Drag st cont.

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So we can write

$$\dot{r} = \left(\frac{2\sigma}{m}\right)^{1/2}\left[\frac{1}{R^2} - \frac{1}{r^2}\right]^{1/2}.$$

Suppose we follow orbit from R to $\infty \Rightarrow \dot{r} > 0$

and $$dt = \left(\frac{m}{2\sigma}\right)^{1/2}\frac{dr}{\left[\frac{1}{R^2} - \frac{1}{r^2}\right]^{1/2}} \Rightarrow$$

$$t = \left(\frac{m}{2\sigma}\right)^{1/2}\int_R^r \frac{dr'}{\left[\frac{1}{R^2} - \frac{1}{(r')^2}\right]^{1/2}} \Rightarrow$$

$$t = \left(\frac{m}{2\sigma}\right)^{1/2} R \int_R^r \frac{r'\,dr'}{\left[r'^2 - R^2\right]^{1/2}}$$

Let $r' = R\tau \Rightarrow dr' = R\,d\tau \Rightarrow$

$$t = \left(\frac{m}{2\sigma}\right)^{1/2} R^2 \int_1^{r/R} \frac{\tau\,d\tau}{[\tau^2 - 1]^{1/2}} \Rightarrow$$

$$t = \left(\frac{m}{2\sigma}\right)^{1/2} R^2 \left.\left[\tau^2 - 1\right]^{1/2}\right|_1^{r/R} \Rightarrow$$

$$t = \left(\frac{m}{2\sigma}\right)^{1/2} R^2 \left[\left(\frac{r}{R}\right)^2 - 1\right]^{1/2} \Rightarrow$$