ASTR367

HW #9

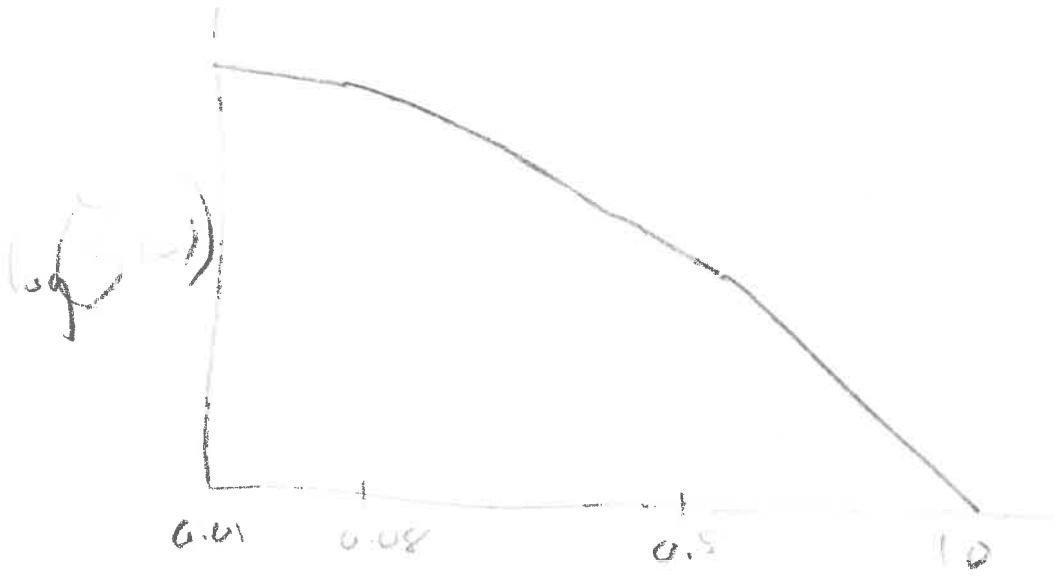
1) a) $\alpha_0 = -0.3 \pm 0.7$ $\quad 0.01 \leq m/M_\odot < 0.08$

$\alpha_1 = -1.3 \pm 0.5$ $\quad 0.08 \leq m/M_\odot \leq 0.50$

$\alpha_2 = -2.3 \pm 0.3$ $\quad 0.50 \leq m/M_\odot \leq 1.00$

$\alpha_3 = -2.3 \pm 0.7$ $\quad 1.00 \leq m/M_\odot$

$\xi(m) \propto m^{-\alpha}$



b) $N_{tot} = A \int_{0.01}^{0.08} M^{-0.3} dM + B \int_{0.08}^{0.5} M^{-1.3} dM + \left(\int_{0.5}^{100} m^{-2.3} dM \right.$

at boundaries, require same value

$A(0.08)^{-0.3} = B(0.08)^{-1.3}$

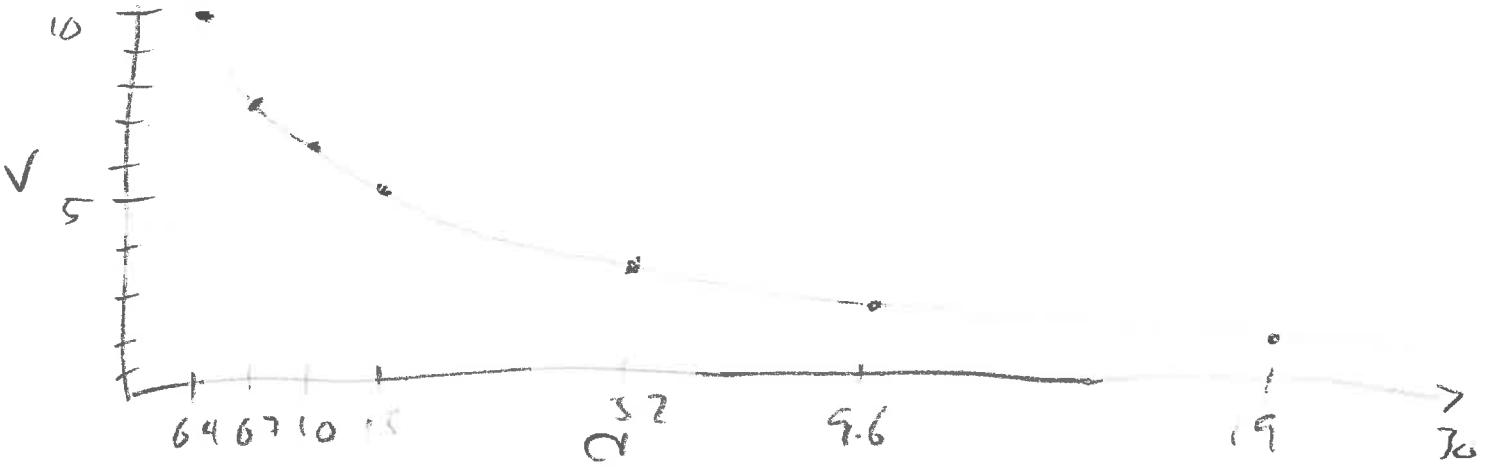
2) $v = \frac{\text{distance}}{\text{time}} = \frac{2\pi a}{P}$

$P = a^{3/2}$ so $v = \frac{2\pi a}{a^{3/2}} = 2\pi a^{-1/2}$

a 0.4 0.7, 1.0, 1.5, 5.2, 9.6, 19.2, 30 AU

v 9.9, 7.5, 6.3, 5.1, 2.7, 2.6, 1.4, 1.1

units are screwy, but



b) $P^2 = \frac{4\pi^2}{G(M_0 + M_1)} a^3 \approx 2.96 \times 10^{-19}\ s^2\ m^{-3}$

$G(M_0 + M_1) \sim GM_0$

$\Rightarrow P = 5.44 \times 10^{-10}\ a^{3/2}$ s

in m

$v = \frac{2\pi a}{P} = 1.15 \times 10^{10}\ a^{-1/2}$ in m/s

in m

3) $\left(\frac{P}{yr}\right)^2 = \left(\frac{a}{AU}\right)^3$

At 5.2 AU, $\left(\frac{P}{yr}\right)^2 = 140.60800$

$\Rightarrow P = 11.8578244\ yr = 3.74119487 \times 10^8\ s$

$P^2 = \frac{4\pi^2}{G(M_\odot + M_J)} a^3$

$M_\odot = 1.98547 \times 10^{30}\ kg$

$M_J = 1.89813 \times 10^{27}\ kg$

$a = 5.2\ AU = 7.77908527640 \times 10^{11}\ m$

$P^2 = 1.39596507 \times 10^{17}\ s^2$

$P = 3.74027414 \times 10^8\ s$

$\frac{P}{P} = \frac{3.74119487 \times 10^8}{3.74027414 \times 10^8} = 1.00045703165$

4) $v^2 = GM\left(\frac{2}{r} - \frac{1}{a}\right)$

if $a \to \infty$,

$$v^2 = \frac{2GM}{r}$$

or

$$v = \left(\frac{2GM}{r}\right)^{1/2}$$