P2

(a) Newton $\hat{r}$:

$$-m r_0 \dot{\theta}^2 = \left[-m \frac{v_0^2}{r_0} = -\frac{GMm}{r_0^2} \right] \Rightarrow \boxed{v_0 = \sqrt{\frac{GM}{r_0}}}$$

Se cons. Ambas ¿Pq?

$$\boxed{\vec{L}_T = r_0 v_0 (5m - m)\hat{z} = 4m r_0 v_0 \hat{z} = 4m\sqrt{GMr_0}\,\hat{z}}$$

$$E = \frac{m}{2}v_0^2 + \frac{5m}{2}v_0^2 - \frac{GMm}{r_0} - \frac{GM5m}{r_0} = \frac{6m}{2}v_0^2 - \frac{GM6m}{r_0}$$

$$= \boxed{-3GMm/r_0}$$

(b) Se cons. $\vec{P}$ y $\vec{L}_T$; no E ¿Pq? $\Rightarrow$ $\vec{L}_T' = 4m\sqrt{GMr_0}\,\hat{z}$

$$\vec{P}_T' = 4m v_0 \hat{\theta} = 6m \boxed{\sqrt{\frac{4}{9}\frac{GM}{r_0}}\,\hat{\theta}} = \vec{v}'$$

$$\boxed{E' = \frac{6m}{2}v'^2 - \frac{GM6m}{r_0} = -\frac{14}{3}\frac{GMm}{r_0}}$$

(c) Luego del choque se conservan E' y $\vec{L}_T'$ ¿Pq?

$$E' = \frac{6m}{2}\left[\dot{r}^2 + r^2\dot{\theta}^2\right] - \frac{GM6m}{r}$$

$$= \frac{6m}{2}\dot{r}^2 + \underbrace{\boxed{\frac{L^2}{12mr^2} - 6\frac{GMm}{r}}}_{U_{eff}} \Rightarrow \boxed{U_{ef}(r) = \frac{4}{3}\frac{GMmr_0}{r^2} - 6\frac{GMm}{r}}$$

En los ptos de retroceso r_c: $U_{ef}(r_c) = E' \Rightarrow$

$$\Rightarrow 14r_0^2 - 18r_0 r_c + 4r_0^2 = 0 \Rightarrow \boxed{r_c = \begin{cases} r_0 \\ \frac{2}{7}r_0 \end{cases}}$$

$\hookrightarrow R = r_0/10 \Rightarrow$ No choca