Name: __________________________ Partner(s): __________________________

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PRE-LAB #10

EMISSION SPECTRUM OF ELEMENTAL GASES

Before starting the laboratory session, be sure read *Investigation #10: Emission Spectrum of Elemental Gases*. You may also need to review some concepts of interference and diffraction. Then answer the following questions:

1. Consider four photons of light: a green photon, a red photon, a blue photon, and an orange photon. Rank these four photons (greatest first) according to…

   a) …their wavelengths:

   b) …their velocities:

   c) …their energies:

   d) …diffraction angle in the grating spectroscope:

2. Which element will you use to <u>calibrate</u> the optical grating spectroscope?

3. You will use the optical grating spectroscope to determine what physical constant?

4. You are looking for the points of maximum constructive interference from four colors of light, green, red, blue and orange. In what order will you see the colors in your spectrometer if you start at 0^0 (straight-on) and rotate the spectroscope arm clockwise? (See Fig. 1.)

5. Assume you are looking at a gas that emits three different wavelengths of visible light: green, orange and red light. If you see constructive interference from red light at 20^0 from straight-on, what color will you see next if you continue to increase the angle?

6. By equating the Coulomb force to the centripetal force:

$$\frac{e^2}{4\pi\varepsilon_0 r^2} = \frac{mv^2}{r}$$

and then applying the quantum restriction to the angular momentum, show that the allowed orbital radii are given by

$$r_n = \frac{\varepsilon_0 h^2 n^2}{\pi m e^2}, \ (n = 1, 2, 3, \ldots)$$

7. By using the result above for the allowed orbital radii and applying energy conservation ($K + U = E$), show that the total energies of the allowed orbits is given by

$$E_n = -\frac{me^4}{8\varepsilon_0^2 h^2 n^2}, \ (n = 1, 2, 3, \ldots)$$