Chpt 9 Even solutions #30

#30 Conservation of Energy gives:

$$E_i = E_f$$

$$U_i + KE_i = U_f + KE_f$$

$$-\frac{GM_{sun}\, m_{can}}{R_{orbit}} + 0 = -\frac{GM_{sun}\, m_{can}}{R_{sun}} + \frac{1}{2} m_{can} v^2$$

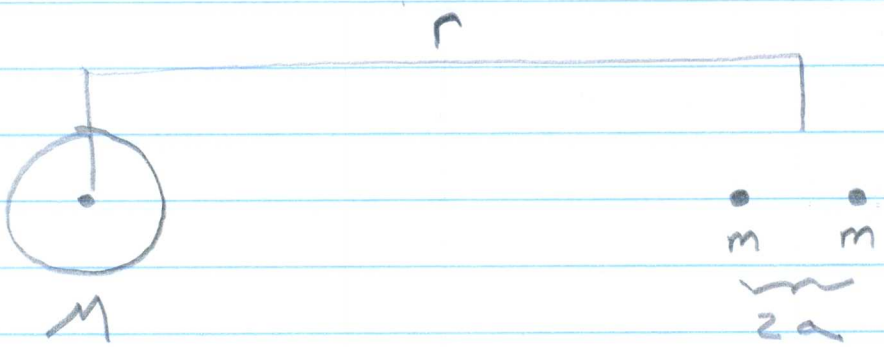
=> solving for v:

$$\Rightarrow v = \sqrt{2GM_{sun}\left[\frac{1}{R_{sun}} - \frac{1}{R_{orbit}}\right]}$$

$$= \sqrt{2(6.67\times10^{-11})(1.99\times10^{30})\left\{\frac{1}{6.96\times10^{8}} - \frac{1}{1.5\times10^{11}}\right\}}$$

$$\Rightarrow \boxed{v = 6.16\times10^{5}\ \frac{m}{s}}$$

#50



For the nearest mass:

$$F_{near} = \frac{GMm}{(r-a)^2}$$

For the distant mass:

$$F_{far} = \frac{GMm}{(r+a)^2}$$

$$\Rightarrow \Delta F = F_{near} - F_{far}$$

$$= \frac{GMm}{(r-a)^2} - \frac{GMm}{(r+a)^2}$$

$$= \frac{GMm\left[(r+a)^2 - (r-a)^2\right]}{\left[(r-a)(r+a)\right]^2} =$$

$$= \frac{GMm\left[r^2 + 2ra + a^2 - (r^2 - 2ra + a^2)\right]}{\left[(r+a)(r-a)\right]^2}$$

$$= \frac{GMm\left[4ra\right]}{\left[(r+a)(r-a)\right]^2}$$

$$= \frac{GMm\,4ra}{(r+a)^2(r-a)^2} = \frac{GMm\,4ra}{r^2\left(1+\frac{a}{r}\right)^2 r^2\left(1-\frac{a}{r}\right)^2}$$

in the limit $a \ll r$

$$\left(1+\frac{a}{r}\right),\ \left(1-\frac{a}{r}\right) \longrightarrow 1$$

$$\Rightarrow F = \frac{GMm\,4ra}{r^4}$$

$$= \frac{GMm\,4a}{r^3}$$