$$KE = N\left(\frac{1}{2}mv^2\right)$$

$$N\left(\frac{1}{2}mv^2\right) = \frac{3}{5}\,\frac{GM^2}{R}$$

$$2KE + GPE = 0$$

$$2KE = -GPE$$

$$KE = \frac{3}{2}NkT$$

$$GPE = -\frac{3}{5}\,\frac{GM^2}{R}$$

$$N = \frac{M}{\mu\, m_H}$$

$$M = N\,\mu\, m_H$$

$$2\left[\frac{3}{2}\;\frac{M}{\mu\, m_H}\;kT\right] = \frac{3}{5}\;\frac{GM^2}{R}$$

$$M = \frac{4\pi}{3}R^3\;\rho$$

$$R = \left[\frac{3M}{4\pi\rho}\right]^{1/3}$$

$$\frac{kT}{\mu\, m_H} < \frac{1}{5}GM^{2/3}\left(\frac{4\pi\rho}{3}\right)^{1/3}$$

$$M_J = \left[\frac{5kT}{\mu\, m_H G}\right]^{3/2}\left(\frac{3}{4\pi\rho}\right)^{1/2}$$

$$\frac{1}{2}\,mv_{\rm esc}^2 - \frac{GM_{\rm int}\,m}{R} = 0$$