Name ______________________ Class ______________ Date ______________

Refinements of the Atomic Model

Section Review 4.1

DIRECTIONS: Write on the line at the right of each statement the letter preceding the word or expression that best completes the statement.

1. Electromagnetic radiation has some properties of particles when it (a) travels through space; (b) is transferred to matter; (c) interacts with photons; (d) interacts with other radiations. ______ 1
2. The wave model of light was not able to explain (a) light's frequency; (b) the continuous spectrum; (c) interference; (d) the photoelectric effect. ______ 2
3. In wave motion, the product of frequency and wavelength is equal to (a) the number of waves passing a given point in a second; (b) the speed of the wave; (c) the distance between successive wave crests; (d) the time for one full wave to pass a given point. ______ 3
4. The common characteristic shown by X rays, visible light, infrared radiation, and radio waves is that they all have the same (a) energy; (b) wavelength; (c) speed; (d) frequency. ______ 4
5. Red light has a longer wavelength than blue light. Compared to the blue line on the hydrogen spectrum, the red line would represent (a) higher energy and lower frequency; (b) higher energy and higher frequency; (c) lower energy and higher frequency; (d) lower energy and lower frequency. ______ 5
6. A line spectrum is produced when an electron moves from one energy level (a) to a higher energy level; (b) to a lower energy level; (c) into the nucleus; (d) to another position in that same sublevel. ______ 6
7. The drop of an electron from a high energy level to the ground state in a hydrogen atom would be most closely associated with (a) long wavelength radiation; (b) low frequency radiation; (c) infrared radiation; (d) high frequency radiation. ______ 7
8. The change of an atom from excited state to ground state always involves (a) absorption of energy; (b) emission of electromagnetic radiation; (c) release of visible light; (d) an increase in electron energy. ______ 8
9. An orbital may be defined as (a) the most stable state of an atom; (b) the circular path followed by an electron around the nucleus; (c) the positively charged central part of an atom; (d) a highly probable location of an electron within the atom. ______ 9
10. The quantum model of the atom locates the electron (a) at a specific distance from the nucleus; (b) in a definite path around the nucleus; (c) within a region of high probability; (d) at any distance from the nucleus. ______ 10
11. The size and shape of an electron cloud is most closely related to the electron's (a) charge; (b) mass; (c) spin; (d) energy. ______ 11

DIRECTIONS: Complete the following statements, forming accurate sentences.

12. A quantum of electromagnetic energy is called a(n) ______________________. 12
13. The spectral lines of hydrogen that occur in the ultraviolet region of the electromagnetic spectrum are called the ______________________. 13
14. An optical instrument that separates light entering it into component wavelengths is a(n) ______________________. 14
15. The lowest total energy of the electron in a hydrogen atom occurs when the electron is in the state called the ______________________. 15

Name ______________________ Date ______________ Class ______________

Chapter 4

RETEACHING

SPECTRA OF ELEMENTS

The electrons in atoms are located at various energy levels. When an electron absorbs energy, it moves up to a higher energy level that is farther from the nucleus. When it later releases the energy, it drops back down to a lower level. The energy that is released is in the form of light that has a definite wavelength (x) and color.

Atoms of different elements have electron levels that differ in their energy. These different kinds of atoms therefore absorb and emit light of different wavelengths. The frequencies are characteristic of the different elements and provide an easy way to identify the elements.

For example, the hydrogen atom has one electron that is generally in the lowest energy level. It can absorb energy, rise to higher levels, and then drop down to lower ones, releasing light of characteristic energy and wavelength. There are many possible drops the electron can make. For example, an electron that has absorbed energy and been raised from the first energy level to the fourth one could drop down to the third or second level, giving off light, before dropping again back to the first level. The descent of electrons down to the second energy level from the sixth, fifth, fourth, and third levels produces visible light of four different colors and wavelengths, as illustrated in Figure 1. This set of colors shows up on an emission spectrum as a series of lines that are characteristic for hydrogen. As you can see, the largest drop in energy—from level 6 to level 2—produces the violet line, which has the highest energy but the shortest wavelength. These lines would immediately indicate to anyone trained in spectroscopy that the element being observed is hydrogen.

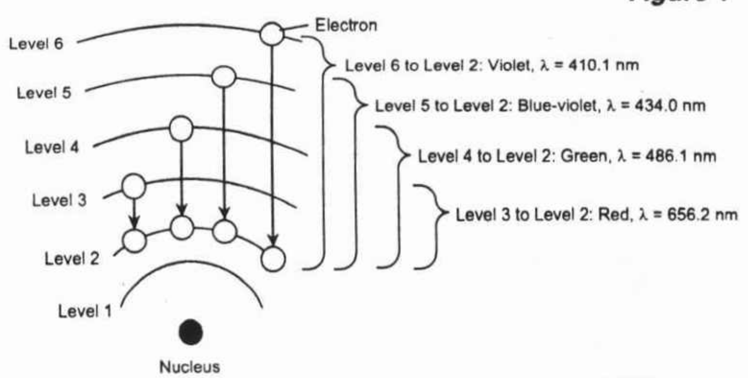
Similar changes in energy levels account for the spectral lines of other elements. The following table of visible spectral lines can be used to identify specific elements. In most cases, a large number of lines other than the ones listed are also produced, but most of those are less frequently used for identification purposes. Use the table below to answer the questions on the next page.

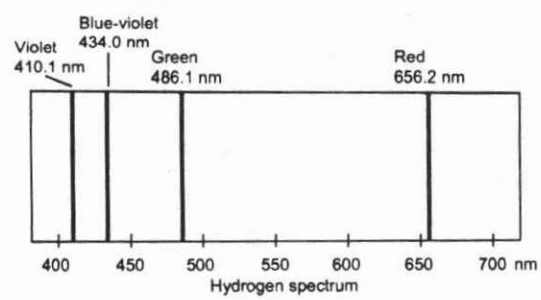
Wavelengths of Spectral Lines of Some Common Elements

Element	Wavelength (nanometers)	Color
Barium	659.5	red
	614.1	orange
	585.4	yellow
	577.7	yellow
	553.5*	green
	455.4*	blue
Copper	521.8	green
	515.3	green
	510.5	green
Helium	706.5	red
	667.8	red
	587.5*	orange
	501.5	green
	471.3	blue
	388.8*	violet
Lithium	670.7*	red
	610.3	orange
	460.3	violet
Potassium	404.7*	violet
	404.4*	violet

* = bright

Figure 1

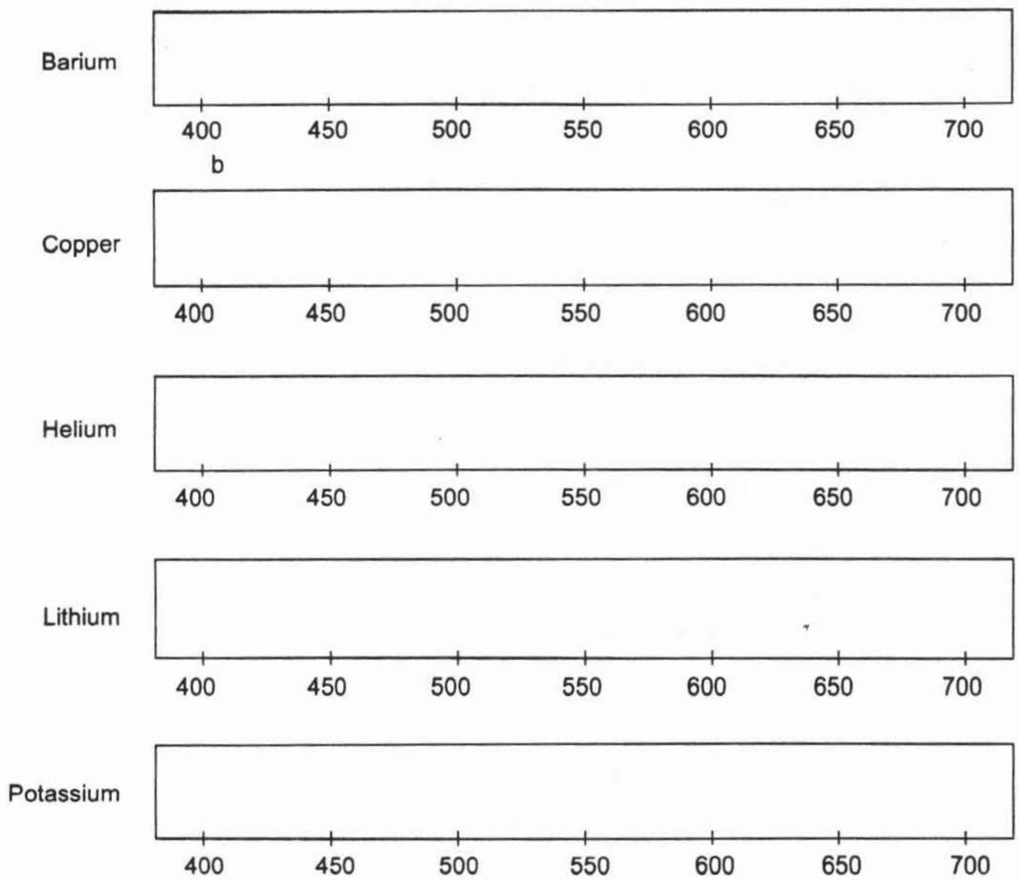




Name ______________________ Date ______________ Class ______________

1. Draw the characteristic spectral lines of the following five elements: barium, copper, helium, lithium, and potassium. Use violet, blue, green, yellow, orange, and red pencils to draw spectral lines for each element in the boxes provided. (Color the spectral lines for starred wavelengths more intensely than the other spectral lines. These represent the brightest and most obvious lines.)

Figure 2



2. What must be happening to electrons to produce these spectral lines?

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3. For the element barium, which wavelength of light is produced by the largest energy drop of an electron? Which wavelength is produced by the smallest drop? Explain your answer. Make a general statement on wavelength and energy that applies to all the elements.

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