1) **Text Problem 8.3** – assume that at the instant $k$ changes, both $r$ and $v$ have the same values that they did in the circular orbit.

2) An object moves along a trajectory given by the equation $r(\theta) = a(1+\cos \theta)$, where $a$ is a constant. Show that the force law responsible for this behavior is

$$F(r) = -\frac{\alpha}{r^4}$$

and find the constant $\alpha$ in terms of $a$ and the object's angular momentum $\ell$ and mass $m$.

3) An object of mass $m$ moves in a circular orbit under the influence of an harmonic oscillator potential given by $U(r) = \frac{1}{2}\alpha r^2$, where $\alpha$ is constant and $r$ is measured from the center of the circle.

a) Since the center of the circular orbit and the force center coincide, the force must always be directed radially inward toward the center of the circle. Use this fact to show that the orbital period is independent of the radius of the orbit.

b) Determine the energy of the orbiting object and its angular momentum as functions of the orbital radius $r$.

4) An object moves under the influence of a *repulsive* force given by $F(r) = \frac{\alpha}{r^3}$, where $\alpha$ is a constant.

a) Show that the trajectory of the object has the form

$$\frac{1}{r} = A \cos[\beta(\theta-\theta_o)]$$

where $A$, $\beta$, and $\theta_o$ are constants. Determine the constant $\beta$ in terms of $\alpha$ and the object's angular momentum $\ell$ and mass $m$.

b) Suppose that $r=r_o$ and $\theta=\theta_o$ at time $t=0$. Derive an expression for the particle's energy $E$ in terms of $\alpha$, $\ell$, $m$, and $r_o$. 
5) **Text Problem 8-20** – it's useful in this problem to change the variable in the time average integral from the time to the angle around the orbit.

6) **Text Problem 8-27** – the simplest approach here is to find a relationship between the velocities at apogee and perigee in terms of \( r_{\text{min}} \) and \( r_{\text{max}} \).

7) Halley's comet moves in an elliptical orbit around the sun with eccentricity \( \varepsilon = 0.967 \). Its distance from the sun at perihelion is \( r_{\text{min}} = 8.9 \times 10^7 \) km.
   
   a) Find the distance of Halley's comet from the sun at aphelion.
   
   b) Determine the speeds of Halley's comet at aphelion and perihelion.
   
   c) Calculate the orbital period of Halley's comet.