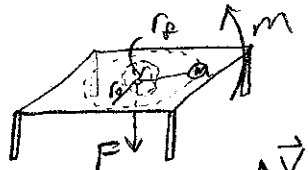
LECTURE 32

(thanks to Brett for notes from class)

- Kepler's Law explored & an additional angular momentum example.

10-8 Ex

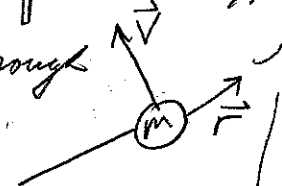


pulled through hole

particle mass m moves at V_0 in circle radius r_0

(a) V_f in terms of r_0, V_0 & r_f

(b) find tension for motion in circle of radius r in terms of m, r & $\vec{L}$



$\tau_{ext} = 0 \Rightarrow L_0 = L_f$ ($\hat{k}$ component)

$\vec{L} = \vec{r} \times \vec{p} = \vec{r} \times m\vec{v}$

$= m\vec{r} \times \vec{v}$

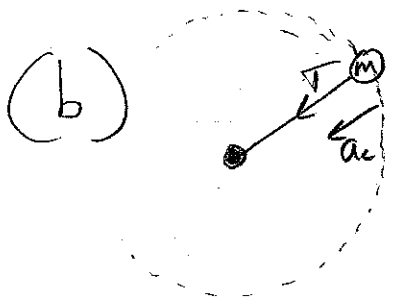
$= mrv$

$m V_0 r_0 = m V_f r_f$

(a) $V_f = \dfrac{r_0 V_0}{r_f}$ $\quad r_f < r_0$

$1 < \dfrac{r_0}{r_f}$

(b)



$T = \dfrac{mv^2}{r} = \dfrac{m}{r}\left(\dfrac{L}{mr}\right)^2$ $\quad L = mrv$ $\quad v = \dfrac{L}{mr}$

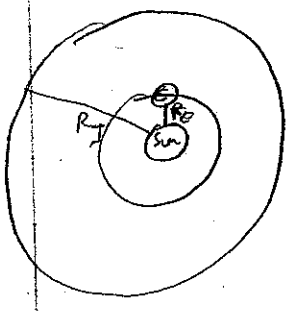
$= \dfrac{m L^2}{r^3 m^2} = \dfrac{L^2}{r^3 m}$

$T = \dfrac{\vec{L} \cdot \vec{L}}{mr^2}$

Gravitation:

Ex 11-1 Jupiter's mean orbital radius is 5.20 AU

(1 AU = distance from earth to the sun)



$$T^2 = Cr^3 \quad \text{Kepler's 3rd Law}$$

$$\frac{4\pi^2}{GM_{sun}} = C = \frac{T_E^2}{r_E^3} = \frac{T_J^2}{r_J^3}$$

$$T_J^2 = T_E^2\left(\frac{R_E^3}{R_J^3}\right)$$

$$T_J^2 = (1\,yr.)^2\frac{(5.2\,AU)^3}{(1\,AU)^3} = (5.2^3)(1\,yr)$$

$$T_J = \sqrt{5.2^3}\ yr$$

$$= \boxed{11.86\ yr.}$$

$$G = 6.67E^{-11}\ \frac{N \cdot m^2}{kg^2}$$

$$\vec{F}_g = -\frac{GM_1M_2}{r_{12}^2}\hat{r}_{12}$$