Physics 2010
Fall 2003
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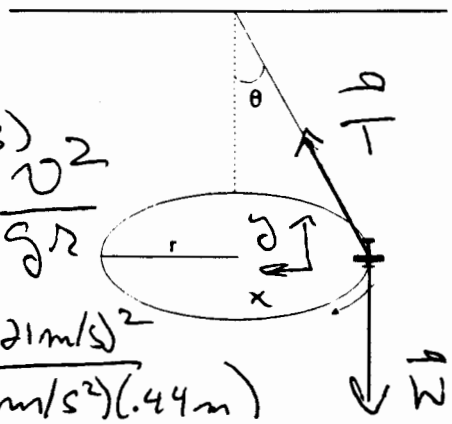
EXAM 2

3

Name:_____ Student ID #:_____

TA (circle one): Bobela Schrank Shepherd Stoker Tsunoda

A. A 0.0750 kg toy plane is tied to the ceiling with a string. When the airplane's motor is started, it moves with a constant speed of 1.21 m/s in a horizontal circle or radius 0.440 m. See figure.



1. *[10 pts.]* What is the angle of θ the string makes with the vertical?

(3) $\Sigma F_{EXT\,x} = mv^2/r = T\sin\theta$

(3) $\Sigma F_{EXT\,y} = 0 = T\cos\theta - mg$

(3) $\tan\theta = \frac{v^2}{gr}$

$= \frac{(1.21\,m/s)^2}{(9.8\,m/s^2)(.44\,m)}$

$= 0.3395$

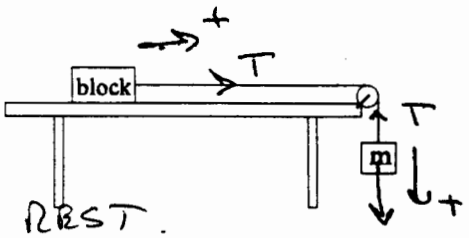
(1) $\boxed{\theta = 18.8^\circ}$

2. *[5 pts.]* What is the tension in the string?

(2) $T = \frac{mg}{\cos\theta} = \frac{(0.075\,kg)(9.8\,m/s^2)}{\cos 18.8^\circ}$ (2)

$\boxed{T = 0.776\,N}$ (1)

B. A 3.50 kg block is at rest on a table. A rope is tied to the right side of this block, hung over a frictionless pulley, and tied to a mass m (see figure). For the block on the table $\mu_s = 0.650$ and $\mu_k = 0.450$.



1. *[10 pts.]* What is the largest mass for m such that the 3.50 kg block does not slip? IF BLOCK REMAINS AT REST.

$T = f_s = f_{s(MAX)} = \mu_s F_N = \mu_s m_B g$ (4 PTS)

(2 PTS) $T - mg = 0$ THUS,

(2 PTS) $mg = \mu_s m_B g$ AND $m = \mu_s m_B = (0.65)(3.50\,kg)$

$\boxed{m = 2.28\,kg}$ (2 PTS)

2. *[10 pts.]* Suppose m = 5.00 kg. What is the acceleration of the 3.50 kg block when the system is allowed to move?

BLOCK

$T - f_k = ma$

$T - \mu_k m_B g = m_B a$

(3 PTS)

m

$mg - T = ma$ (3 PTS)

ADD

$mg - \mu_k m_B g = (m_B + m)a$

$a = \frac{(m - \mu_k m_B)g}{m_B + m}$ (3 PTS)

$a = \frac{(5\,kg - (.45)(3.5\,kg))}{8.5\,kg}(9.8\,m/s^2)$

$\boxed{a = 3.95\,m/s^2}$ -(1 PT)