Myrophora Christo
4/29/08
Pd.1

Wave of Electrons

Background:

When atoms or ions are heated to high temperatures, some electrons may absorb enough energy to "jump" to higher energy levels. These electrons are said to be in an excited state. Because this is an unstable state, the electrons will "fall" back to their normal or ground state and release the extra energy. When the energy released is in the visible light range, a flash of color can be seen. The color of the light depends on the energy change that took place. The series of lines one can see when electron transitions from higher-energy orbits to lower ones is called the Balmer series. There are also the Lyman series (ultraviolet) and the Paschen series (infrared).

Now Louis de Broglie began to think that quantized electron orbits had characteristics similar to those of waves. He began to think that if waves can have particlelike behavior, could the opposite be true? He knew that if an electron has wavelike motion and is restricted to circular orbits of fixed radius, the electron is allowed only certain possible wavelengths, frequencies, and energies. Developing his idea, de Brogile derived an equation for the wavelength (λ) of a particle of mass (m) moving at velocity (ν). Planck's constant (h) is 6.626×10^{-34}J *s

$$\lambda = h/m\nu$$

Problem:

Can particles of matter, including electrons, behave like waves?

Purpose:

- Observe emission spectra of hydrogen gas
- Draw Chart of emission spectra
- Use Louis de Brogile's equation
- Compare answers to the electromagnetic spectrum to identify with proper color

Hypothesis:

If each line from hydrogen's atomic emission spectrum is used in the de Brogile equation and its answer is compared to the electromagnetic spectrum then the wavelength (form the de Brogile equation) will match the color on the electromagnetic spectrum.

Materials:

Hydrogen Spectrum tube	Spectrum Tube Power Supply
Spectroscope	Calculator
Colored Pencils	Chemistry Text Book
Paper	

Safety:

For this lab goggles do not have to be worn in order to look through the spectroscope and see hydrogen's emission spectrum. However use care around the spectrum tube power supplies because spectrum tubes will get hot when used. Allow to cool for several minute after use.

Pre-Lab:

1.) Read entire Lab.
2.) What happens to some atoms or ions when heated at high temperatures?
3.) What is an emission spectrum?
4.) What is Planck's constant?
5.) Prepare Data Table

Procedure:

1.) Put hydrogen tube in the spectrum tube power supply.
2.) Turn on power supply.
3.) Look at the glowing hydrogen tube through the spectroscope.
4.) Use colored pencils to make drawings in the data table of the spectra observed.

Analysis:

1.) From the observations you gathered in the data table look in you chemistry book to find the numerical value of the four distinct colored lines of hydrogen and write them down.
2.) These values in question 1 are your wavelengths, now use this to plug into de Brogile's equation along with the atomic mass of hydrogen and Planck's constant. Solve for each line of color emitted.
3.) Compare the frequencies found with an electromagnetic spectrum, what do you observe? How do the values you obtained relate to de Brogile's observations on electrons?

Conclusion:

1.) Why do only certain colors appear in an elements atomic emission spectrum?
2.) Based on your data was your hypothesis correct? Explain.
3.) Does your data make sense based on your research? Explain.
4.) What further experiments could you do to support your findings?
5.) What questions do you still have about this topic?

Error:

1.) What sources of error did you encounter in your investigation?
2.) How did these sources of error affect your data?
3.) How can stated sources of error be eliminated?

Real World Chemistry:

1.) How can the emission spectra be used by the Hubble space telescope to study the structures of stars or other objects found in deep space?

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Teacher answer Key

Pre-Lab Answers:

2.) When atoms or ions are heated to high temperatures, some electrons may absorb enough energy to "jump" to higher energy levels. These electrons are said to be in an excited state. Because this is an unstable state, the electrons will "fall" back to their normal or ground state and release the extra energy. When the energy released is in the visible light range, a flash of color can be seen. The color of the light depends on the energy change that took place.
3.) An emission spectrum is of an element is the set of frequencies of the electromagnetic waves emitted by atoms of the element.
4.) Planck's constant is 6.626×10^{-34} J *s
5.) Data Table looks like:

Drawing of Emission Spectra

Hydrogen	