## Diffraction - Hydrogen Spectrum

**Name** _____ **Date** _____

$$m\lambda = d\sin\theta$$

### Part 1: Find the wavelength of a laser

Use a laser to demonstrate the diffraction pattern when the light passes through a known diffraction grating (530 lines/ mm).

Measure the distances from the slide to the screen (x) and between the zeroth and first bright fringe of the pattern (y). Use $\text{Tan}^{-1}(y/x)$ to solve for θ.

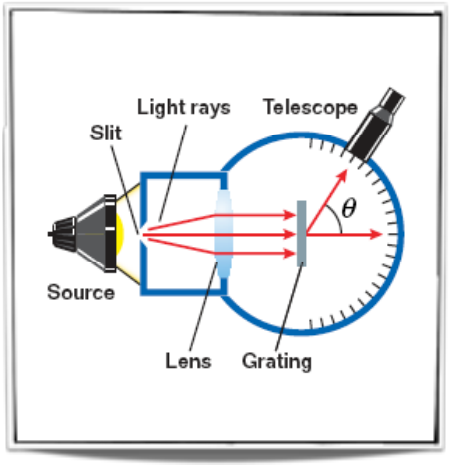
Solve for the wavelength of the laser.

### Part 2: Find the diffraction separation for your spectrometer

Switch the diffraction grating from the known slide to the spectrometer grating.

Measure the distances from the slide to the screen (x) and between the zeroth and first bright fringe of the pattern (y). Use $\text{Tan}^{-1}(y/x)$ to solve for θ.

Using the known wavelength of the laser, solve for the grating separation of the spectrometer.

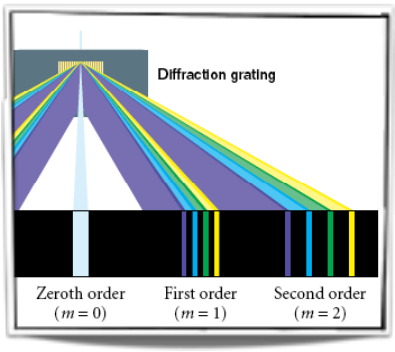



**Grade**

## Diffraction - Hydrogen Spectrum

**Name** _____ **Date** _____

### Part 3: Find the wavelengths for the first series of hydrogen emission lines.




Observe the spectrum of excited hydrogen electrons.

Use the spectrometer to find the angles for the first bright fringes of each color. If you find two lines nearly violet, try to get both angles.

Use the value of d that you found in step 2 to calculate the wavelength of the observed colors and compare them against the known wavelengths.

| | d | θ | $\lambda_{exp}$ (nm) | $\lambda_{known}$ (nm) |
|---|---|---|---|---|
| **Violet** | | | | 410/434 |
| **Cyan** | | | | 486 |
| **Red** | | | | 656 |

### Part 4: Find the energy levels for the first series of hydrogen emission lines.

$$E = \frac{hc}{\lambda}$$

speed of light

**c = 3.0 x $10^{8}$ m/s**

Planck's Constant

**h = 4.136 x $10^{-15}$ eV s**

**1 eV = 1.602 × $10^{-19}$ J**

Use the known and experimental wavelengths of the colors to calculate the energy of the photons responsible for the colors.

| | $E_{exp}$ | $E_{known}$ |
|---|---|---|
| **Violet** | | |
| **Cyan** | | |
| **Red** | | |

**Grade**

## Diffraction - Hydrogen Spectrum

**Name** _____ **Date** _____

### Part 4: Demonstrate the shell levels to match the known values of energy transitions

Complete the binding energy information for the 3rd through 5th shells.

Determine what shells are involved in the release of the three photons that showed as red, cyan, and violet bands.

**$E = 13.6\ eV / n^2$**

| | | | |
|---|---|---|---|
| O Shell | (n = ) | _____ | (E= ) |
| N Shell | (n = ) | _____ | (E= ) |
| M Shell | (n = ) | _____ | (E= ) |
| L Shell | (n = 2 ) | _____ | (E= 3.4 eV ) |
| K Shell | (n = 1 ) | _____ | (E= 13.6 eV ) |

### Summary

**Violet**

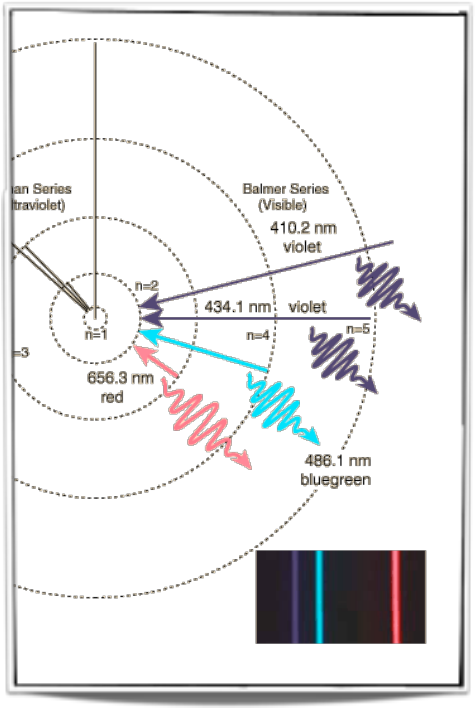
_____ eV is released when electrons fall from the _____energy level to the _____energy level of the Hydrogen atom.

**Blue-green**

_____ eV is released when electrons fall from the _____energy level to the _____energy level of the Hydrogen atom.

**Red**

_____ eV is released when electrons fall from the _____energy level to the _____ energy level of the Hydrogen atom.




**Grade**