Astronomy 160b - Spring 2007

Problem Set #2 — due February 1, 2007 in class

I. (15 points total) On the Exoplanets site (see links on Astr 160 website) you can find information on the proposed Rocky Planet Finder telescope (click on "Rocky Planet Search" on the home page of http://exoplanets.org). To quote the site, this telescope "will enable a Doppler precision of 1 m/s" and will thus be able to observe stellar velocities induced by planets of 1 m/s or greater.

1) (2 points) How big a shift in the wavelength of green light will this instrument be able to detect?

2) (2 points) Show that, for a nearly circular orbit, $a = GM/V^2$, where V is the total velocity of the system ($V = V_{planet} + V_{star}$).

3) (2 points) In question 2, why is it important to specify that the orbit is nearly circular?

4) (3 points) Suppose you observe a Sun-like star with a planet in an Earth-like orbit. How massive does the planet have to be for it to be detected by the Rocky Planet Finder?

5) (3 points) What is the maximum orbital period and semi-major axis of an Earth-like planet that could be detected by the Rocky Planet Finder?

6) (3 points) Given the results you have obtained, evaluate the claim that "the Rocky Planet Finder permits the detection of planets of 1-20 Earth masses." (Fun fact: the radius of the Sun is 7×10^8 meters).

II. (5 points) Arguments that there are likely to be many instances of life ("as we know it") throughout the Universe tend to depend on the premise that there are lots of Earth-like planets in Earth-like orbits for such life to evolve on. To what extent are arguments of this kind strengthened or weakened by the discovery of Hot Jupiters?