

Astronomy 45
Introduction to Astrophysics

Problem Set 6 Due November 2, 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 6.0×10^{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 6.38×10^3 km.)

2. 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.

3. 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? Mars lies at a distance of 1.52 AU from the Sun. The mass of the Earth is 6.0×10^{27} g and its radius is 6.38×10^3 km.

4. Two small bodies, each of mass m , lie at a small distance d from each other, on a line with a large body of mass M at a large distance R from the midpoint of the two small bodies. What is the distance d at which the gravitational attraction of the small bodies is matched by the differential gravitational force caused by their attraction to M ?