8-14 Differentiate Equation 8-17 to get

$$\left(\frac{dr}{d\theta}\right)^2 = \frac{2\mu r^4}{l^2}\left[E - U(r) - \frac{l^2}{2\mu r^2}\right]$$

But $r = k\theta^2$ so

$$\left(\frac{dr}{d\theta}\right)^2 = (2k\theta)^2 = 4k\left(\frac{r}{k}\right) = 4kr$$

$$\therefore \quad 4kr = \frac{2\mu r^4}{l^2}\left[E - U(r) - \frac{l^2}{2\mu r^2}\right]$$

So

$$U(r) = E - \frac{2kl^2}{\mu}\frac{1}{r^3} - \frac{l^2}{2\mu}\frac{1}{r^2}$$

$$F(r) = -\frac{dU}{dr} = -\frac{l^2}{\mu}\left[\frac{6k}{r^4} + \frac{1}{r^3}\right]$$