Mini-Lab & WS (25 points)
Emission Spectra and The Bohr Atom

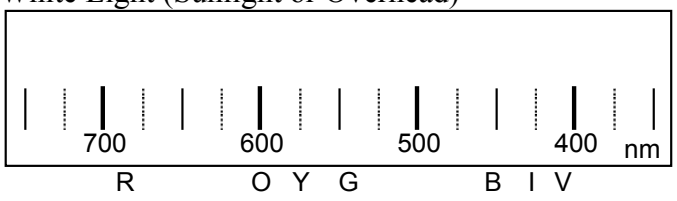
Name _____
Partner: _____
Period _____ **Date** _____

Introduction: As you know, light can have a variety of colors. The color of light we see is really a combination of many colors. If one looks at light through a **spectroscope** (basically a prism or diffraction grating), the light will be split into its composite colors. Light is emitted (given off) in a variety of situations. It can be emitted by chemical reactions, nuclear reactions or just by heating or passing electricity through a substance. The colors of light that are emitted will vary depending on what element is involved. Thus, elements can be identified by the specific "fingerprint" of light that they emit.
In this activity, you will look at a variety of light sources and take note of their emission spectra (the specific colors of light which are emitted.) Using the spectra obtained, you will identify the gas that is in fluorescent light bulbs.
In addition, we will analyze the emission spectrum and try to understand what it can tell us about the arrangement of electrons in atoms. Our analysis will lead us to the model of the atom that Niels Bohr developed around 1915. His model is now referred to as the **Bohr Atom**.

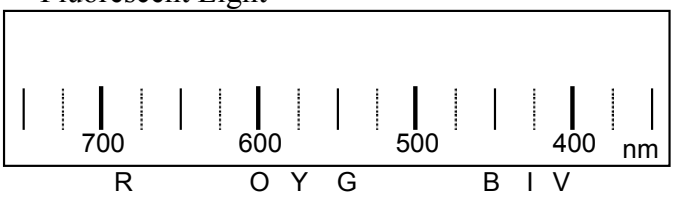
Emission Spectra:

1) [3 pts] For the following light sources, draw in the approximate spectra that you observe. (Draw vertical lines at the approximate wavelength and in the correct color.)

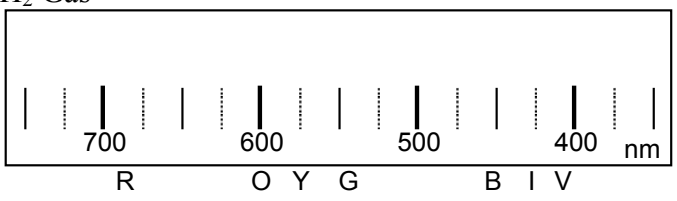
White Light (Sunlight or Overhead)



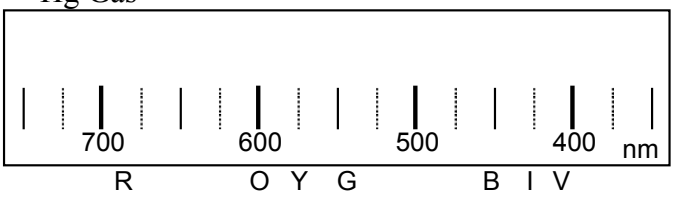
Fluorescent Light



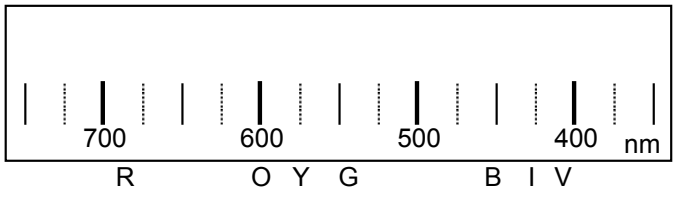
H_2 Gas



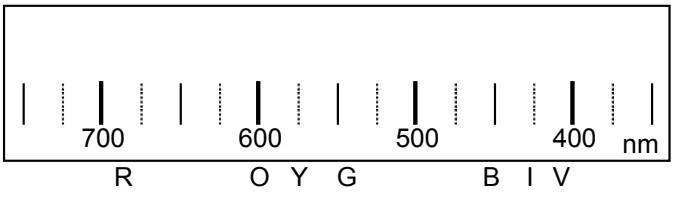
Hg Gas



He Gas



Xe Gas

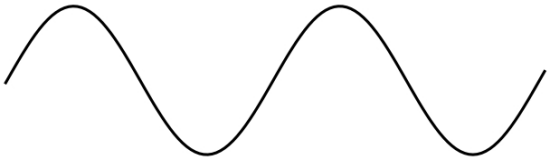


2) [2 pts] Based on the above spectra, what gas must be inside a fluorescent light bulb? ***Explain***.

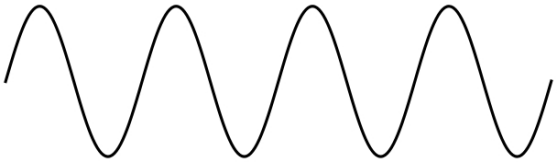
3) [1 pt] Describe what you see when you look at the **sun** through a spectroscope. (Sunlight is an example of "white" light.)

Light as energy and waves:

4) [3 pts] Below are diagrams of two different waves of light. Compare the two light waves by circling the correct words.



(long, short) wavelength
(low, high) frequency
(low, high) energy



(long, short) wavelength
(low, high) frequency
(low, high) energy

5) [5 pts] Answer the following general questions about spectroscopy and light:

a) Which has a shorter wavelength — red light or violet light? _____

b) As the wavelength gets longer, does the frequency get higher or lower? _____

c) Which has a higher frequency— red light or violet light? _____

d) As the frequency increases, does the energy increase or decrease? _____

e) Which is more energetic— red light or violet light? _____

The Bohr Atom: Analysis of emission spectra

6) [1 pt] Electrons are attracted to the nucleus. Why?

7) [1 pt] Since electrons are attracted to the nucleus, it is relatively difficult to move an electron further away from the nucleus. Thus, when an electron does move further away from a nucleus, energy must be:

a) absorbed by the electron b) released by the electron

8) [1 pt]Thus, when an electron moves further away from the nucleus, the electron must:

a) gain potential energy b) lose potential energy

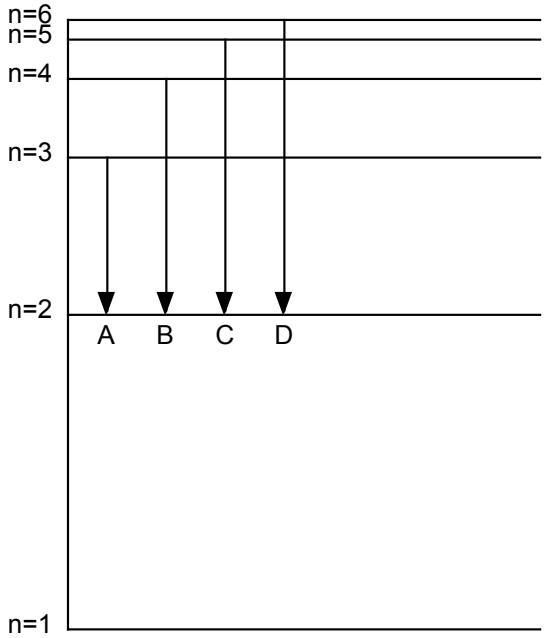
9) Earlier, you looked at the emission spectra produced when electricity was passed through tubes filled with various gases. Answer the following questions about how electrons are involved with producing the light.

a) [1 pt]When electricity is passed through a gas, some electrons in the atoms of gas absorb the energy. What must happen to the energy of the electrons when they **absorb** this energy?

b) [1 pt]Describe what naturally happens to the electrons next. Explain why light is emitted.

10) Refer to the diagram on the right to answer these questions.

a) [1 pt] Which jump releases the LEAST energetic light waves?



b) [2 pts] Suppose that an emission spectrum has four lines with the colors below. Each colored line corresponds to an electron jump. Use what you have learned about differences in energy levels and the relationship between wavelength and energy to match the correct jump with its corresponding color by writing in the correct letter next to each color.

COLOR	LETTER
RED	_____
YELLOW	_____
GREEN	_____
BLUE	_____

11) [3 pts] In Bohr's model of the atom, electrons are quantized. This means that electrons can only occupy certain energy levels. Why does the emission spectra of gases provide evidence that electrons can only occupy certain energy levels? What do the energies of the colored lines in the spectrum correspond to? *[Hint: what happens to electrons when they emit light?]* What would you expect the spectrum to look like if electrons were not quantized?