ASTR 368
HW #3

1) $\frac{V^2}{R} = \frac{GM_{int}}{R^2}$

$M_{int} = \frac{RV^2}{G}$

$\frac{M_{int}}{M_{int,0}} = \frac{8.2}{8.5}\left(\frac{235}{220}\right)^2 = 1.10$, so 10% higher

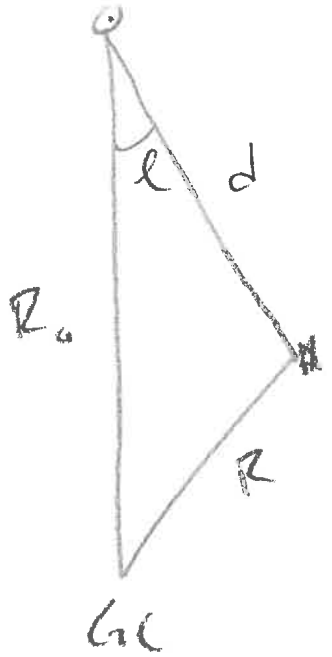
b) $v_r = A d \sin 2\ell$ Assume small

$A = \frac{1}{2}\left(\frac{\Theta_0}{R_0} - \left.\frac{d\Theta}{dR}\right|_{R_0}\right)$

$\frac{d}{d_0} = \frac{v_r}{v_{r,0}} \frac{\sin 2\ell_0}{\sin 2\ell} \frac{A_0}{A} = \frac{220}{8.5} \cdot \frac{8.2}{235}$

$= 0.90$, so 10% lower

2) a)



$$R^2 = R_0^2 + d^2 - 2R_0 d\cos\ell$$

$$R = (R_0^2 + d^2 - 2R_0 d\cos\ell)^{1/2}$$

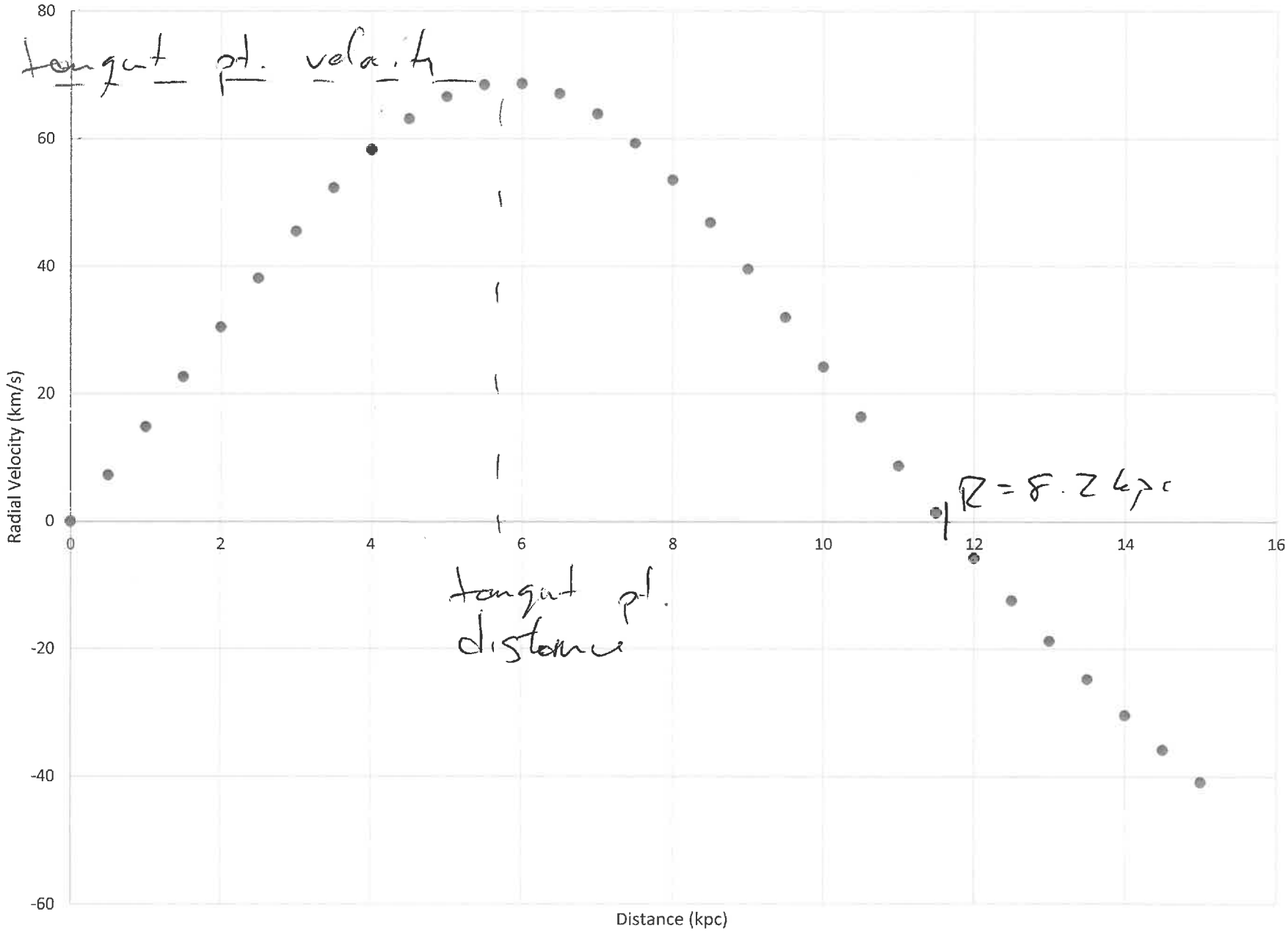
c) $v_r = (\Omega - \Omega_0) R_0 \sin\ell$

$\Omega = \Theta / R$

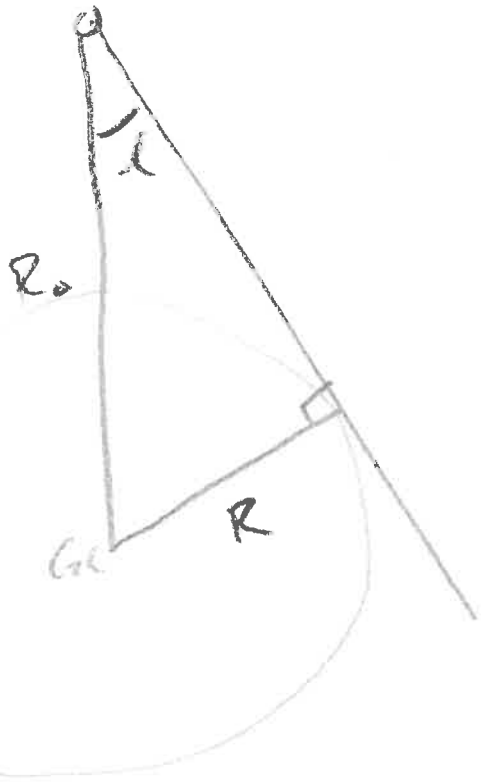
$$v_r = \left(\frac{\Theta}{R} - \frac{\Theta_0}{R_0}\right) R_0 \sin\ell$$

Can assume $\Theta = \Theta_0$

$$v_r = \left(\frac{R_0}{R} - 1\right) \Theta_0 \sin\ell$$


tangent pt. velocity
R = 8.2 kpc
tangent pt. distance
Radial Velocity (km/s)
Distance (kpc)
80
60
40
20
0
-20
-40
-60
0
2
4
6
8
10
12
14
16

3) a) from #7, $v_r = \left(\frac{R_0}{R} - 1\right)\Theta_0 \sin\ell$



$\sin\ell = \frac{R}{R_0}$

This sets ℓ for given R

$\ell = \sin^{-1}\left(\frac{R}{R_0}\right)$

$R = 4$: $\ell = 29.2°$

$R = 6$: $\ell = 47.0°$

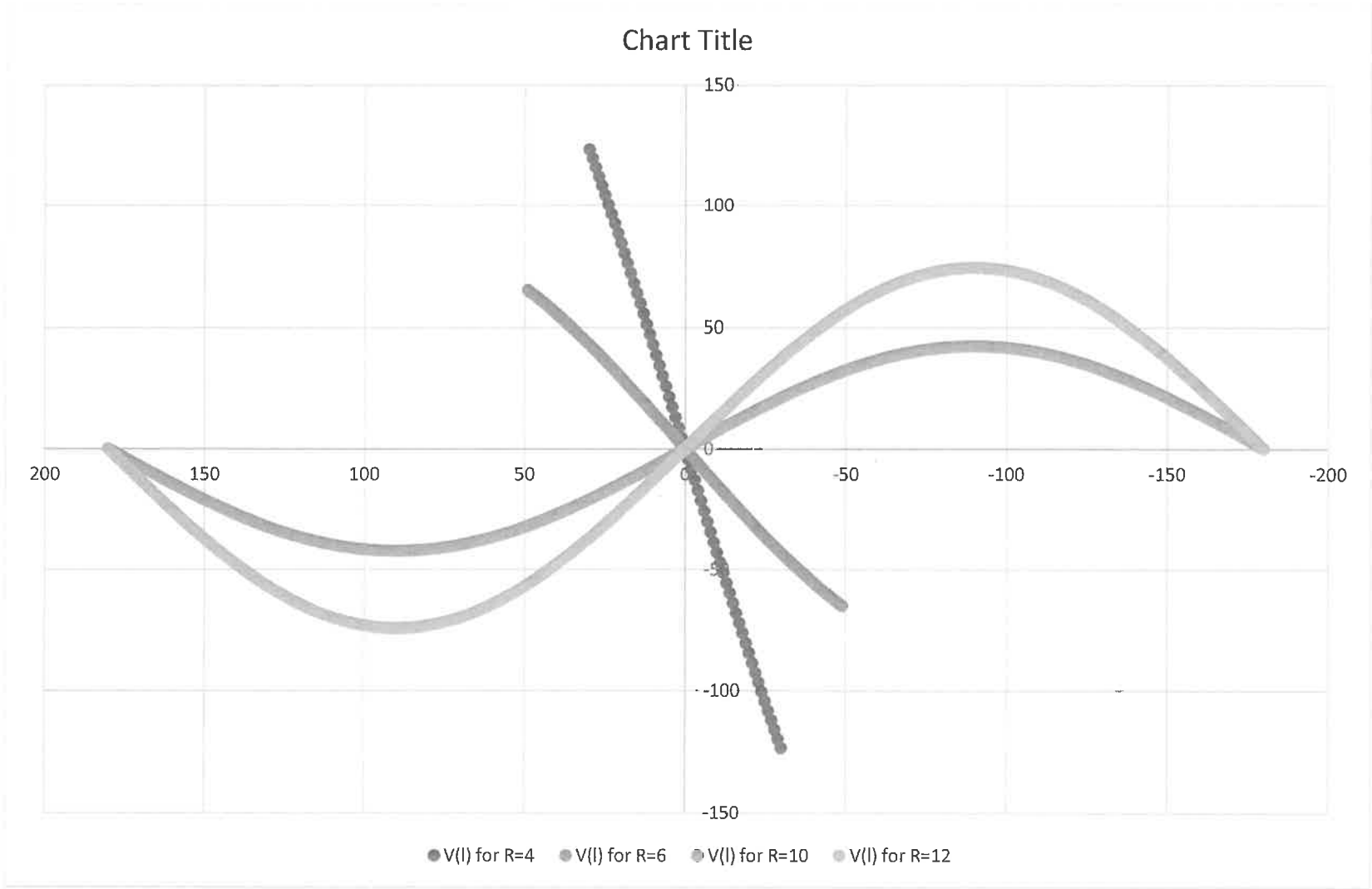


Chart Title
150
100
50
0
-100
-150
200
150
100
50
0
-50
-100
-150
-200
V(l) for R=4
V(l) for R=6
V(l) for R=10
V(l) for R=12