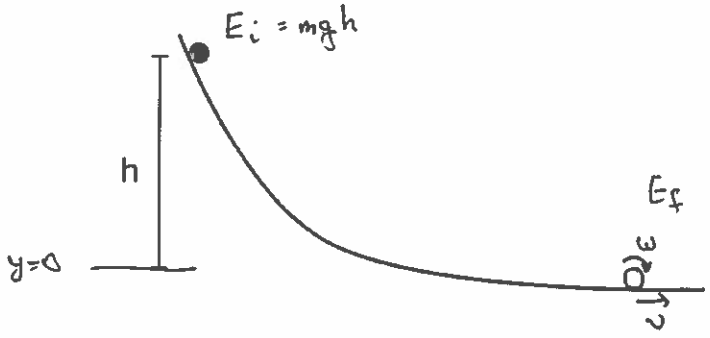
Name: UFID:

PHY2053 Health, Summer C 2016

Quiz 5

Date: Thursday, July 7, 2016

Problem 1: A solid sphere of mass $m = 1.5$ kg and radius $r = 0.10$ m sits a height $h = 5.0$ m above the base of a curved ramp. When the sphere is released, it rolls without slipping down the ramp. Calculate the difference in speed at the base of the ramp between the rolling sphere and a block of the same mass that slides without friction from the same initial height. If there is a difference, which object is traveling faster? Explain your answer.



Ball: $E_i = mgh$

$E_f = \frac{1}{2}mv_{ball}^2 + \frac{1}{2}I\omega^2$ (rotational KE)

all without slipping $v = r\omega \rightarrow \omega = \frac{v_{ball}}{r}$

use $I = \frac{2}{5}mr^2$ for sphere

$\rightarrow E_f = \frac{1}{2}mv_{ball}^2 + \frac{1}{2}\left(\frac{2}{5}mr^2\right)\left(\frac{v_{ball}}{r}\right)^2$

$= \frac{1}{2}m\left(1 + \frac{2}{5}\right)v_{ball}^2$

$= \frac{7}{10}mv_{ball}^2$

$E_i = E_f \rightarrow mgh = \frac{7}{10}mv_{ball}^2$

$v_{ball} = \sqrt{\frac{10}{7}gh} = 8.45$ m/s

Block: $E_i = mgh$

$E_f = \frac{1}{2}mv_{block}^2$ no rotation

$\rightarrow E_i = E_f$

$mgh = \frac{1}{2}mv_{block}^2$

$v_{block} = \sqrt{2gh} = 10$ m/s

So $\Delta v = v_{block} - v_{ball}$

$= 1.55$ m/s

and the block travels faster. All the initial PE went into translation and wasn't split between rotation.

(Problem 2 on the next page)

Problem 2: A city businessman and a grizzled outdoorsman (think Robert Downey Jr. and Kris Kristofferson, resp.) decide to take a trek out into the snow one evening. The businessman wears sleek, pointy shoes, designed for a slim profile, while the outdoorsman wears large, lumbering snowshoes. Assume that each man weighs the same.

(a) If the bottom of the snowshoes have 3 times as much surface area compared to the business shoes, how much pressure does the businessman exert on the surface of the snow compared to the outdoorsman?

(b) If the businessman has a mass of 70 kg and each of his shoes has an area of .004 m^2, how much pressure does he exert on the ground while standing still (on both feet)?

(a)

$P_{business} = \frac{Weight_{bus}}{A_{business}}$ $\quad P_{outdoors} = \frac{Weight_{outdo}}{A_{outdoor}}$ $\quad$ Weights are the same!

$A_{outdoors} = 3\,A_{business}$

Then $\frac{P_{bus}}{P_{out}} = \frac{A_{out}}{A_{bus}} = 3$ so $\boxed{P_{business} = 3\,P_{outdoors}}$

(b) Given $m_b = 70$ kg and $A_{shoe} = 0.004 m^2$, then

$P = \frac{m_b g}{2\,A_{shoe}} = \frac{(70)(10)}{2\,(.004)} = \boxed{87.5\ kPa}$

(weight; 2 shoes!)