Phys101 Assignment Cover Sheet

First Name:_____ Last Name:_____ Mark: _____

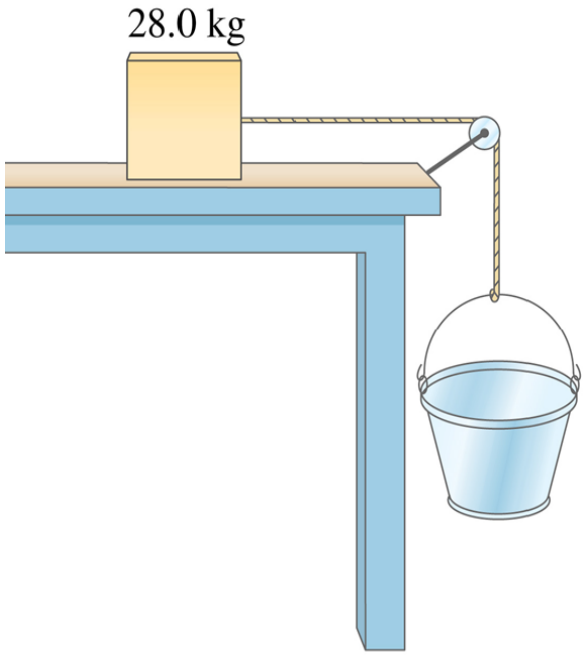
Student ID:_____ Date: _____

Phys101 Written Assignment #3

Due Wed/Thur. Jan 16/27, 2011, at the end of tutorial

Textbook (Giancoli, 6th edition) page 104 problem #76.

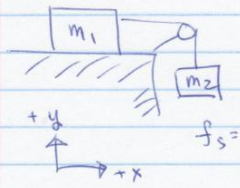
76. A 28.0-kg block is connected to an empty 1.35-kg bucket by a cord running over a frictionless pulley. The coefficient of static friction between the table and the block is 0.450 and the coefficient of kinetic friction between the table and the block is 0.320. Sand is gradually added to the bucket until the system just begins to move. (*a*) Calculate the mass of sand added to the bucket. (*b*) Calculate the acceleration of the system.



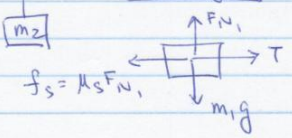
P101 WRITTEN ASSIGNMENT #3

A 28.0 kg block is connected to an empty 1.35 kg bucket by a cord running over a frictionless pulley. The coefficient of static friction between the table and the block is 0.450 and the coefficient of kinetic friction between the table and the block is 0.320. Sand is gradually added to the bucket until the system just begins to move.

a) Calculate the mass of sand added to the bucket.



FBD of m_1:



$\Sigma F_y = m a_y = 0$

$F_N - m_1 g = 0$

$F_{N_1} = m_1 g$

$\Sigma F_x = m_1 a_x = 0$

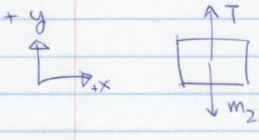
$T - \mu_s F_{N_1} = 0$

$T = \mu_s m_1 g$

$= (0.450)(28.0)(9.8)$

$= 123.5\ N$

FBD of m_2:



$\Sigma F_y = m_2 a_y = 0$

$T - m_2 g = 0$

$123.5 = m_2 (9.8)$

$m_2 = 12.6\ kg$

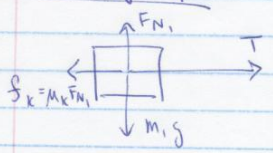
$\therefore m_{SAND} = m_2 - m_{BUCKET}$

$= 12.6 - 1.35$

$m_{SAND} = \underline{11.3\ kg}$

b) Calculate the acceleration of the system:

FBD of m_1:



$$\sum F_y = m_1 a_{y_1} = 0$$

$$F_{N_1} - m_1 g = 0$$

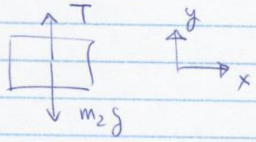
$$F_{N_1} = m_1 g$$

$$\sum F_x = m_1 a_{x_1}$$

$$T - \mu_k F_{N_1} = m_1 a_{x_1}$$

$$T - \mu_k m_1 g = m_1 a_{x_1} \rightarrow T = \mu_k m_1 g + m_1 a_{x_1}$$

FBD of m_2:



$$\sum F_y = m_2 a_{y_2}$$

$$T - m_2 g = m_2 a_{y_2}$$

$$T = m_2 g + m_2 a_{y_2}$$

$$* \; -a_{y_2} = +a_{x_1} = a$$

$$\therefore \mu_k m_1 g + m_1 a = m_2 g - m_2 a$$

$$(m_1 + m_2)\, a = m_2 g - \mu_k m_1 g$$

$$a = \frac{m_2 g - \mu_k m_1 g}{(m_1 + m_2)}$$

$$a = \frac{12.6\,(9.8) - 0.320\,(28.0)(9.8)}{(12.6 + 28.0)}$$

$$a = \frac{123.5 - 87.8}{40.6} = \boxed{0.88 \text{ m/s}^2}$$