Jillian's quick review sheet

From the exam:

Seasons

You understood that the tilt of the Earth's rotation axis causes the seasons. However, it is not because the summer hemisphere of the Earth is then closer to the Sun than the winter hemisphere. The distance change is so small it doesn't affect anything.

The reason the tilt makes a difference is that during the summer the Sun will be in the sky longer. Also, the Sun will be higher in the sky, meaning the rays strike the Earth almost perpendicularly, compared to striking the Earth at an angle during the winter. (You've experienced this when you warm yourself up at a fire: to warm up your hands the fastest, you make sure your palm faces the fire and isn't tilted away.)

From the last homework:

Quantum mechanics (the Bohr model)

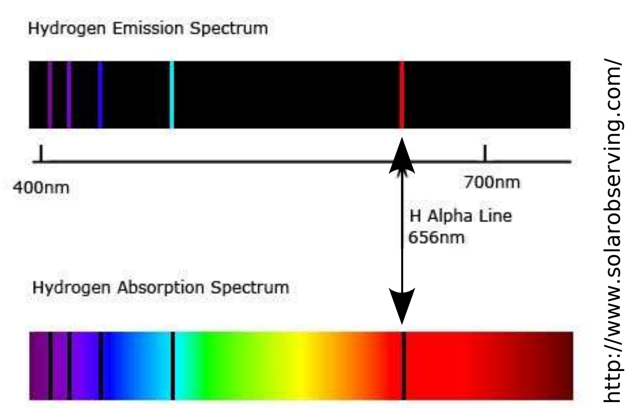
Electrons are only allowed to exist in special energy levels around an atom. The exact structure of these levels is determined by how many protons the element has. Electrons can jump between levels, but the difference in energy between the two levels must be dealt with --- the electron must absorb the exact energy difference between levels when going to a higher level and emit it when going to a lower one.

Energy comes in packets called photons. The more energy a photon has the shorter its wavelength. Since an electron jumping levels only emits/absorbs photons with specific energy, the atom only interacts with photons of specific wavelengths.

Each element has a unique pattern or list of the wavelengths its electrons can interact with, and these wavelengths can range across the entire electromagnetic spectrum (radio, microwave, infrared, visible, ultraviolet, X-ray).

Emission/absorption spectrum (sharp peaks only at certain colors)

This applies for less dense objects like gas clouds and the atmospheres for stars.



If the gas is **hot**, the atoms in the gas **emit** light at the special wavelengths associated with the element. The spectrum will have no light except for bright peaks at those special wavelengths.

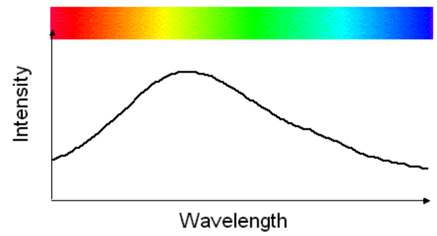
If the gas is too **cold** to emit light on its own, and **light shines through** the gas, the atoms in the gas **absorb** light at the special wavelengths associated with the element. The spectrum will be the same as the light that shone on the gas but with dark peaks at those special wavelengths.

However, if the gas is too **cold** and **no light shines through** it, nothing really happens.

This is all good for gas.
What happens when you look at denser things?

Blackbody/continuum spectrum (smooth smear of colors like a rainbow)

This applies to dense objects like people, planets, and the insides of stars. The spectrum only depends only on how hot the object is, and any dense object with a temperature above absolute zero will emit blackbody radiation.

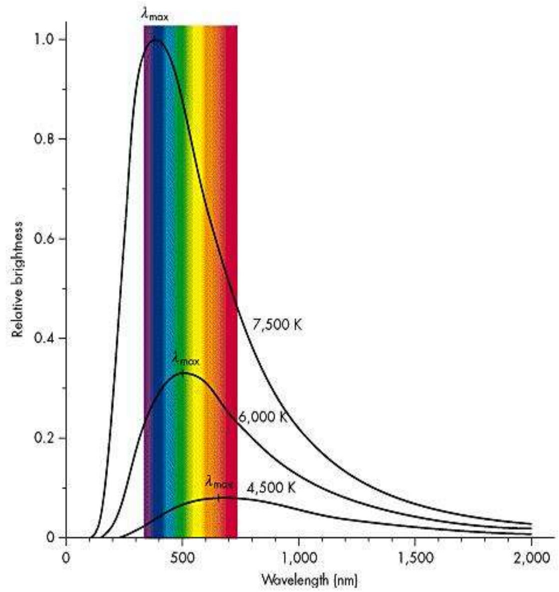


http://www.astro.bas.bg/~petrov/herter00.html#lect09

The **hotter** the object, the **shorter the peak wavelength** and the more energy is emitted at shorter wavelengths.

The **cooler** the object, the **longer the peak wavelength** and the more energy is emitted at longer wavelengths.

The spectrum always has that humpy-curve shape with a peak at a certain wavelength, and it can range the entire electromagnetic spectrum. **Each temperature has a unique peak wavelength**. Humans' spectra peak in the infrared, the Sun's in the visible.



http://www.astro.washington.edu/labs/clearinghouse/labs/Spectclass/spectralclassweb.html

Just one more thing ...

Doppler shift

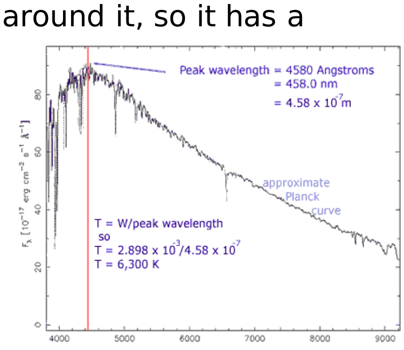
Only use this when stuff is **moving either toward or away from you** (radial motion). That radial motion causes in shift in wavelength of all the light the object emits. This is handy if you identify a spectral line. Compare the wavelength of the line observed from the moving object to the wavelength of the line from the element sitting in a lab and not moving. This comparison gives you the speed at which the object is moving toward or away from you.

Apply all of this to astronomy ...

What can we learn about stars from their spectra?

A star is like a blackbody with a thin shell of gas around it, so it has a blackbody spectrum with some absorption lines.

1) We can measure the **peak** of the blackbody spectrum to get **temperature** of star.
2) We can identify spectral **emission and absorption lines** to determine the star's **composition**.
3) We can look for the **Doppler shift** of the spectral lines to determine if the star has any **motion** toward or away from us.



http://outreach.atnf.csiro.au/education/senior/astrophysics/spectra_info.html