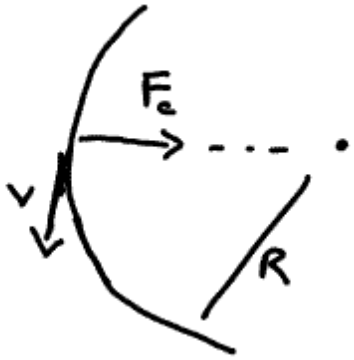
Physics 102 – Spring 2014 – Recitation module 6

Briefly defend or refute the statement, "astronauts in the space station are in a weightless environment."

For an object to move on a circle, there must be a net force toward the center of the circle, $F_c=mv^2/R$, where Fc is the force toward the center (called the centripetal force), m is the mass of the object, v is the speed tangent to the circle, and R is the radius of the circle.



If you were the commander of the space shuttle, how would you point your rocket nozzle to move to a higher orbit if asked to do so by NASA?

What supplies the centripetal force for a speedskater going around a curve?

For a given set of road conditions, what happens if you take a curve too fast? If you take too sharp a curve? Why?

Your TA will supply you with a length of fishing line with masses attached to each end. The fishing line passes through a tube. Design and perform an experiment that confirms the mathematical formula for centripetal force given above.

In the Bohr model of the atom, what is the force that acts as the centripetal force?

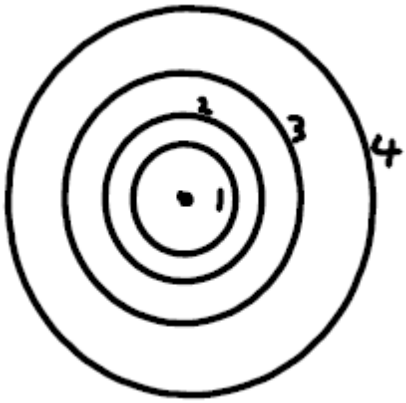
In the Bohr model of the atom, what happens to the elecron when the atom absorbs a photon? What happens to the electron when the atom emits a photon?

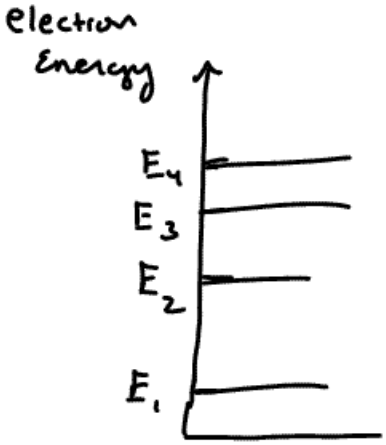
Below is a schematic diagram of an atom which four different states (or orbits) in which the electron could exist. Next to it is a graphical representation of the electron energy in each possible state … E1<E2<E3<E4.

Let E1=-13.6eV, E2=-3.4 eV, E3=-1.5 eV, and E4=-0.85 eV.

The negative signs mean that the electron is bound in the atom. It takes 13.6 eV in energy to free an electron in orbit 1, for example.

Planck's constant, h= 4.1×10^{-15} eV-seconds.



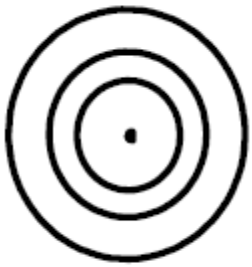


What is the highest frequency light emitted by the atom?

What is the lowest frequency light emitted by the atom?

What part of the electromagnetic spectrum will these "spectral lines" be found? (See Hobson, [p. 198 in 4th ed.] for a useful table.)

An atom has three possible energy states in which the electron could exist. How many spectral lines could be emitted by this atom?



Which has a lower energy: a photon of red light or a photon of blue light? Why?

How does the speed of an x-ray compare to the speed of blue light?

What limits how small an object can be imaged by an optical microscope?

Can you estimate the size of the smallest object that can be imaged by a visible light microscope?

In an "electron microscope" a beam of electrons plays the role of light in a normal optical microscope. If the electron beam energy can be as high as 400 keV, how small an object could an electron microscope image?