1. We decided to call the mass function of the companion \( f_c \)

\[
f_c = \frac{P_{orb} (V_{\text{e} \sin i})^3}{2\pi G} = \frac{(M_x \sin i)^3}{(M_x + M_c)^2}
\]

and use it to derive a lower limit on the mass of the compact object \( M_x \)

\[
P_{\text{orb}} = 5.6 \text{ days} = 4.84 \times 10^5 \text{ s} \]

\[
V_{\text{e} \sin i} = 7.6 \times 10^6 \text{ cm s}^{-1}
\]

\[
(M_x \sin i)^3 = 0.254 (M_x + M_c)^2 \text{ in solar mass units}
\]

Assume \( M_c = 20 \) and \( \sin i = 1 \)

Then \( M_x \geq \left[ 0.254 (20 + M_x)^2 \right]^{1/3} \)

This can be solved by iteration, or trial and error to find \( M_x \geq 5.98 \text{ M}_\odot \). If \( \sin i < 1 \), then \( M_x \) must be even larger, so it would increase confidence that \( M_x \) is a black hole.

2. Begin with angular momentum \( \mathcal{L} = \mu \sqrt{6(M_c + M_x)} \)

where \( \mu = \frac{M_c M_x}{M_c + M_x} \), and assume \( \frac{d\mathcal{L}}{dt} = 0 \), \( \frac{d(M_c + M_x)}{dt} = 0 \)

Then \( \frac{d}{dt} (\mu a^{1/2}) = 0 \)

\[
\frac{da^{1/2}}{dt} + \frac{a}{2a^{1/2}} \frac{da}{dt} = 0
\]

\[
\frac{1}{a} \frac{da}{dt} = -2 \frac{d}{dt} \left( \frac{dM_c M_x + M_c dM_x}{dt} \right)
\]

\[
\frac{1}{a} \frac{da}{dt} = -2 \frac{d}{dt} \left( \frac{dM_c M_x}{dt} \right)
\]

\[
\frac{1}{a} \frac{da}{dt} = -2 \frac{d}{dt} \left( \frac{M_c M_x}{dM_c} \right)
\]

\[
\frac{1}{a} \frac{da}{dt} = -2 \frac{d}{dt} \left( \frac{M_c M_x}{dM_c} \right)
\]