Dr. Lankar assignment 5 fingerprints of atoms NAME ____________

1) source: http://cas.sdss.org/dr7/en/

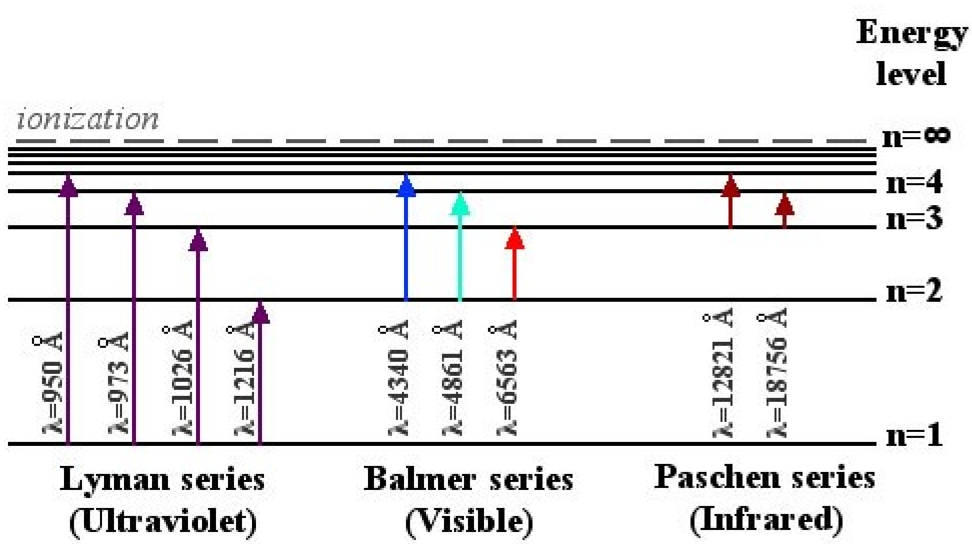
Even though hydrogen has only one electron, the electron can jump between many different energy levels. The table below shows the wavelength of light that will be emitted or absorbed for a transition between one energy level and another. Read the table by reading down from one level at the top and to the right from one level at the left. For example, a transition between n=2 and n=1 requires that a photon of wavelength 1216 Ångstroms (A) be emitted or absorbed. 1A = 10^{-10} m so 1216 A = 121.6 nanometers 9or nm =0.0000001216 meters

table1:

	n=1	n=2	n=3	n=4	n=5
n=1	-	1216 Å	1026 Å	973 Å	950 Å
n=2	-	-	6563 Å	4861 Å	4340 Å
n=3	-	-	-	18,756 Å	12,821 Å

The graph below is another way of presenting the information in the table. The label on the y-axis shows the energy level. The arrows show the jumps in energy level for possible electron transitions.

Picture2:

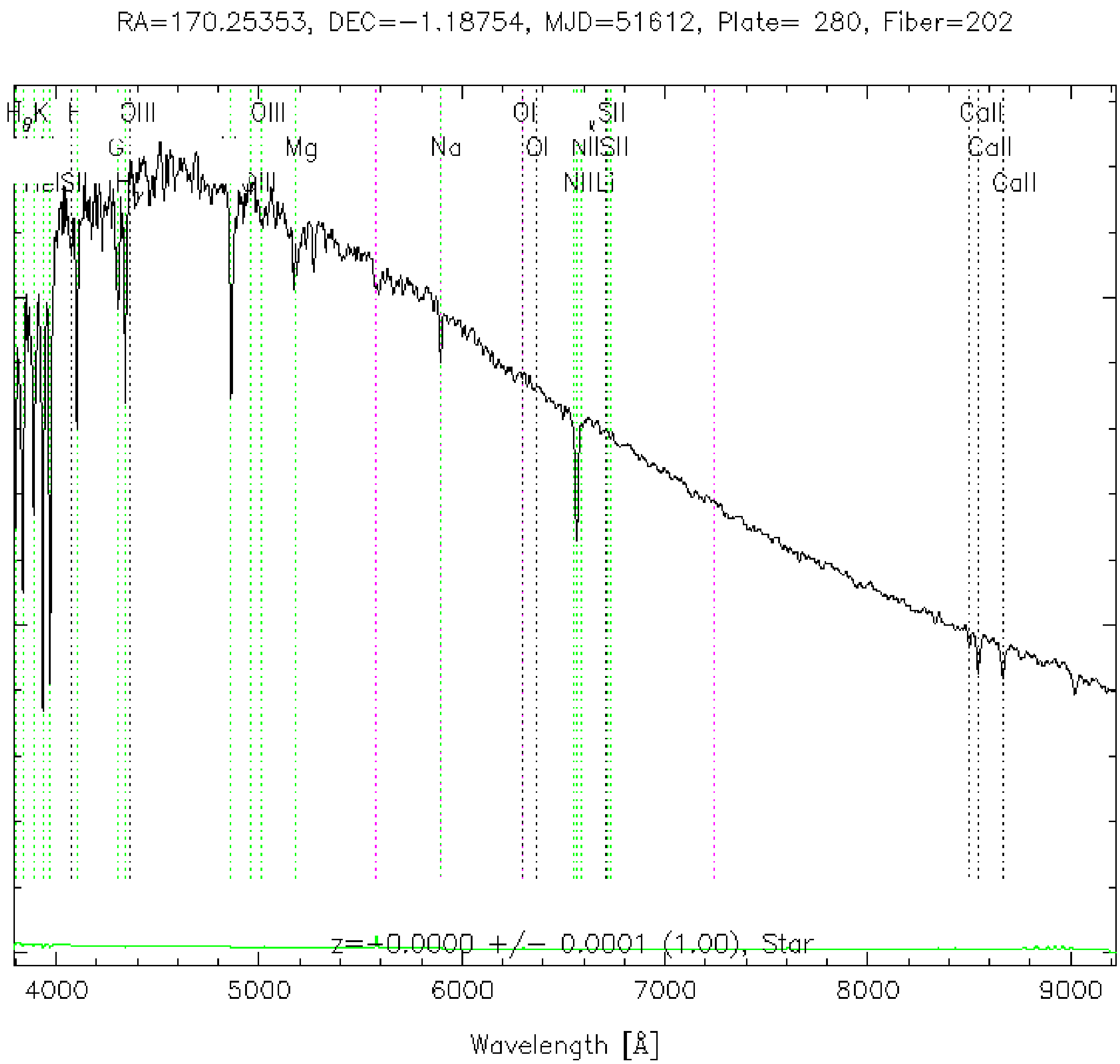


The transition that is most useful to astronomers is the one in the middle, with electrons jumping up from n=2 or down into n=2. These transitions are called the **Balmer** series, after the physicist who first studied them. The reason that they are so useful is that the wavelengths emitted or absorbed are wavelengths of **visible light**.

How does this apply to star spectra?

Below is the spectrum of a typical star. The valleys indicate a deficit in light so it shows the wavelengths of the absorption lines. Each line corresponds to a transition inside an element like hydrogen, sodium, magnesium..
It is by looking at these spectra that we know what stars are made of.

Each pattern of deficits is produced by an element. You should be able to identify the deficits corresponding to the Balmer serie. The deficit at 6500 A (transition from 3 to 2) is called **Hα** (hydrogen-alpha).



The transition from 2 to 4 (see table to find the wavelength) is called **Hβ** and the transition 2 to 5 is called **Hγ.**
Can you identify the lines on the graph and label them **Hα or Hβ or Hγ on the graph**

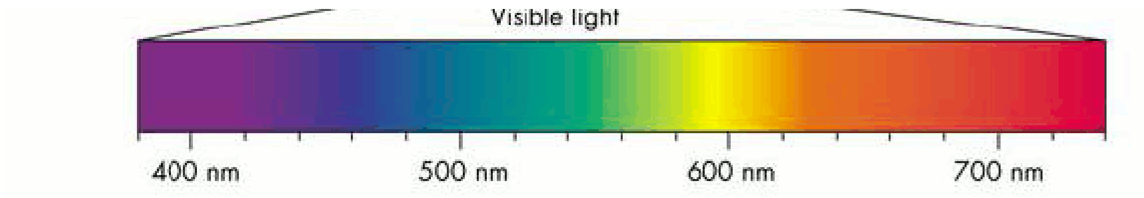
Look at the continuum spectrum of light in picture 3 below (without lines).
The scale is in nanometers. So you need to add a 0 to get the scale in Angstroms(like in the table and pictures above).
Use the picture 3 to find the color of the transitions (use the wavelength of the transitions in table1)

2 to 3

2 to 4

2 to 5

picture 3: .



A) When an electron jumps from level 2 to level 1 it emits a photon. Refer to the picture 1 or table 1 to find the wavelength of this photon and its color. Can we see that color?

B) Convert this wavelength to meters.

C) The energy of the photon emitted is given by the formula :

$$\text{Energy of photon} \quad E = h\,\nu = h\,\frac{c}{\lambda}$$

λ is the wavelength of the photon in meters

h is the Planck's constant = 6.626 × 10-34 m2 kg / s (about)

c is the speed of light = 3 10^8 m/s

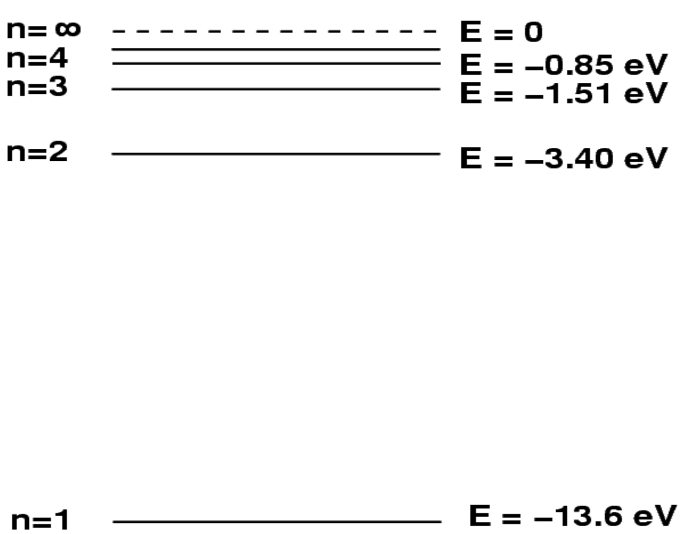
Find the energy of the photon emitted during the transition. The units is joules.

D) Keep all the decimals in your calculator and divide by 1.6 10^{-19} J/eV to get the energy in electron volts.
I it easier to use this unit, electron volts or eV, because you get rid of the scientific notation.
Round to the nearest decimal.

E) The picture 4 below show the energy levels for the hydrogen atoms.

Picture4

When the electron jumps from 2 to 1 a photon is emitted. The energy of the photon is equal to the different between the energy levels. Compute the difference in eV.



Is it about the same thing that found in D ?

3) same questions as 2) but for transition 1 to 3 (use a different paper).