# Chapter 8 & 9.

1. Gun (8.6)

a) $\vec{r} = b\hat{x} + ct\hat{y} + dt^2\hat{z}$

$b = m$
$c = m/s$
$d = m/s^2$

b) $\vec{v} = c\hat{y} + 2dt\hat{z}$

$\vec{a} = 2d\hat{z}$

c) Acceleration $\longrightarrow$ const $2d = g$ $\hat{z}$ $\downarrow$

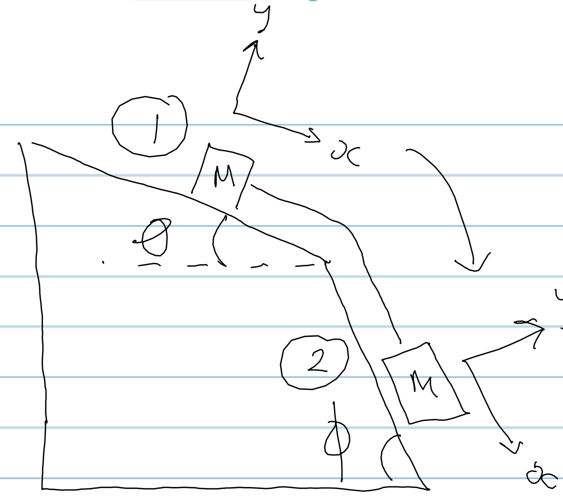
Velocity $t=0$ $\vec{v} = c\hat{y}$ $\longrightarrow$ West. $\leftarrow$

initial v.

Position $t=0$ $\vec{r} = b\hat{x}$ $\longleftarrow$ $\uparrow$

posⁿ from some origin

8.18




① $ma = mg\sin\theta + T$

② $ma = mg\sin\phi - T$

a) $2T = mg(\sin\phi - \sin\theta)$

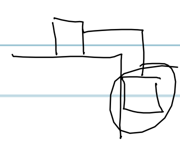
$$\underline{T} = \frac{mg}{2}\left(\underbrace{\sin\phi - \sin\theta}\right)$$

b) ✓

c) $\theta = \phi \longrightarrow T = 0$ rope goes slac.

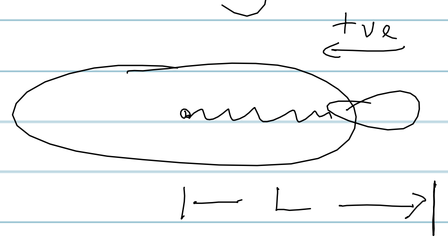
$\phi < \theta \longrightarrow T = -ve$ We assumed rope taut ✗

$\theta = 0, \phi = 90$



$T = \frac{mg}{2}$ $a = \frac{g}{2}$

9.7 Rotating guinea pig




$$F = k(L - b)$$

a)

$$\cancel{F = m} \qquad k(L-b) = \frac{mv^2}{r} \qquad v^2 = \frac{4\pi^2 L^2}{T^2}$$

$$k(L-b) = \frac{4\pi^2 m L^{\cancel{2}}}{T^2 \cancel{L}}$$

$$kL - kb - \frac{4\pi^2 m L}{T^2} = 0$$

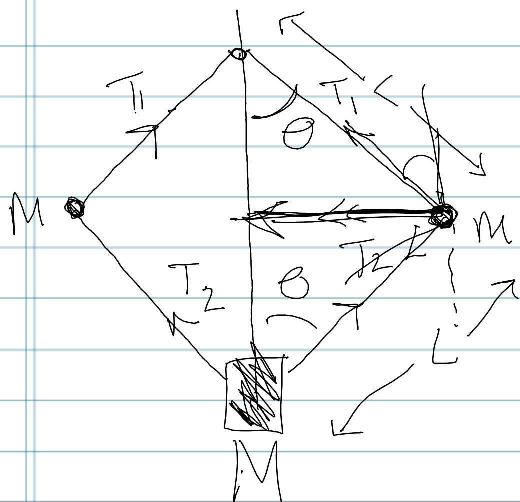
$$L\left(k - \frac{4\pi^2 m}{T^2}\right) = kb$$

$$L = \left(\frac{b}{1 - \frac{4\pi^2}{kT^2}}\right)$$

b)

$$T^2 = \frac{4\pi^2}{k} \qquad \text{denom} \to 0 \qquad L \to \infty$$

9.14 Governor




① Vertical forces on M

$$2T_2\cos\theta = Mg$$

② Vertical forces on m

$$T_1\cos\theta = mg + T_2\cos\theta$$

③ $$(T_1+T_2)\sin\theta = \frac{mv^2}{r}$$

$$v = \frac{2\pi r}{T}$$

$$v^2 = \frac{4\pi r^2}{T^2}$$

$$= \frac{4\pi (L\sin\theta)^2}{P^2}$$

$$= \frac{m\,4\pi^2 L^2\sin^2\theta}{P^2 L\sin\theta}$$

$$= \frac{m\,4\pi^2 L\sin\theta}{P^2}$$

③ $$T_1+T_2 = \frac{4\pi^2 mL}{P^2}$$

from ① $$T_2 = \frac{Mg}{2\cos\theta}$$

Into 2 $$T_1\cos\theta = mg + \frac{Mg}{2\cancel{\cos\theta}}\cancel{\cos\theta}$$

$$= g(m + M/2)$$

~~From Eqn 3~~

$$T_1 =$$

$$T_1 = \frac{mg + Mg/2}{\cos\theta}$$

$$3 \quad \frac{mg + Mg/2}{\cos\theta} + \frac{Mg/2}{\cos\theta} = \frac{4\pi^2 mL}{P^2}$$

$$\frac{mg + Mg}{\cos\theta} = \frac{4\pi^2 mL}{P^2}$$

$$\boxed{\cos\theta = \frac{P^2 g (m + M)}{4\pi^2 mL}}$$