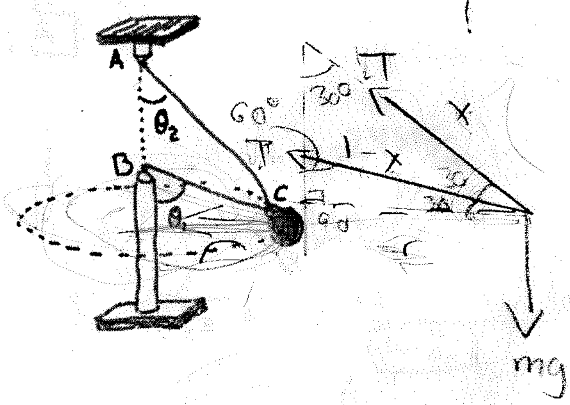
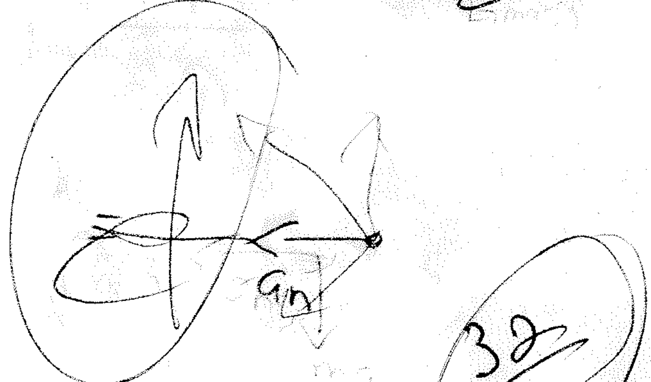
ENGR243 Winter 2014 77 Name : Danny Shash / 9548912

Test #2 A: Marked on 100, worth 20 % of semester MARK ARE GIVEN ON DRAWINGS (FBD...)

#1:/35 A wire ACB of length 1m passes through a ring at C that is attached to a sphere which revolves at a constant speed v, in a horizontal circle. Knowing that θ_1=60° and θ_2=30°, and that there is only one tension (no friction in the ring), determine the speed v. Answer: 1.76 m/s





32/38

① : $\sin 30 = \frac{r}{x}$

② : $\sin 60 = \frac{r}{1-x}$

$a_n = \frac{v^2}{\rho}$, $\rho \to r$

$\Sigma F_x = (\Sigma F_x)_{eff}$

$-\frac{1}{2}T\cos 30 - \frac{1}{2}T\cos 60 = -a_n$

$-0.68\,T = -a_n$

$T = \frac{m a_n}{0.68}$ --- ③

$\Sigma F_y = (\Sigma F_y)_{eff}$

$-\frac{1}{2}T(\sin 30) - \frac{1}{2}T(\sin 60) = -mg$

$-0.68\,T = -mg$

$T = \frac{-mg}{-0.68}$

$T = \frac{mg}{0.68}$ --- ④ replace ④ into ③

① : $0.5x = r$

② : $0.86(1-x) = r$

$0.86 - 0.86x = r$

$0.5(x) = 0.86 - 0.86x$

$1.36x = 0.86$

$x = 0.63$

$r = 0.5(0.63) = 0.315$

$a_n = g$

$g = \frac{v^2}{\rho}$, $\rho \to 0.315$

$\Rightarrow g = \frac{v^2}{r}$

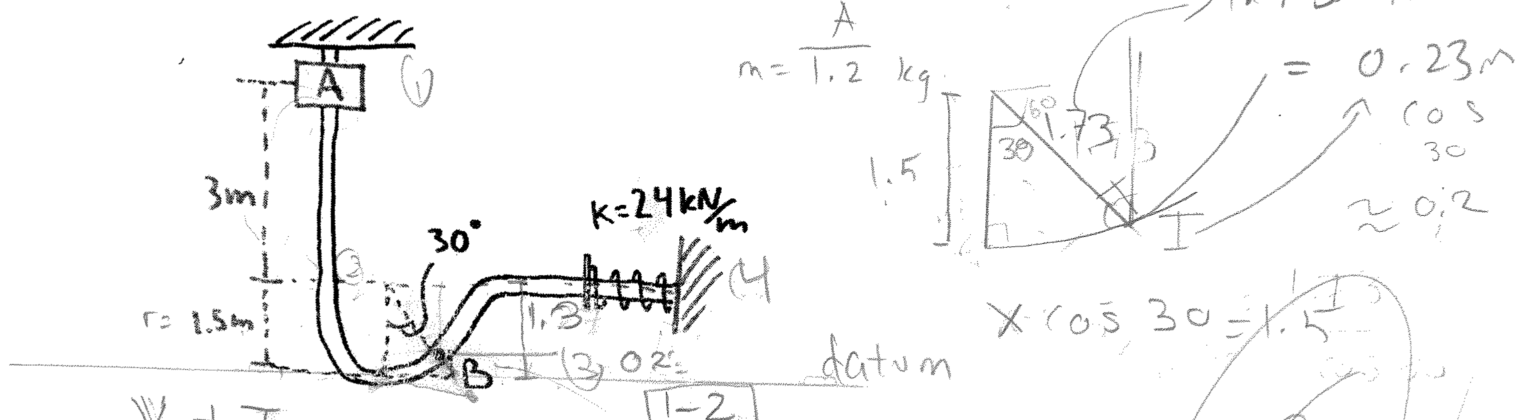
$9.81 = \frac{v^2}{0.315}$

$= 1.76\, m/s$

#2: /30 The 1.2 kg slider is released from rest at A and slides without friction along the vertical guide shown (B is on a circular portion of 1.5 m in radius). Find:

a) The speed at B; Answer: 9.18 m/s

b) The maximum deflection of the spring. Answer: ~~1.7~~ X



1–2

$V_1 + T_1 = V_2 + T_2$

$mgh + \frac{1}{2}kx^2 + \frac{1}{2}mv^2 = mgh + \frac{1}{2}kx^2 + \frac{1}{2}mv^2$

$1.2(9.81)(4.5) = 1.2(9.81)(1.5) + \frac{1}{2}(1.2)(v^2)$

$53 = 17.66 + 0.6v^2$

2–3

$v = 7.67$ m/s

$V_2 + T_2 = V_3 + T_3$

$mgh + \frac{1}{2}kx^2 + \frac{1}{2}mv^2 = mgh + \frac{1}{2}kx^2 + \frac{1}{2}mv^2$

$1.2(9.81)(1.5) + \frac{1}{2}(1.2)(7.67)^2 = (1.2)(9.81)(0.2) + \frac{1}{2}(1.2)v^2$

$17.66 + 35.3 = 0.6v^2 + 2.35$

$V_B = 9.18$ m/s

3–4

$V_3 + T_3 = V_4 + T_4$

$mgh + \frac{1}{2}kx^2 + \frac{1}{2}mv^2 = mgh + \frac{1}{2}kx^2 + \frac{1}{2}mv^2$

$(1.2)(9.81)(0.2) + \frac{1}{2}(1.2)(9.15)^2 = 1.2(9.81)(1.5) + \frac{1}{2}(24)x^2$

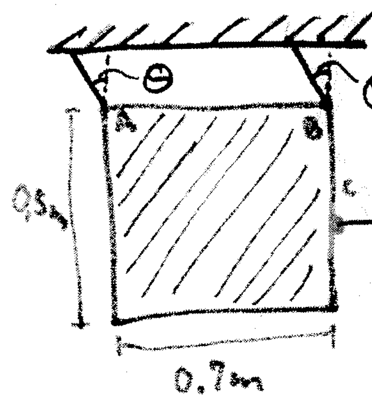
2:35, + 50.23 = 17.658 + 12x²

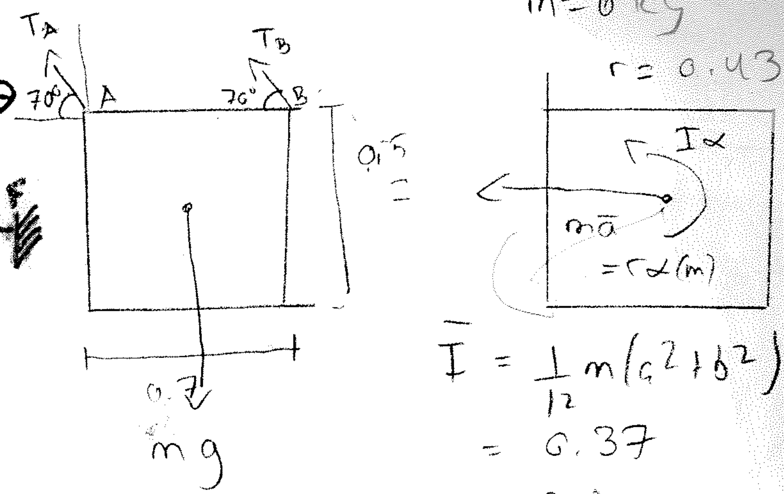
x = 1.7

#3 : /35 The uniform rectangular plate has a mass of 6 kg and is held in position by three ropes as shown. Knowing that the angle theta is 20°, determine, immediately after rope CF has been cut,

a) The acceleration of the plate (linear and angular) Answer: ~~3.57 m/s²~~ and -8.3 rad/s²

b) The tension in the two remaining ropes. Answer: ~~T_A = 27.8 N~~ and T_B = 34.43 N





$\bar{I} = \frac{1}{12} m(a^2+b^2)$

$= 0.37$

$\circlearrowleft +\ \Sigma M_A = (\Sigma M_A)_{eff}$

$-mg(0.35) + T_B \sin(70)(0.7) = \bar{I}\alpha - m(r\alpha)(0.25)$

$-6(9.81)(0.35) + T_B(0.657) = 0.37\alpha - 6(0.1075)\alpha$ --- (3)

$\Sigma F_y = (\Sigma F_y)_{eff}$

$T_A \sin 70 + T_B \sin 70 - mg = 0$

$T_A = \dfrac{+mg - T_B \sin 70}{\sin 70}$

$T_A = 62.63 - T_B$ --- (1)

$\Sigma F_x = (\Sigma F_x)_{eff}$

$T_A \cos 70 + T_B \cos 70 = -6(0.43\alpha)$ -- replace (1) into 2

$(62.63 - T_B)\,0.342 + T_B(0.342) = -2.58\alpha$

$21.4 - 0.342 T_B + T_B(0.342) = -2.58\alpha$

$\alpha = -8.3$ rad/s²

$\bar{a} = r\alpha = 0.43(-8) = -3.57$