Name: [redacted] **Lab section:** 14

Please keep this booklet closed until given the signal to start. We will end promptly at 2:40, at which time you will send your papers to the end of the row to be collected. If you finish early, please wait until 2:40.

There are 5 pages with questions; each page is worth 10 points.

You may use a calculator, but no other materials are allowed. Please be sure to show all of your work as these intermediate steps are worth partial credit and unsupported answers will receive no credit.

Here are the equations that you may find useful:

$$x = x_0 + v_{0x}t + \frac{1}{2}a_x t^2 \qquad v_x = v_{0x} + a_x t \qquad v_x^2 = v_{0x}^2 + 2a_x(x - x_0)$$

$$x - x_0 = \left(\frac{v_{0x} + v_x}{2}\right)t \qquad a_{\text{rad}} = \frac{v^2}{r} \qquad C = 2\pi r \qquad \sum \vec{F} = m\vec{a}$$

$$f_s \le \mu_s N \qquad f_k = \mu_k N \qquad w = mg \qquad a_{\text{rad}} = \frac{v^2}{R} = \frac{4\pi^2 R}{T^2}$$

For grading use only:

proj 8

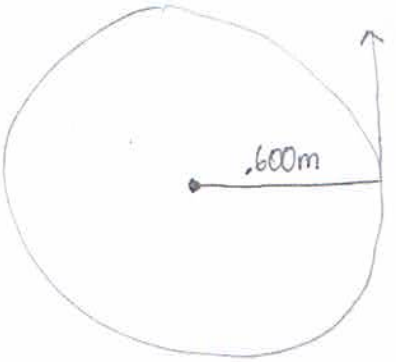
x(t) 10

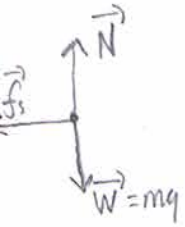
fma 8

vec 8

circ 9

A penny is placed on a horizontal rotating platform. The platform has a radius of 0.600 m. The penny will remain in place on the platform as the rotational speed is slowly increased, but at some point, it is rotating so fast that the penny flies off. The coefficient of static friction between the penny and the platform is 0.120. If the penny is placed at the edge of the platform, what is the rotation rate at which the penny will fly off? Give your answer in revolutions per minute.





$\Sigma \vec{F} = m\vec{a}$

$\Sigma \vec{F} = \vec{N} + \vec{w} + \vec{f_s} = m\vec{a}$

$\Sigma F_x = -f_s = ma_x$

$= -\mu_s N = ma_x$

$\Sigma F_y = N - mg = ma_y$

$N - mg = 0$

$N = mg$

$C = 2\pi r = 2\pi(.600)$

$C = 3.7699\,m$

$-\mu_s mg = ma_x$

$-\mu_s g = a_x$

$a_x = -(.120)(9.8)$

$a_x = 1.176\,m/s^2$

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

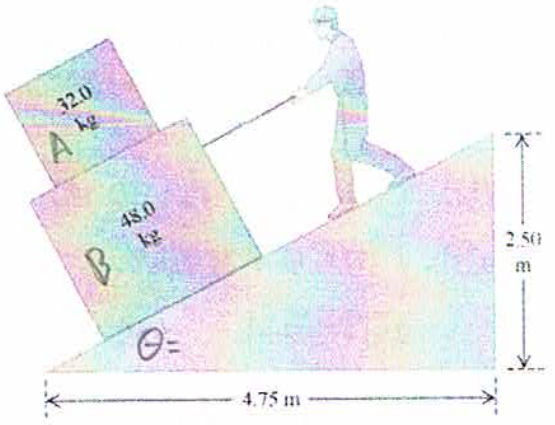
$1.176 = \frac{v^2}{.600}$ ← algebra

$v^2 = 1.176/.600$

$v = 1.4\,m/s$

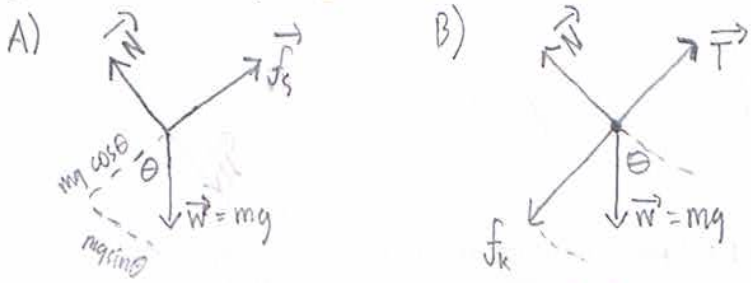
$\frac{1.4\,m}{s} \left| \frac{1\,rev}{3.7699\,m} \right| \frac{60\,s}{1\,min} = 22.3\,revs/min$

A person is pulling two boxes up a ramp at a constant speed. The 32-kg box remains in place on top of the 48-kg box, and is held in place only by friction. The rope remains parallel to the ramp.



a) Draw a free body diagram for each box. Label the forces clearly.

4/4.



b) Write two vector equations that describe how Newton's laws apply to the forces shown in part a. (Don't solve anything, just write down two equations.)

3/4

A) $\sum \vec{F} = \vec{N} + \vec{f_s} + \vec{w} = m\vec{a}$ $= 0$

B) $\sum \vec{F} = \vec{N} + \vec{T} + \vec{f_k} + \vec{w} = m\vec{a} = 0$

c) Suppose that the person is still pulling on the rope, just not strongly enough to keep the boxes from sliding downward. Also, the small box stays in place atop the heavier box. What would be different about your answers to parts a and b if the boxes were sliding down the ramp at a constant speed?

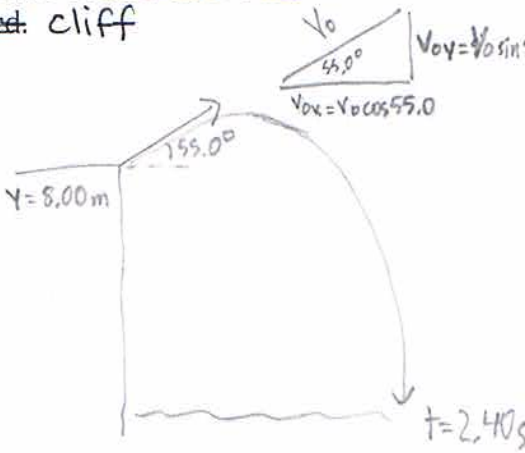
1/2

The difference would be that the magnitude of the force of tension (the person pulling) would be less than the magnitude of gravity. Also, f_k would be in the opposite direction as drawn in part A.

no

ok

A stuntman jumps off of a cliff at an angle of 55.0°. The cliff is 8.00 meters above the water. He enters the water 2.40 seconds after leaving the ~~board~~ cliff



3/3 a) What was the stuntman's initial speed?

X_0	0
t_0	0
V_{ox}	$V_0\cos55.0$
a_x	$0 m/s^2$

X	?
t	2.40s
V_x	$V_0\cos55.0$
a_x	$0 m/s^2$

Y_0	8.00m
t_0	0s
V_{oy}	$V_0\sin55.0$
a_y	$-9.8 m/s^2$

Y	0m
t	2.40s
V_y	?
a_y	$-9.8 m/s^2$

$Y = Y_0 + V_{oy}t + \frac{1}{2}a_y t^2$

$0 = 8.00 + 2.40V_{oy} + \frac{1}{2}(-9.8)(2.40)^2$

$0 = 8.00 + 2.40V_{oy} - 28.22$

$0 = -20.22 + 2.40V_{oy}$

$V_{oy} = \frac{20.22}{2.40} = 8.425 m/s$

$V_0\sin55.0 = 8.425$

$V_0 = 8.425/\sin55.0$

$V_0 = 10.29 m/s$ at 55.0° above x-axis ✓

3/3 b) What is the horizontal distance that the stuntman traveled while in the air?

$X = X_0 + V_{ox}t + \frac{1}{2}at^2$

$V_{ox} = 10.29\cos55.0$

$V_{ox} = 5.902 m/s$

$X = 0 + (5.902)(2.40) + \frac{1}{2}(0)(2.40)^2$

$X = (5.902)(2.40)$

X = 14.2m from cliff ✓

2/4 c) Sketch plots of x vs. t, v_x vs. t, y vs. t, and v_y vs. t.