Diffraction - Hydrogen Spectrum

Name _____ **Date** _____

Source Notes:

This lab was modeled after the “Measuring the Wavelengths of Light Waves” lab #36
“Laboratory Physics”, Murphy Doyle, Merrill, 1990.
ISBN 0-675-02477-3

Jim Haine - Wissahickon High School, Ambler PA.
1997(?)
Modified 2010

Teacher Notes:

Modifications:

This version of the lab also looks at the emission spectrum of hydrogen and was designed to use a classic classroom grating spectrometer.

Grade

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Part 1 Purpose:

Find the wavelength of a laser

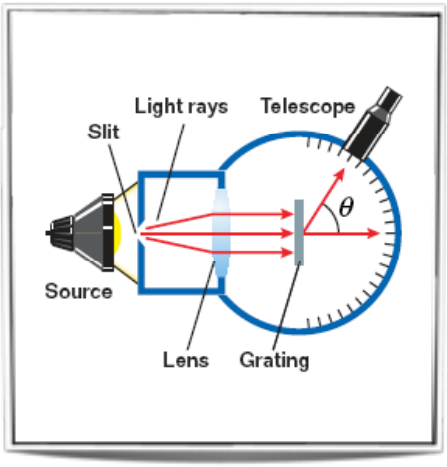
$$m\lambda = d\sin\theta$$

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 and between the zeroth and first bright fringe of the pattern. Solve for θ.

Solve for the wavelength of the laser.

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 and between the zeroth and first bright fringe of the pattern. Solve for θ.



Now that you know the wavelength of the laser, you can solve for the separation of the spectrometer grating.

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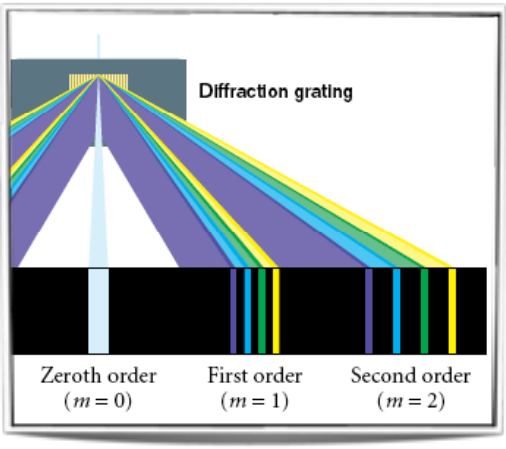
Part 2 Purpose:



- To observe the spectrum of excited hydrogen electrons
- To calculate the wavelength of the observed colors and compare them against the known wavelengths.
- To use the known wavelengths of the colors to calculate the energy of the photons responsible for the colors.
- To use the calculated energies to determine the electron transitions (what shells are involved) Find the wavelength of a laser and the diffraction separation for your spectrometer

	d	θ	λ_{exp} (nm)	λ_{known} (nm)
Violet				**410/434**
Cyan				**486**
Red				**656**

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

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

	E_{exp}	E_{known}
Violet		
Cyan		
Red		

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Determine what shells are involved in the release of the three photons (as determined on the first page).

$E = 13.6\ eV / n^2$

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

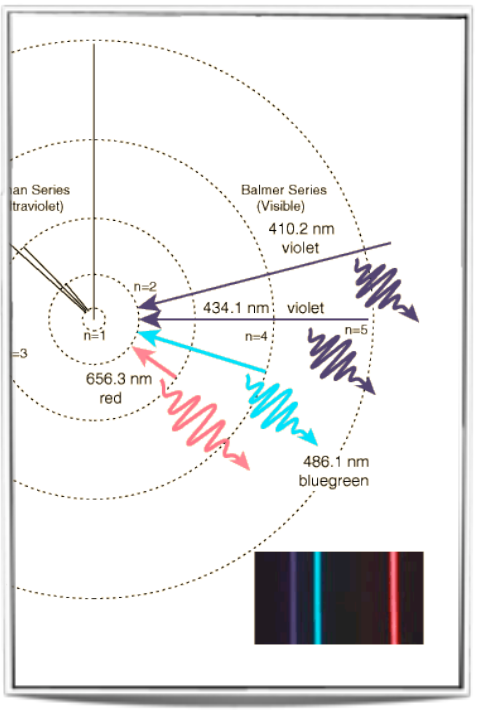
_____ eV is released when electrons fall from the _____energy level to the _____energy level of the Hydrogen atom.

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