Emission Spectroscopy

Observation Sheet

Name ____________________________

Date _________________Period ____

The Instructions are on the BACK of this sheet.

Draw the spectra below that are observed during this lab. Place vertical lines in the approximate location of each of the various spectral lines as you observe with your spectroscope.

Fluorescent Ceiling Lights:

| | 4 | | | | | | | | | 5 | | | | | | | | | 6 | | | | | | | | | 7 |

Element: ________________________

| | 4 | | | | | | | | | 5 | | | | | | | | | 6 | | | | | | | | | 7 |

Element: ________________________

| | 4 | | | | | | | | | 5 | | | | | | | | | 6 | | | | | | | | | 7 |

Element: ________________________

| | 4 | | | | | | | | | 5 | | | | | | | | | 6 | | | | | | | | | 7 |

Element: ________________________

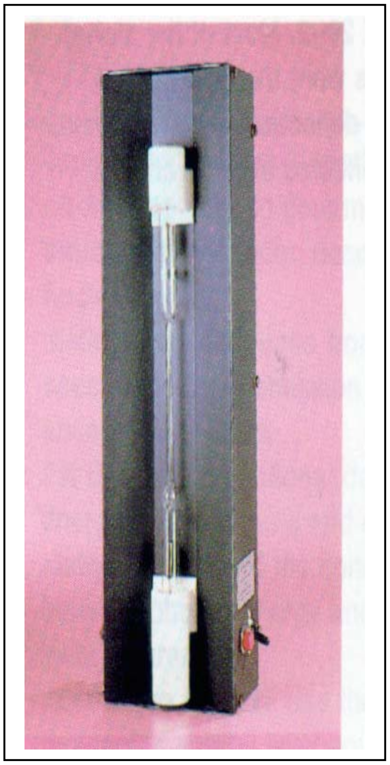
| | 4 | | | | | | | | | 5 | | | | | | | | | 6 | | | | | | | | | 7 |

Element: ________________________

| | 4 | | | | | | | | | 5 | | | | | | | | | 6 | | | | | | | | | 7 |

What does each spectral line represent?

Outline the step-by-step process causing atoms to give off light.
(You may refer to the "Background Information" on the following pages for help if necessary.)

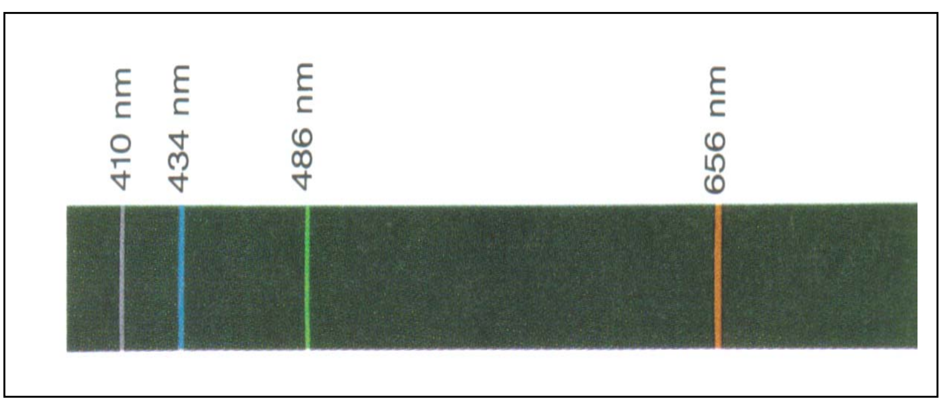


Instructions:

- Obtain a power supply and set of spectrum tubes like that shown at the left.
- Obtain a hand-held spectroscope and/or a spectroscopy probe.

- Observe and record the spectral lines of each of the elemental gases provided. Use your "observation sheet" to record your data.
- If you produce computer-generated data, print the graph or data for your report.

EXAMPLE:



The emission spectrum of hydrogen in the visible range has four spectral lines.

Background Information: The amount of energy given off is calculated by the colors of the quanta of light given off when the electrons “cascade” from upper energy levels to the natural ground state. **Atomic Spectroscopy** is the analytical measurement of the quantum energy level jumps of different electron energy states. It is a spectral analysis of the colors (frequencies or wavelengths) that an atom gives off when its electrons change energy levels.

In this technique, the atoms are heated up or electrified to the point that the thermal energy or electrical energy promotes the electron up to an excited energy level (higher level) and then measures the color (wavelength) of light that is given off when the electron collapses back into the ground state (lower energy level).

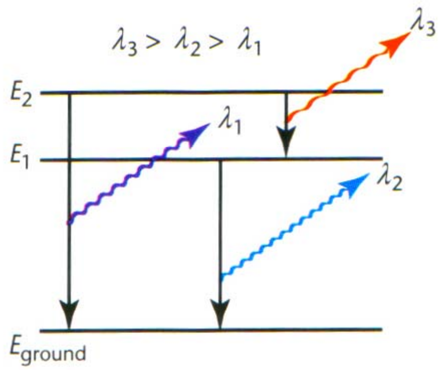


FIGURE 28–10 The energy of the emitted photon is equal to the difference in energy between two energy levels.

Einstein proposed that electrons, besides emitting electromagnetic radiation in quanta, also absorb it in quanta. Einstein's work demonstrated that electromagnetic radiation has the characteristics of both a wave--because the fields of which it is composed rise and fall in strength--and a particle--because the energy is contained in separate "packets." These packets were later called PHOTONS.

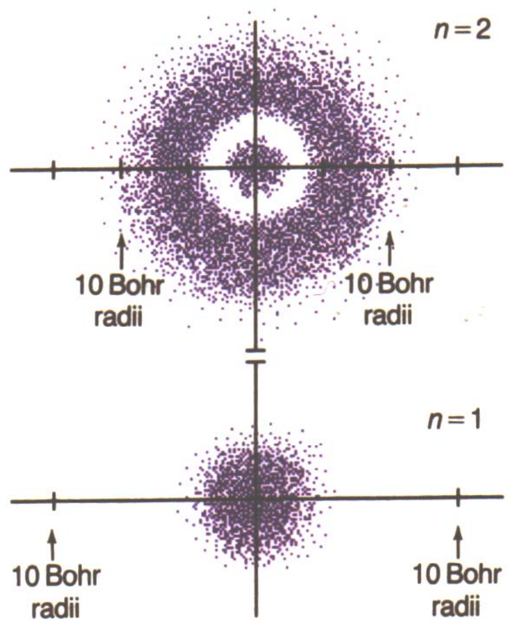


FIGURE 28–15. These plots show the probability of finding the electron in a hydrogen atom at any given location. The denser the points, the higher the probability of finding the electron.

Electron energy orbitals are the regions of space around the atom where there is the greatest chance of finding the electrons. The shapes of these orbital regions are determined by the specific energy of the electrons they contain. An “s” orbital is shown at the left.

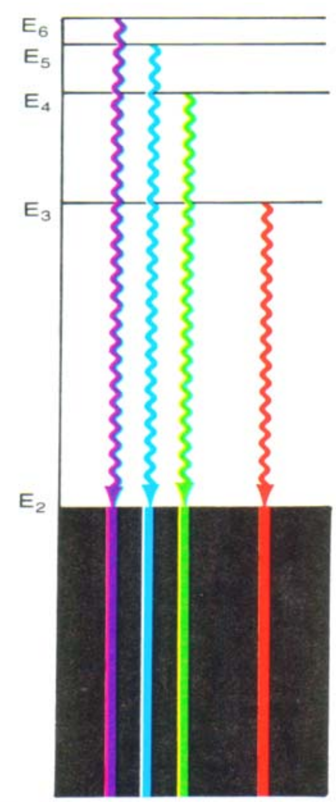
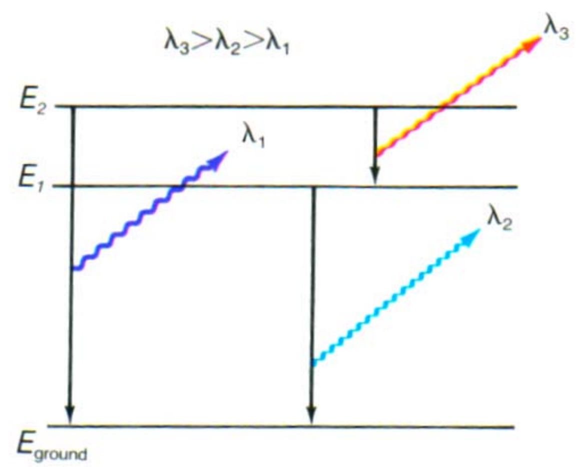


FIGURE 28–13. Bohr's model of the hydrogen atom showed that a definite amount of energy is released when an electron moves from a higher to a lower energy level. The energy released in each transition corresponds to a definite line in the hydrogen spectrum.

When the electron absorbs the energy, it is promoted to the higher energy orbital.
Nature wants the electron to go back to the ground state level (stability and entropy reasons) and so it does so very quickly. Therefore, it gives the energy back off at frequencies that are unique for that atom at that level of energy, and it travels back down to a lower level as it does this. The energy photon it gives off is equal to the energy difference of where it was to where it goes. This is shown in the diagrams below.

FIGURE 28–10. The energy of the emitted photon is equal to $E_f - E_i$.



Notice below the many different pathways photon energy release can take back to ground state. The larger the move made by the electron, the greater the photon's energy -or the shorter its wavelength.