Homework Assignment 2 (due 12 noon, Fri Sep 23rd)

This assignment is composed of the following questions from Chapter 2 of *An Introduction to Modern Stellar Astrophysics*, augmented with some supplementatry questions:

- Q2.1
- Q2.2
- Based on your answer to Q2.2, confirm that

$$\int_0^{2\pi} \frac{d\theta}{(1+e\cos\theta)^2} = 2\pi(1-e^2)^{-3/2}, \tag{1}$$

  as claimed in class. **HINT:** Start by deriving *in polar coordinates* an integral expression for the area of an ellipse
- Q2.8
- Q2.12
- Q2.14
- Q2.15. To help with the calculations, I've created a web interface for the `ORBIT` computer program; you can access this interface at `http://www.astro.wisc.edu/~townsend/static.php?ref=oc-web`.
- Starting from the radial equation of motion,

$$\mu(\ddot{r} - r\dot{\theta}^2) = -G\frac{M\mu}{r^2} \tag{2}$$

  derive the result

$$r = \frac{L^2}{GM\mu^2(1+e\cos\theta)} \tag{3}$$

  HINTS: (i) Use conservation of angular momentum to eliminate $\dot{\theta}$; (ii) Use the identity $d/dt = \dot{\theta}d/d\theta$ to re-express time derivatives as derivatives with respect to θ; (iii) use the substitution $u = 1/r$ and solve first for u.