

**Niels Bohr, 1913**

(Bohr was awarded the 1922 Nobel Prize in Physics. He worked at Cambridge, Manchester, Copenhagen...)

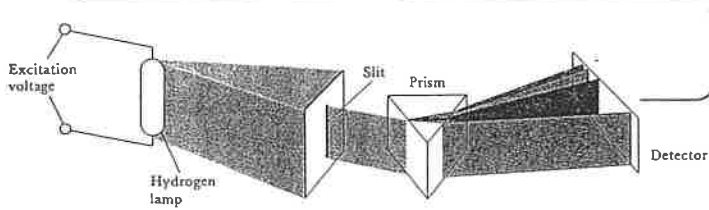
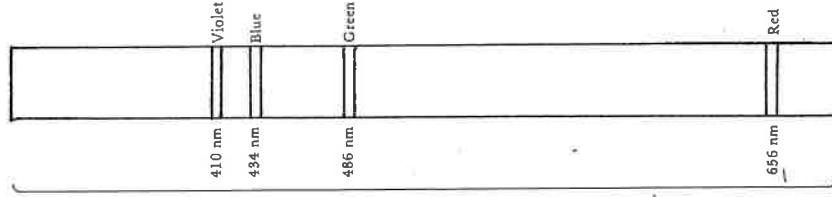
**1. Calculate the energy of the first and last photons. (Show work.)**

$$\lambda = 656 \text{ nm} \quad E = \underline{\hspace{2cm}}$$

$$\lambda = 486 \text{ nm} \quad E = 4.09 \times 10^{-19} \text{ J}$$

$$\lambda = 434 \text{ nm} \quad E = 4.58 \times 10^{-19} \text{ J}$$

$$\lambda = 410 \text{ nm} \quad E = \underline{\hspace{2cm}}$$



- 2. a.** Draw a picture of Bohr's atomic model and explain how the n-levels are related to the energy of an electron.  
**b.** What are the electrons doing when the atom produces light?  
**c.** How do the light spectra of elements provide evidence for quantized energy levels (n-levels) in the atom? Explain the logic.  
 Vocab to include: Photon, quantum, ground state, excited state, potential energy, absorb, emit

3. Determine whether an atom will *absorb* or *emit* energy if the following changes occur.

- a. an electron jumps from  $n = 2$  to  $n = 4$  \_\_\_\_\_
- b. an electron jumps from  $n = 5$  to  $n = 4$  \_\_\_\_\_
- c. an electron jumps from  $n = 6$  to  $n = 3$  \_\_\_\_\_
- d. if an electron jumps from  $n = 1$  to any other n-level \_\_\_\_\_
- e. If an electron in a sodium atom starts out at  $n=3$  and then leaves the atom (because the sodium atom became a sodium ion ( $\text{Na}^+$ ) by losing an electron) \_\_\_\_\_
- f. An electron jumps from  $n = 4$  to  $n = 2$  \_\_\_\_\_

4. Why does the electron generally have lower potential energy when it is at a lower n-level?

5a. Niels Bohr determined that the  $n=1$  level can hold up to 2 electrons,  $n=2$  can hold up to 8 electrons,  $n=3$  can hold up to 18 electrons, and  $n=4$  can hold up to 32 electrons. Determine which n-level the electrons are in for the following atoms, assuming the electrons are in the "ground state." Then determine how many valence electrons each atom has. The valence electrons are the electrons in the atom's outermost shell (n-level).

<u>Atom</u>	<u>Total # of e-</u>	<u>n = 1</u>	<u>n = 2</u>	<u>n = 3</u>	<u>n = 4</u>	<u># of valence electrons</u>
Li	_____	_____	_____	_____	_____	_____
As	_____	_____	_____	_____	_____	_____
Mg	_____	_____	_____	_____	_____	_____
F	_____	_____	_____	_____	_____	_____
Ne	_____	_____	_____	_____	_____	_____
Kr	_____	_____	_____	_____	_____	_____
C	_____	_____	_____	_____	_____	_____
Na	_____	_____	_____	_____	_____	_____
N	_____	_____	_____	_____	_____	_____
Al	_____	_____	_____	_____	_____	_____
Cl	_____	_____	_____	_____	_____	_____

b. Which elements in the above chart have 8 valence electrons? \_\_\_\_\_

Where are these elements found on the periodic table? (Which column or row?) \_\_\_\_\_

c. Which elements in the above chart have 1 valence electron? \_\_\_\_\_

Where are these elements found on the periodic table? (Which column or row?) \_\_\_\_\_

d. Which elements in the above chart have 7 valence electrons? \_\_\_\_\_

Where are these elements found on the periodic table? (Which column or row?) \_\_\_\_\_