10.2 $m = 50\,g = 0.05\,kg$

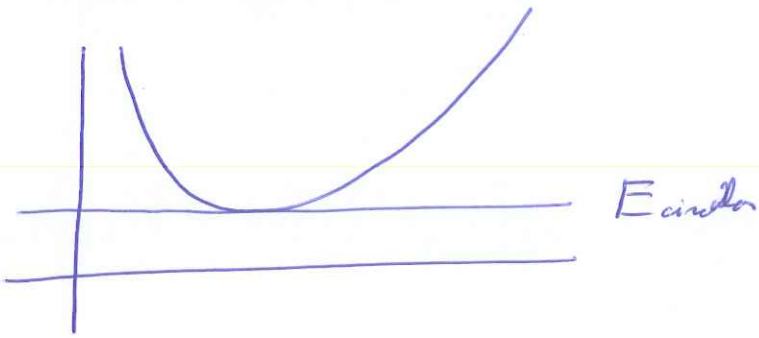
$l = 1000\,g\,cm^2/s$

$= 10^{-4}\,kg\,m^2/s$

$F = 4r^3 \times 10^{-5}\,N$

a) $U_{eff} = \frac{l^2}{2mr^2} + kr^4$ with $k = 10^{-5}\,N\,m^{-3}$

b)



c) We have

$$\frac{l^2}{2mr_0^2} + kr_0^4 = E = \frac{l^2}{8mr_0^2} + 16kr_0^4$$

$$\Rightarrow \quad \frac{3}{8}\frac{l^2}{mr_0^2} - 15kr_0^4 = 0$$

$$r_0 = \left(\frac{l^2}{40mk}\right)^{\frac{1}{6}} = 0.28\,m$$

Problem 2.

1. $l = v_0 r_- m = m\sqrt{1.8\, GMr_-}$

2. $E = \frac{l^2}{2mr^2} - \frac{C}{r} = -0.1\,\frac{GMm}{r_-}$

3. $r_0 = \frac{l^2}{mC} = \frac{v_0^2 r_-^2}{GM} = 1.8\, r_-$

$\Longrightarrow \quad \varepsilon = 0.8$