level 2 consists of (2s and 3s, 2s and 2p) orbitals.

nine **22.** Hydrogen's principal energy level 3 consists of (nine, three) orbitals.

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Name ______________________ Date ____________ Class ____________

Section 5.3 Electron Configuration

In your textbook, read about ground-state electron configurations.

Use each of the terms below just once to complete the passage.

Aufbau principle	electron configuration	ground-state electron configuration	Hund's rule
lowest	Pauli exclusion principle	spins	stable

The arrangement of electrons in an atom is called the atom's **(1)** electron configuration. Electrons in an atom tend to assume the arrangement that gives the atom the **(2)** lowest possible energy. This arrangement of electrons is the most **(3)** Stable arrangement and is called the atom's **(4)** ground state electron configuration

Three rules define how electrons can be arranged in an atom's orbitals. The **(5)** Aufbau Principle states that each electron occupies the lowest energy orbital available. The **(6)** Pauli Exclusion Principle states that a maximum of two electrons may occupy a single atomic orbital, but only if the electrons have opposite **(7)** spins. **(8)** Hund's Rule states that single electrons with the same spin must occupy each equal-energy orbital before additional electrons with opposite spins occupy the same orbitals.

Complete the following table.

Element	Atomic Number	Orbitals 1s	2s	$2p_x$	$2p_y$	$2p_z$	Electron Configuration
9. Helium	2	↑↓					$1s^2$
10. Nitrogen	7	↑↓	↑↓	↑	↑	↑	$1s^2 2s^2 2p^3$
11. Neon	10	↑↓	↑↓	↑↓	↑↓	↑↓	$1s^2 2s^2 2p^6$

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Name ______________________ Date __________ Class __________

CHAPTER 5 **STUDY GUIDE**

Section 5.3 *continued*

Answer the following questions.

12. What is germanium's atomic number? How many electrons does germanium have?

At # 32 32 e⁻

13. What is noble-gas notation, and why is it used to write electron configurations?

Is a method of representing electron configurations of noble gases with complete outer shells.
It is used to make writing electron configurations easier.

14. Write the ground-state electron configuration of a germanium atom, using noble-gas notation.

$[Ar]4s^2 3d^{10} 4p^2$ $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^2$

In your textbook, read about valence electrons.

Circle the letter of the choice that best completes the statement or answers the question.

15. The electrons in an atom's outermost orbitals are called
a. electron dots. **b.** quantum electrons. **c.** valence electrons. **d.** noble-gas electrons.

16. In an electron-dot structure, the element's symbol represents the
a. nucleus of the noble gas closest to the atom in the periodic table.
b. atom's nucleus and inner-level electrons.
c. atom's valence electrons.
d. electrons of the noble gas closest to the atom in the periodic table.

17. How many valence electrons does a chlorine atom have if its electron configuration is $[Ne]3s^2 3p^5$?
a. 3 **b.** 21 **c.** 5 **d.** 7

18. Given boron's electron configuration of $[He]2s^2 2p^1$, which of the following represents its electron-dot structure?
a. •Be• **b.** •Ḃ• **c.** B̈: **d.** B̈e

19. Given beryllium's electron configuration of $1s^2 2s^2$, which of the following represents its electron-dot structure?
a. •Be• **b.** •Ḃ• **c.** B̈: **d.** B̈e

20. Which electrons are represented by the dots in an electron-dot structure?
a. valence electrons **c.** only s electrons
b. inner-level electrons **d.** both a and c

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Exponents and Scientific Notation

EXERCISES

Express the following numbers in scientific notation. Keep three digits in your answer.

1. 1 930 1.93×10^{3}
2. 262 000 2.62×10^{5}
3. 71 400 7.14×10^{4}
4. 93 100 000 9.31×10^{7}
5. 704 7.04×10^{2}
6. 0.0713 7.13×10^{-2}
7. 0.000 067 2 6.72×10^{-5}
8. 26.1 2.61×10^{1}
9. 0.195 1.95×10^{-1}
10. 7 790 7.79×10^{3}
11. 0.000 001 34 1.34×10^{-6}
12. 55.600 0 5.56×10^{1}
13. 2.940 2.94×10^{0}
14. 0.006 21 6.21×10^{-3}

Express the following numbers in expanded form.

15. 1.00×10^{4} 10,000

16. 1.00×10^{-6} 0.000001

17. 4.38×10^{-5} 0.0000438

18. 3.00×10^{8} 300,000,000

19. 6.626×10^{-34} 0.0000000000000000000000000000000006626

20. 6.02×10^{23} 602,000,000,000,000,000,000,000

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Arithmetic Operations in Scientific Notation

Suppose you need to add or subtract measurements expressed in scientific notation, $M \times 10^n$. The measurements must be expressed in the same powers of 10 and the same units.

Example Problem

Addition and Subtraction Using Scientific Notation

Solve the following problems. Express the answers in scientific notation.

a. 4×10^8 m + 3×10^8 m

b. 4.1×10^{-6} kg − 3.0×10^{-7} kg

c. 4.02×10^6 m + 1.89×10^2 m

Calculate Your Answer

Strategy:

a. If the numbers have the same exponent, n, add or subtract the values of M and keep the same n.

b. If the exponents are not the same, move the decimal to the left or right until they are the same. Then add or subtract M.

c. If the magnitude of one number is quite small when compared to the other number, its effect on the larger number is insignificant. The smaller number can be treated as zero.

Calculations:

$4 \times 10^8\ \text{m} + 3 \times 10^8\ \text{m}$
$= (4 + 3) \times 10^8\ \text{m}$
$= 7 \times 10^8\ \text{m}$

$4.1 \times 10^{-6}\ \text{kg} - 3.0 \times 10^{-7}\ \text{kg}$
$= 4.1 \times 10^{-6}\ \text{kg} - 0.30 \times 10^{-6}\ \text{kg}$
$= (4.1 - 0.30) \times 10^{-6}\ \text{kg}$
$= 3.8 \times 10^{-6}\ \text{kg}$

$4.02 \times 10^6\ \text{m} + 1.89 \times 10^2\ \text{m}$
$= 40\,200 \times 10^2\ \text{m} + 1.89 \times 10^2\ \text{m}$
$= (40\,200 + 1.89) \times 10^2\ \text{m}$
$= 40\,201.89 \times 10^2\ \text{m}$
$= 4.020\,189 \times 10^6\ \text{m}$
$= 4.02 \times 10^6\ \text{m}$

Practice Problems

Solve the following problems. Write your answers in scientific notation.

6. **a.** 5×10^{-7} kg + 3×10^{-7} kg = 8×10^{-7} kg
   b. 4×10^{-3} kg + 3×10^{-3} kg = 7×10^{-3} kg
   c. 1.66×10^{-19} kg + 2.30×10^{-19} kg = 3.96×10^{-19} kg
   d. 7.2×10^{-12} kg − 2.6×10^{-12} kg = 4.6×10^{-12} kg
7. **a.** $6 \times 10^{-8}\ \text{m}^2 - 4 \times 10^{-8}\ \text{m}^2$ = $2 \times 10^{-8}\ \text{m}^2$
   b. $3.8 \times 10^{-12}\ \text{m}^2 - 1.90 \times 10^{-11}\ \text{m}^2$ = $.38 \times 10^{-11} - 1.9 \times 10^{-11} = -1.52 \times 10^{-11}\ \text{m}^2$
   c. $5.8 \times 10^{-9}\ \text{m}^2 - 2.8 \times 10^{-9}\ \text{m}^2$ = $3 \times 10^{-9}\ \text{m}^2$
   d. $2.26 \times 10^{-18}\ \text{m}^2 - 1.8 \times 10^{-18}\ \text{m}^2$ = $.46 \times 10^{-18}\ \text{m}^2 = 4.6 \times 10^{-17}\ \text{m}^2$

Multiplication and Division Using Scientific Notation

To multiply quantities written in scientific notation, simply multiply the values and units of M. Then add the exponents. To divide quantities expressed in scientific notation, divide the values and units of M, then subtract the exponent of the divisor from the exponent of the dividend. If one unit is a multiple of the other, convert to the same unit.

Example Problem

Find the value of each of the following quantities.

a. $(4 \times 10^3\ \text{kg})(5 \times 10^{11}\ \text{m})$

b. $\dfrac{8 \times 10^6\ \text{m}^3}{2 \times 10^{-3}\ \text{m}^2}$

Calculate Your Answer

Strategy:

a. Multiply the values of M and add the exponents, n. Multiply the units.

Calculations:

$(4 \times 10^3\ \text{kg})(5 \times 10^{11}\ \text{m}) = (4 \times 5) \times 10^{3+11}\ \text{kg·m}$
$= 20 \times 10^{14}\ \text{kg·m}$
$= 2 \times 10^{15}\ \text{kg·m}$

b. Divide the values of M and subtract the exponent of the divisor from the exponent of the dividend.

$\dfrac{8 \times 10^6\ \text{m}^3}{2 \times 10^{-3}\ \text{m}^2} = \dfrac{8}{2} \times 10^{6-(-3)}\ \text{m}^{3-2}$
$= 4 \times 10^9\ \text{m}$

USING A CALCULATOR

Scientific Notation

Using a calculator simplifies performing arithmetic operations on numbers in scientific notation.

$\dfrac{8 \times 10^6\ \text{kg}}{2 \times 10^{-3}\ \text{m}^3}$

Keys	Display
[8] [EXP] [6] [÷]	8^{06}
[2] [EXP] [3] [+/-] [=]	4^{09}

Answer
$4 \times 10^9\ \text{kg/m}^3$

$4.0 \times 10^{-6}\ \text{kg} - 3.0 \times 10^{-7}\ \text{kg}$

Keys	Dis
[4.0] [EXP] [6] [+/-] [−]	4.0^{-06}
[3.0] [EXP] [7] [+/-] [=]	3.7^{-06}

Answer
$3.7 \times 10^{-6}\ \text{kg}$

ractice Problems

Find the value of each of the following quantities.

9. a. $(2 \times 10^4\ \text{m})(4 \times 10^8\ \text{m})$ = $8 \times 10^{12}\ \text{m}^2$
   b. $(3 \times 10^4\ \text{m})(2 \times 10^6\ \text{m})$ = $6 \times 10^{10}\ \text{m}^2$
   c. $(6 \times 10^{-4}\ \text{m})(5 \times 10^{-8}\ \text{m})$ = $30 \times 10^{-12} = 3 \times 10^{-11}\ \text{m}^2$
   d. $(2.5 \times 10^{-7}\ \text{m})(2.5 \times 10^{16}\ \text{m})$ = $6.25 \times 10^9\ \text{m}^2$

10. a. $\dfrac{6 \times 10^8\ \text{kg}}{2 \times 10^4\ \text{m}^3}$ = 3×10^4 c. $\dfrac{6 \times 10^{-8}\ \text{m}}{2 \times 10^4\ \text{s}}$ = 3×10^{-12}
    b. $\dfrac{6 \times 10^8\ \text{kg}}{2 \times 10^{-4}\ \text{m}^3}$ = 3×10^{12} d. $\dfrac{6 \times 10^{-8}\ \text{m}}{2 \times 10^{-4}\ \text{s}}$ = 3×10^{-4}

11. a. $\dfrac{(3 \times 10^4\ \text{kg})(4 \times 10^4\ \text{m})}{6 \times 10^4\ \text{s}}$ = 2×10^4
    b. $\dfrac{(2.5 \times 10^6\ \text{kg})(6 \times 10^4\ \text{m})}{5 \times 10^{-2}\ \text{s}^2}$ = 3×10^{12}

Wave Calculations

Use the formula **wave speed = wavelength x frequency** ($c = \lambda \upsilon$) to complete the following problems.

1. After careful analysis, an electromagnetic wave is found to have a frequency of 7.8×10^6 Hz. What is the speed of the wave?

   3×10^8 m/s

2. Objects get their colors from reflecting only certain wavelengths when hit with white light. Light reflected from a green leaf is found to have a wavelength of 4.90×10^{-7} m. What is the frequency of the light? The speed of light (c) = 3.00×10^8 m/s.

   $$\upsilon = \frac{c}{\lambda} = \frac{3 \times 10^8 \text{ m/s}}{4.9 \times 10^{-7} \text{ m}} = \boxed{6.12 \times 10^{14} \text{ Hz}}$$

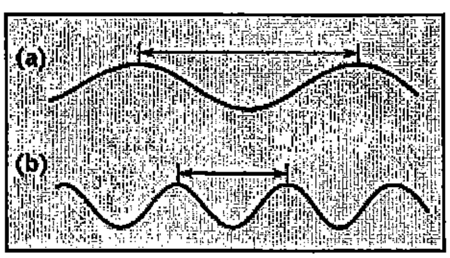
3. X-rays can penetrate body tissues and are widely used to diagnose and treat disorders of internal body tissues. What is the wavelength of an X-ray with a frequency of 2.61×10^{18} Hz?

   $$\lambda = \frac{c}{\upsilon} = \frac{3 \times 10^8 \text{ m/s}}{2.61 \times 10^{18} \text{ Hz}} = 1.149 \times 10^{-10} \text{ m}$$

4. While an FM radio station broadcasts at a frequency of 101.9 MHz (1.019×10^8 Hz), an AM station broadcasts at a frequency of 660 kHz (6.60×10^5 Hz). What are the wavelengths of the broadcasts? Which of the 2 drawings below corresponds to the FM station? To the AM station?

AM — longer λ

FM



FM: $$\lambda = \frac{c}{\upsilon} = \frac{3 \times 10^8 \text{ m/s}}{1.019 \times 10^8 \text{ Hz}} = \boxed{2.94 \text{ m}}$$ - drawing B

AM: $$\lambda = \frac{c}{\upsilon} = \frac{3 \times 10^8 \text{ m/s}}{6.6 \times 10^5 \text{ Hz}} = \boxed{454.5 \text{ m}}$$ - drawing A

$c = \lambda \nu$ $\quad E = h\nu = \frac{hc}{\lambda}$

Name: Period:

Worksheet- Electromagnetic Radiation $h = 6.626\times10^{-34}$

Fill in the following table dealing with wavelength, frequency, and energy for electromagnetic waves. All travel at the speed of light. Show your work for each on the back of this page.

Velocity (m/s) c	Wavelength (m) λ	Frequency (Hz) ν	Energy (J) E
3×10^8	$\frac{3\times10^8}{5.8\times10^{14}} = 5.17\times10^{-7}$ m	5.80 x 10^{14}	$(6.626\times10^{-34})(5.8\times10^{14})$ 3.84×10^{-19} J
3×10^8	$\frac{3\times10^8}{7.17\times10^{14}}$ 4.18×10^{-7} m	$\nu = \frac{E}{h} = \frac{4.75\times10^{-19}}{6.626\times10^{-34}}$ 7.17×10^{14} Hz	4.75 x 10^{-19}
3×10^8	3.07	$\nu = \frac{c}{\lambda} = \frac{3\times10^8}{3.07} = 9.77\times10^7$ Hz	$(6.626\times10^{-34})(9.77\times10^7)$ 6.47×10^{-26} J
3×10^8	$\frac{3\times10^8}{5.2\times10^{14}} = 5.77\times10^{-7}$ m	5.20 x 10^{14}	$(6.626\times10^{-34})(5.2\times10^{14})$ 3.45×10^{-19} J
3×10^8	$\frac{3\times10^8}{4.53\times10^{14}} = 6.63\times10^{-7}$ m	$\nu = \frac{E}{h} = \frac{3\times10^{-19}}{6.626\times10^{-34}}$ 4.53×10^{14} Hz	3.00 x 10^{-19}
3×10^8	4.75 x 10^{-7}	$\frac{3\times10^8}{4.75\times10^{-7}} = 6.32\times10^{14}$ Hz	$(6.626\times10^{-34})(6.32\times10^{14})$ 4.18×10^{-19} J
3×10^8	$\frac{3\times10^8}{4.53\times10^{15}} = 6.6\times10^{-8}$ m	$\nu = \frac{E}{h} = \frac{3\times10^{-15}}{6.626\times10^{-34}}$ 4.53×10^{15} Hz	3.00 x 10^{-18}
3×10^8	$\frac{3\times10^8}{3.95\times10^{14}}$ 7.59×10^{-7} m	3.95 x 10^{14}	$(6.626\times10^{-34})(3.95\times10^{14})$ 2.62×10^{-19} J
3×10^8	7.50 x 10^{-10}	$\nu = \frac{3\times10^8}{7.5\times10^{-10}} = 4\times10^{17}$ Hz	$(6.626\times10^{-34})(4\times10^{17})$ 2.65×10^{-16} J
3×10^8	$\frac{3\times10^8}{9.55\times10^7} = 3.14$ m	9.55 x 10^7	$(6.626\times10^{-34})(9.55\times10^7)$ 6.33×10^{-26} J
3×10^8	$\frac{3\times10^8}{8.3\times10^{18}} = 3.61\times10^{-11}$ m	$\nu = \frac{E}{h} = \frac{5.5\times10^{-15}}{6.626\times10^{-34}}$ 8.30×10^{18} Hz	5.50 x 10^{-15}

(11)

ELECTRON CONFIGURATION (LEVEL ONE)

Name ____________________

Electrons are distributed in the electron cloud into principal energy levels (1, 2, 3, ...), sublevels (s, p, d, f), orbitals (s has 1, p has 3, d has 5, f has 7) and spin (two electrons allowed per orbital).

Example: Draw the electron configuration of sodium (atomic #11).

Answer: $1s^2$ $2s^2$ $2p^6$ $3s^1$

↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑

Draw the electron configurations of the following atoms.

1. Cl
At #17

$1s^2 2s^2 2p^6 3s^2 3p^5$ - electron config

↑↓ (1s) ↑↓ (2s) ↑↓ ↑↓ ↑↓ (2p) ↑↓ (3s) ↑↓ ↑↓ ↑ (3p) - orbital notation

2. N
At #7

$1s^2$ $2s^2$ $2p^3$

↑↓ (1s) ↑↓ (2s) ↑ ↑ ↑ (2p)

3. Al
At #13

$1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^1$

↑↓ (1s) ↑↓ (2s) ↑↓ ↑↓ ↑↓ (2p) ↑↓ (3s) ↑ __ __ (3p)

4. O
At #8

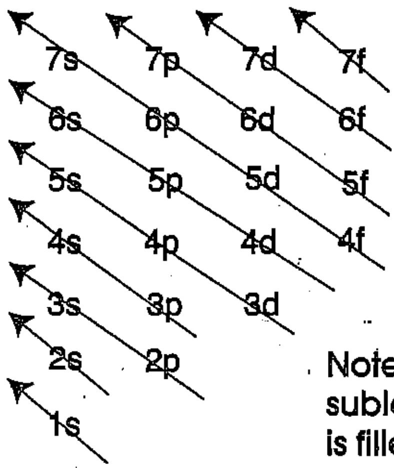
$1s^2$ $2s^2$ $2p^4$

↑↓ (1s) ↑↓ (2s) ↑↓ ↑ ↑ (2p)

ELECTRON CONFIGURATION (LEVEL TWO)

Name ________________

At atomic number greater than 18, the sublevels begin to fill out of order. A good approximation of the order of filling can be determined using the diagonal rule.



Note that after the 3p sublevel is filled, the 4s is filled, then the 3d.

Draw the electron configurations of the following atoms.

		Noble Gas Config.
1. K At #19	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$	[Ar]$4s^1$
2. V At #23	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^3$	[Ar]$4s^2 3d^3$
3. Co At #27	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^7$	[Ar]$4s^2 3d^7$
4. Zr At #40	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^2$	[Kr]$5s^2 4d^2$

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Electron Configurations Worksheet

Write the complete ground state electron configurations for the following:

1) 3 lithium $1s^2 2s^1$

2) 8 oxygen $1s^2 2s^2 2p^4$

3) 20 calcium $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$

4) 22 titanium $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^2$

5) 37 rubidium $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^1$

6) 82 lead $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10} 6p^2$

7) 68 erbium $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{12}$

Write the abbreviated ground state electron configurations for the following:

8) 2 helium $1s^2$

9) 7 nitrogen [He] $2s^2 2p^3$

10) 17 chlorine [Ne] $3s^2 3p^5$

11) 26 iron [Ar] $4s^2 3d^6$

12) 30 zinc [Ar] $4s^2 3d^{10}$

13) 56 barium [Xe] $6s^2$

14) 84 polonium [Xe] $6s^2 4f^{14} 5d^{10} 6p^4$

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Electron Configuration Practice Worksheet

In the space below, write the unabbreviated electron configurations of the following elements:

1) 11 sodium $1s^2 2s^2 2p^6 3s^1$

2) 26 iron $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^6$

3) 35 bromine $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^5$

4) 56 barium $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2$

5) 93 neptunium $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10} 6p^6 7s^2 5f^5$

6) 27 cobalt $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^7$

7) 47 silver $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^9$

8) 52 tellurium $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^4$

9) 88 radium $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10} 6p^6 7s^2$

10) 103 lawrencium $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10} 6p^6 7s^2 5f^{14} 6d^1$

Determine what elements are denoted by the following electron configurations:

11) $1s^2 2s^2 2p^6 3s^2 3p^4$ Sulfur

12) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^1$ Rubidium

13) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 4d^{10} 4p^5$ Bromine

14) $1s^2 2s^2 2p^6 3s^2 3p^5$ Chlorine

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Write the shortcut electron configuration for each

1) sodium $[Ne]3s^1$
2) iron $[Ar]4s^2 3d^6$
3) bromine $[Ar]4s^2 3d^{10} 4p^5$
4) barium $[Xe]6s^2$
5) neptunium $[Rn]7s^2 5f^5$
6) cobalt $[Ar]4s^2 4p^7$
7) silver $[Kr]5s^2 4d^9$
8) tellurium $[Kr]5s^2 4d^{10} 5p^4$
9) radium $[Rn]7s^2$
10) lawrencium $[Rn]7s^2 5f^{14} 6d^1$

Determine what elements are denoted by the following electron configurations:

11) $(Ne)3s^2 3p^4$ Sulfur
12) $(Kr)5s^1$ Rubidium
13) $[Kr]\ 5s^2 4d^{10} 5p^3$ Antimony
14) $[Xe]\ 6s^2 4f^{14} 5d^6$ Osmium
15) $[Rn]\ 7s^2 5f^{11}$ Holmium

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