16.1 For the linear potential, $V(r) = \frac{1}{2} m\omega_0^2 r^2$. It is easy to show that for a particle moving on this potential, its kinetic energy coincides with the potential energy. Therefore, $E = m\omega_0^2 r^2$.

Then, $\frac{\partial V}{\partial r} = m\omega_0^2 r$; and $\frac{dE}{dt} = -\frac{\tau}{m}\left(\frac{\partial V}{\partial r}\right)^2 = -\frac{\tau}{m} m^2\omega_0^2 r^2 = -\omega_0^2 \tau E$,

which leads to the solution $E(t) = E(0) e^{-\Gamma t}$, with $\Gamma = \omega_0^2 \tau$.

Also, $\frac{d\vec{L}}{dt} = -\frac{\tau}{m}\left(\frac{1}{r}\frac{\partial V}{\partial r}\right)\vec{L} = -\omega_0^2 \tau \vec{L}$, which leads to $\vec{L}(t) = \vec{L}(0) e^{-\Gamma t}$

Therefore, both energy and angular momentum decay exponentially.

16.2. (a) For the electron moving on a circular orbit with radius r, its energy is $E = -Ze^2/2r$. Also, $V(r) = -Ze^2/r$. Then Eq. (16.13) leads to

$$\frac{dE}{dt} = -\frac{\tau}{m}\left(\frac{\partial V}{\partial r}\right)^2, \quad \frac{Ze^2}{2r^2}\frac{dr}{dt} = -\frac{\tau}{m}\frac{Z^2e^4}{r^4}, \quad r^2\frac{dr}{dt} = -\frac{2Ze^2\tau}{m} = -\frac{4Ze^4}{3m^2c^3}$$

The solution to the above differential equation is $r(t)^3 - r(0)^3 = -\frac{4Ze^4}{m^2c^3}t$,

which can be written as $r(t)^3 = r_0^3 - 9Z(c\tau)^3\frac{t}{\tau}$, where $r(0) = r_0$.

(b) Since $r = n^2 a_0/Z$, then $\frac{dr}{dt} = \frac{2na_0}{Z}\frac{dn}{dt} = -\frac{4Ze^4}{3m^2c^3r^2}$, or

$$-\frac{dn}{dt} = \frac{2Z^2e^4}{3m^2c^2}\cdot\frac{1}{r^2}\cdot\frac{1}{na_0} = \frac{2Z^2e^4}{3m^2c^3}\cdot\frac{Z^2}{n^5a_0^3} = \frac{2Z^2e^4}{3m^2c^3}\cdot\frac{Z^2}{n^5}\cdot\frac{m^3e^6}{\hbar^6}$$

$$= \frac{2}{3}\frac{Z^4me^{10}}{n^5\hbar^6c^3},$$

which agrees with Prob. 14.7(a)