

**Astronomy 45**  
**Introduction to Astrophysics**

Problem Set 6 Due March 23, 2001

1. A satellite is in a geosynchronous orbit with an orbital period of one day. At what altitude is it located? (The mass of the Earth is  $6.0 \times 10^{24}$  kg.) Compare the escape velocity at the satellite altitude with the escape velocity from the Earth's surface. (The radius of the Earth is  $6.38 \times 10^3$  km.)
  
2. The distance of the Earth from the Sun varies from  $1.471 \times 10^8$  km to  $1.521 \times 10^8$  km. What is the eccentricity of the Earth's orbit?
  
3. Show (i) that in a family of elliptical orbits with a constant energy, the circular orbit has the most angular momentum.  
Show (ii) that in a family with a constant angular momentum, the circular orbit has the most binding energy.
  
4. What critical speed is needed to launch a spacecraft targeted to Mars from (i) the surface of the Earth and (ii) an altitude of 320 km?