Extrasolar Planets

1. Consider a planet orbiting a star where the mass of the planet m_p is much less than the mass of the star M_s so $m_p \ll M_s$. What is the Lagrangian for the system? If the planet follows a circular orbit, then show

$$r = \left[\frac{GT^2M_s}{4\pi^2}\right]^{1/3}$$

where T is the period of the planet's orbit and r is the distance from the star to the planet.

2. For a planet orbiting a much heavier star, show the distance from the planet to the center of mass is

$$r_p = \frac{M_s}{M_s - m_p} r$$

where r is the distance from the planet to the star, M_s is the star's mass, and m_p is the planetary mass.

3. In August 2004, observations of the star μ Arae revealed an oscillatory structure with a period $T = 9.5 \ days$ shown in the figure. From its spectral type the mass of μ Arae is 1.10 solar masses. What is the minimum mass of this planet and its distance from μ Arae? How does this mass compare with planets in our solar system?

