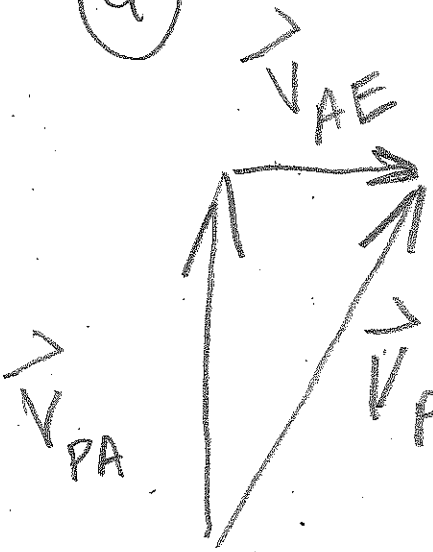
2A

10-25-13 test 2 review

Sample T2

(1) CH3 relative motion

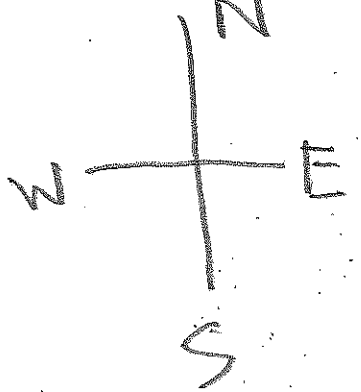
(a)



$\vec{V}_{PE} = \vec{V}_{PA} + \vec{V}_{AE}$

$\vec{V}_{PE} = ?$

$\vec{V}_{PA} = 240 \frac{km}{h}$ N



$\vec{V}_{AE} = 100 \frac{km}{h}$ E

(a) $V_{PE}^2 = V_{PA}^2 + V_{AE}^2$

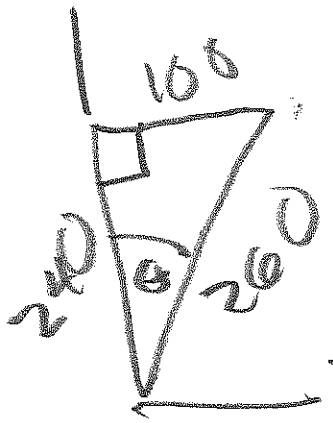
$= (-240)^2 + (100)^2 = 57600 + 10000$

$V_{PE}^2 = 67600$

(2

$$V_{PE} = 260 \frac{km}{h}$$

N direction:



$$\tan\theta = \frac{100}{240} < 1$$

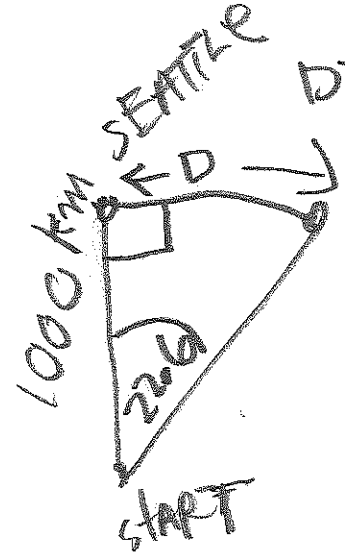
$$\theta < 45^\circ$$

$$\theta > \tan^{-1}\left(\frac{100}{240}\right)$$

$$> 22.6^\circ$$ (b)

E of N

(c)



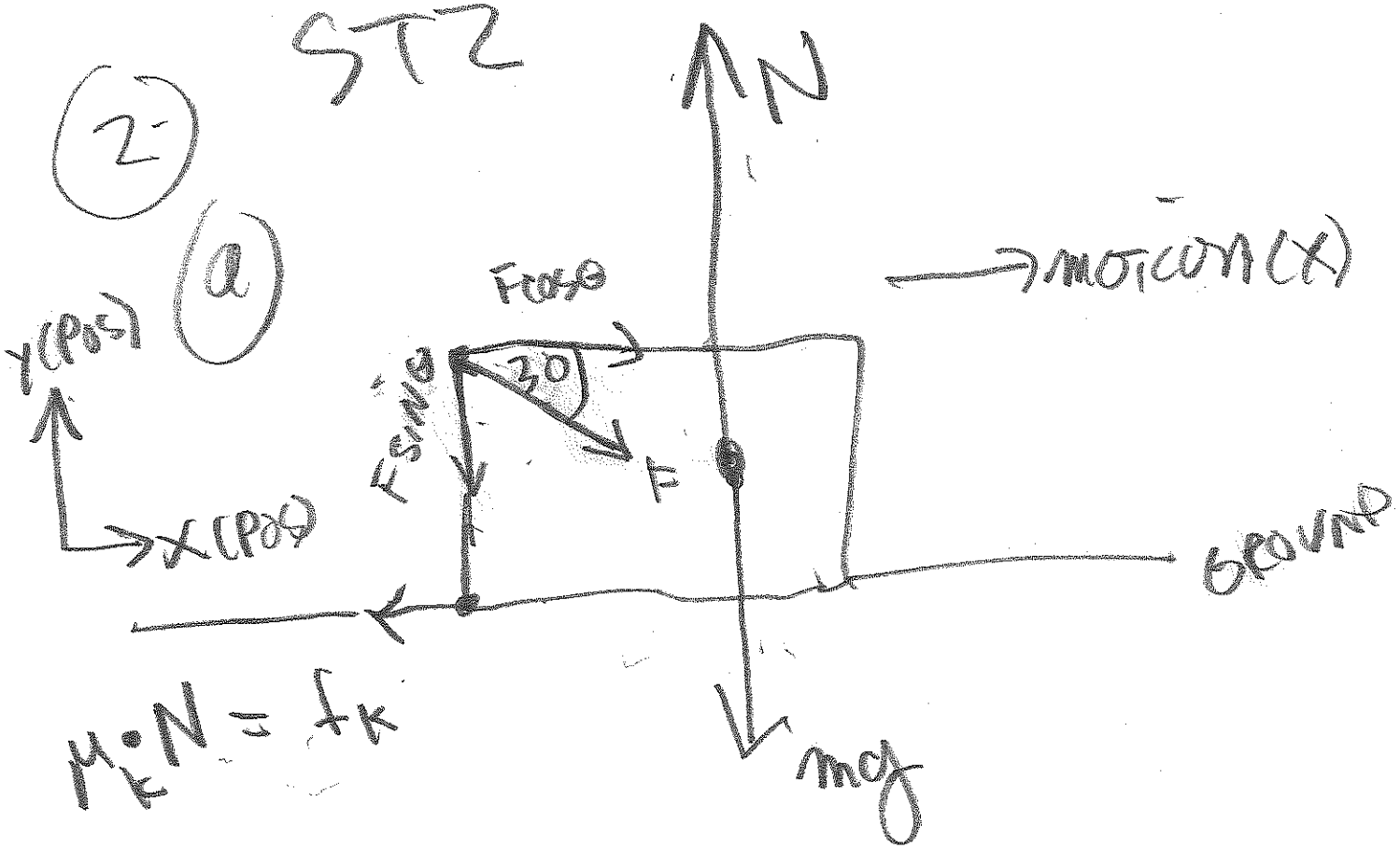
$$\tan 22.6 = \frac{D}{1000}$$

$$D = 1000 \cdot \tan 22.6^\circ$$

$$> 1000 \cdot \frac{100}{240} = \boxed{417 (m)}$$

(2) STZ

(a)



$$\sum F_y = \text{pos} - \text{neg}$$

$$ma_y = N - mg - F\sin\theta$$

$a_y = 0$
v_y motion along x

$$0 = N - mg - F\sin\theta$$

$$N = mg + F\sin\theta$$

$$= (10)(9.8) + 50 \cdot \sin 30$$

$$= 98 + 25 = 123 \text{ (N)}$$

$N > mg$

(a) ST2

(b)

$$\Sigma F_x = pos - neg$$
$$ma_x = Force - f_k$$
$$ma_x = Force - \mu_k \cdot N$$

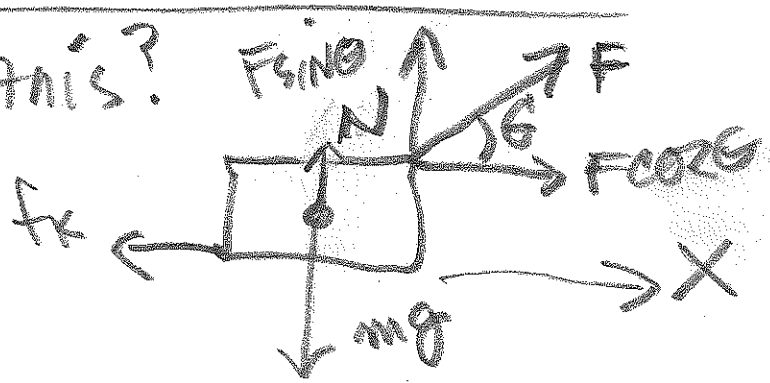
$$(10)a_x = (50)(0.867) - (0.10)(123)$$

$$a_x = \frac{43.35 - 12.3}{10}$$

$$a_x = \frac{31.05}{10}$$

$$a_x = 3.1\ m/s^2$$

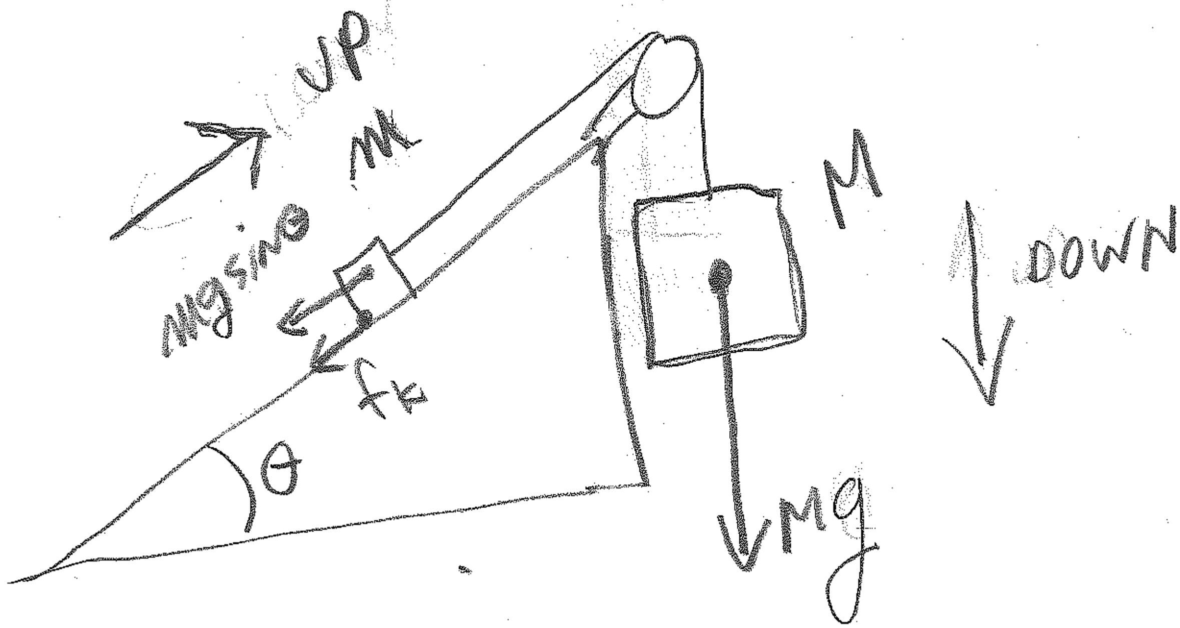
What if I do this?



STZ

(4

(3)



CHECK motion

$Mg > f_k + mg\sin\theta$

$(50)(9.8) > \mu_k N + mg\sin\theta$

$490 > (0.1)mg\cos\theta + mg\sin\theta$

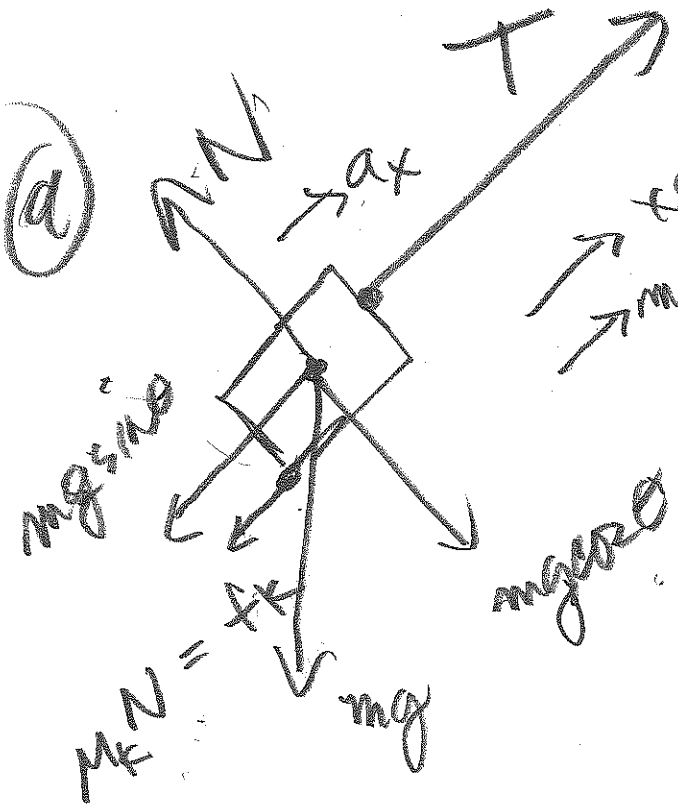
True: $490 > (0.1)(5)(9.8)\cdot\frac{\sqrt{3}}{2}$

$+ (5)(9.8)\cdot\frac{1}{2}$

THUS M moves DOWN.

Isolate m

(a)



$\Sigma F_y = 0$

$0 = N - mg\cos\theta$

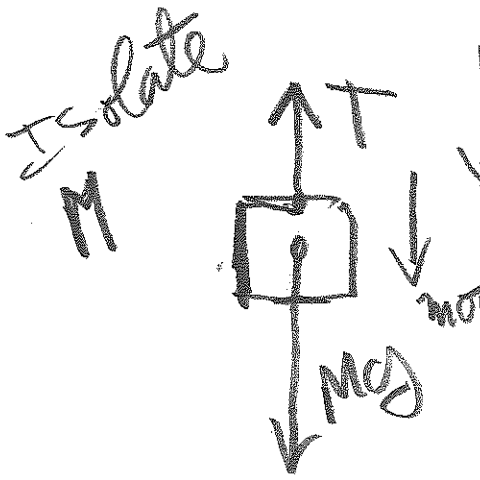
$N = mg\cos\theta$

$\Sigma F_x = \text{pos} - \text{neg}$

$ma_x = T - mg\sin\theta - \mu_k N$

$ma_x = T - mg\sin\theta - \mu_k mg\cos\theta$

Isolate M



$\Sigma F_y = \text{pos} - \text{neg}$

$Ma_y = Mg - T$

$Ma = Mg - T$ for M

$a_x = a_y = a$

Also: $ma = T - mg\sin\theta - \mu_k mg\cos\theta$ for m.

ADD (I) + (II) to cancel T

(I) $Ma = Mg - T$

(II) $ma = T - mg\sin\theta - M_k mg\cos\theta$

$Ma + ma = Mg - mg(\sin\theta + M_k\cos\theta)$

$a = \dfrac{g[M - m(\sin\theta + M_k\cos\theta)]}{(M+m)}$

$a = \dfrac{(9.8)\left[50 - 5\left(\frac{1}{2} + 0.10\cdot\frac{\sqrt{3}}{2}\right)\right]}{55}$

$= \left(\dfrac{9.8}{55}\right)[50 - 2.5 - (5)(0.0867)]$

$= 8.39\ m/s^2$

easiest

(b) $Ma = Mg - T$

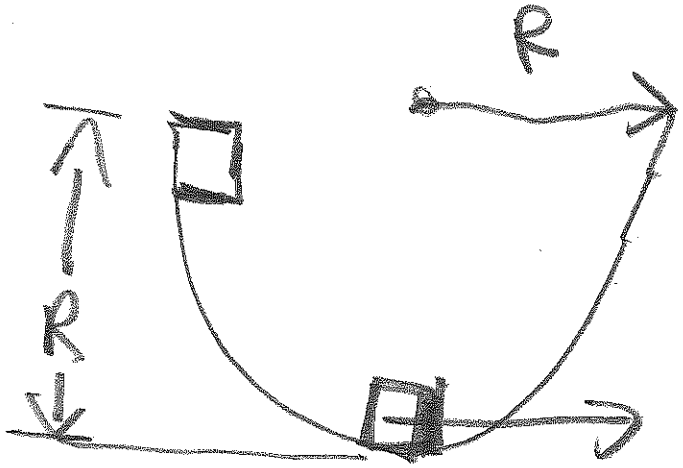
$T = M \cdot (g - a)$

$T = (50)(9.8 - 8.39)$

$T = 70.5 (N)$

STZ #4

CH6-style
CH7-style

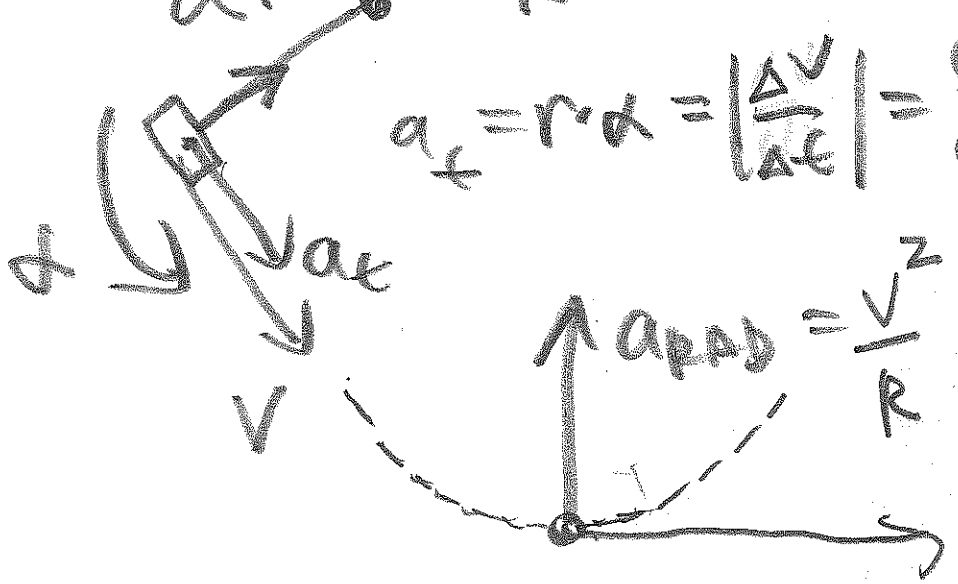


at bottom $a_t = 0$

$\Rightarrow$ only have a_{RAD}.

$a_{RAD} = \frac{v^2}{R}$

$a_t = r\alpha = \left|\frac{\Delta v}{\Delta t}\right| = \frac{dv}{dt}$



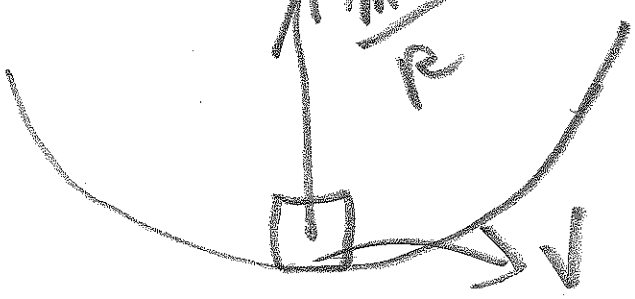
Bottom $\left(\frac{\Delta v}{\Delta t} = 0 = a_t\right)$

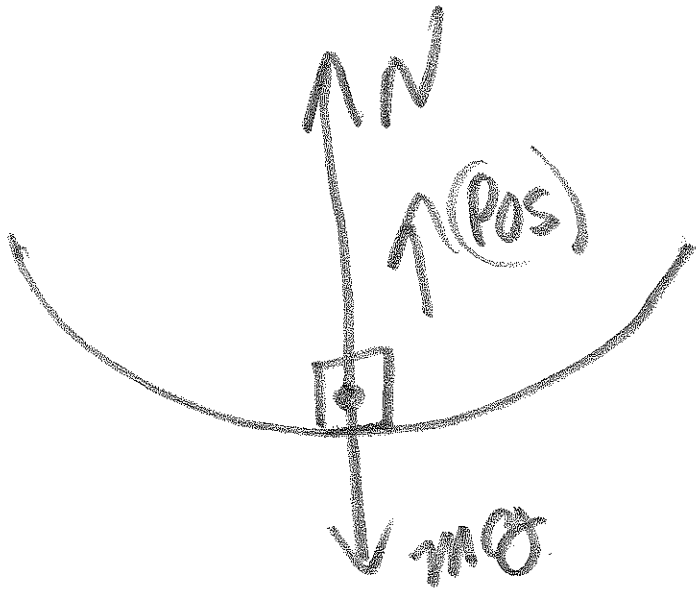
(9

$\frac{mv^2}{r} = F_{R\text{-net}} = m \cdot a_{RAD}$

$a_{RAD} = \frac{v^2}{r}$

- centripetal acceleration





(a) ↑ up

(b) $\frac{mv^2}{R} = \frac{(7)(4)^2}{1} = 112(N)$

$\Sigma F_R = \text{pos} - \text{neg}$

$\frac{mv^2}{R} = N - mg$ (c)

$\Rightarrow N = m\left(\frac{v^2}{R} + g\right)$

(c) see previous page

$$N = m\left(\frac{v^2}{R} + g\right)$$

$$= (7)\left(\frac{16}{1} + 9.8\right)$$

$$= 180\,(N) > mg$$

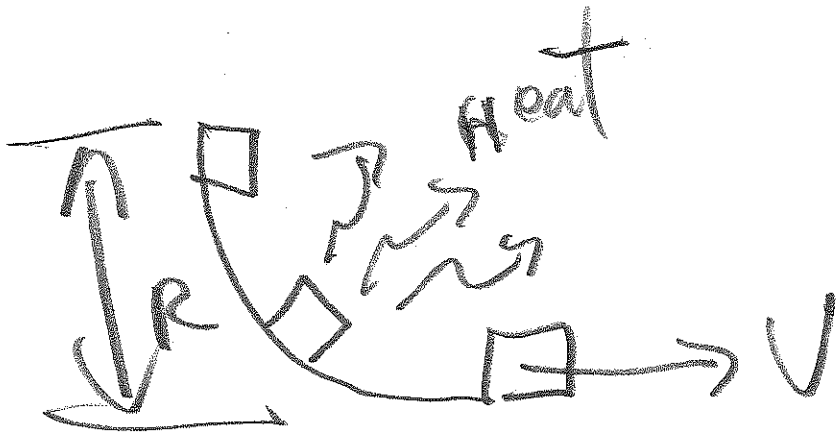
CH7-style warning: on tests, I could force you to get v at bottom:

$KE_{top} + U_{top} = KE_{bot} + U_{bot}$ ($mgy = 0$ (ref.))

$$0 + m \cdot g \cdot R = \frac{1}{2}mv_{bot}^2 + 0$$

$$v_{bot}^2 = 2g \cdot R = 19.6 \Rightarrow v_{bot} = 4.4\,\frac{m}{s}$$

Explanation:



$$m \cdot g \cdot R = \frac{1}{2} m V^2 + \text{Heat}$$

$$\Rightarrow V = 4.0 \frac{m}{s} < 4.4 \frac{m}{s}$$

NO Heat

Note for test 2:

On exam like ST2, #4:

(A) Find V_{bot} using CH7

(B) Find N using CH6