# Challenge Problem 2a & 2b:

# Assignments from Space

(12 mole bucks total)

**Must show work.**

**Drop dead date 9/20/11**

## Challenge Problem #2a (6 mole buck pts)

Two sets of emission lines are recorded by NASA’s orbiting Hubble Space Telescope while studying the light emanating from the Cygnus 4 star cluster. Set #1 is very strong while set #2 is very weak.

a) **Assign the spectra for set #1, e.g., determine what the initial and final quantum numbers (n­initial and nfinal) are for all the lines in set #1 assuming Bohr’s theoretical relationship for H atoms below, which connects emission line wavelength, λ, with initial and final quantum states ninitial and nfinal**.

**1\_** = 0.010973 (1/nfinal2  - 1/ninitial2)

λ(nm)

**set #1**

**observed line wavelength, nm relative intensity of line\* ninitial nfinal**

97.208 5

102.524 10

121.510 100

486.042 3

656.156 7

1874.731 1

**\*assumes maximum intensity line of set #1 = 100**

hint: this is a spectroscopist’s guessing game known as `line assignment’. Trial and error is involved.

challenge problem #3 (continued)

**Challenge Problem #2b (6 mole buck pts)**

**Drop dead date 9/20/11**

**b)** One-electron elements with more than one proton, e.g. Z protons, will emit lines according to the Bohr model with wavelengths in nm as below:

**1\_** = 0.010973 (1/nfinal2  - 1/ninitial2) for atoms with Z protons and 1 electron

λ(nm) Z2

**Predict what element is producing the weak set of lines (set #2) below. I will not accept a guess. You must demonstrate why you conclude what you do**.

**set #2**

**observed wavelength, nm relative intensity\***

388.832 0.05

410.096 0.10

486.04 1.0

1944.168 0.03

2624.624 0.07

7498.924 0.01

**\*assumes maximum intensity line of set #1 = 100**