

PHYSICS 331 ADVANCED CLASSICAL MECHANICS  
Problem Set 25

*Problem 1*

Thornton and Marion: Chapter 8, Problem 10.

*Problem 2*

- (a) By examining the effective potential energy,  $U_{eff}$ , determine the radius by which a planet (or periodic comet) with angular momentum  $\ell$  can orbit the Sun in a circular orbit with fixed radius. Hint: Think about what  $\frac{dU}{dr}$  tells you.
- (b) Show that the circular orbit is stable, in the sense that a small radial nudge will cause only small radial oscillations. Show that the period of these oscillations is equal to the planet's orbital period. Look at  $\frac{d^2U}{dr^2}$ .

*Problem 3*

We showed that the trajectory of any object under the influence of an inverse square central force can be expressed as

$$r(\phi) = \frac{c}{(1 + \epsilon \cos \phi)},$$

where  $c > 0$  and  $\epsilon > 0$ . For the case that  $0 \leq \epsilon < 1$ , rewrite this polar equation in rectangular coordinates  $(x, y)$  and show that the equation can be cast in the form of an equation for an ellipse:

$$\frac{(x + d)^2}{a^2} + \frac{y^2}{b^2} = 1$$

and that

$$a = \frac{c}{1 - \epsilon^2}, \quad b = \frac{c}{\sqrt{1 - \epsilon^2}}, \quad \text{and} \quad d = \epsilon a.$$

*Other Things*

Skim sections 9.1–9.8 of our text. This deals with material that we discussed during the first weeks of class. Please remember to submit your journal entry.