Physics 1135 Homework for recitation 13: Universal gravitational force

1. The Moon has a radius of 1.74×10^6m. It is orbiting the Earth at a distance of 3.84×10^8m, taking 27.3 days for a complete revolution. The free-fall acceleration on Moon is 1.62 m/s^2. From the information given, find the mass of the Moon and the mass of Earth.

2. The center of a moon of mass m is a distance D from the center of a planet of mass M. At some distance x from the center of the planet, along a line connecting the centers of planet and moon, the net force on an object will be zero.
a) Derive an expression for x in terms of m, M, and D.

b) If the net force is zero a distance ⅔D from the planet, what is the ratio R of the mass of the planet to the mass of the moon, M/m?

3. A geosynchronous satellite moves in a circular orbit around the Earth and completes one circle in the same time T during which the Earth completes one revolution around its own axis. The satellite has mass m and the Earth has mass M and radius R. In order to be geosynchronous, the satellite must be at a certain height h above the Earth's surface.
Derive an expression for h in terms of m, M, R, T and constants and find a numerical value. Earth's mass and radius can be found in your textbook.

4. **Binary Star**. Two identical stars of mass M orbit around the center of a circle with radius R. The stars are always on opposite sides of the circle as shown.

Derive expressions for the orbital speed and the orbital period of each star.