2. A particle of mass m moves under the influence of an attractive central force with potential $V(r)$.

   (a) Suppose the particle to move in a circular orbit with angular momentum ℓ. Derive the condition that determines how the orbit radius r_ℓ depends on ℓ.

   (b) Now consider a small perturbation $\delta r(t)$ around such a circular orbit. What is the condition that must be met for this perturbation to oscillate with a real frequency ω_ℓ (in which case the perturbation will not grow with time and the circular orbit will be stable)?

   (c) Now consider the special case $V(r) = -k/r^n$ with $n > 0$. For what values of n and ℓ are circular orbits stable (i.e. such that $\omega_\ell^2 > 0$)?

   (d) Are there any circumstances where the period of the circular orbit matches the period of small radial oscillations about the circular orbit. If so, what does this equality imply for the long-time trajectory of the particle?