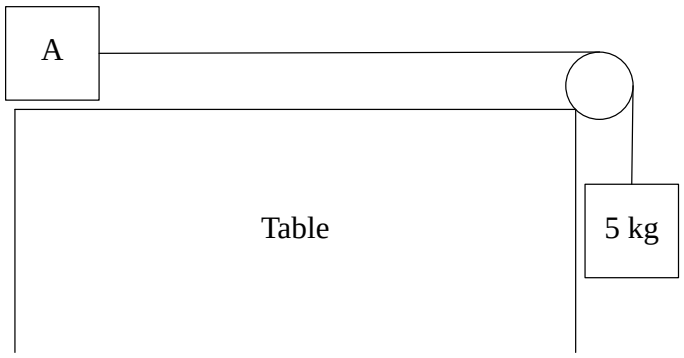
Interacting Objects with Friction

1. (35 pts.) Two blocks are connected by a massless string as shown in the figure. The pulley is frictionless, but the table top has a coefficient of kinetic friction of 0.3. The 5 kg block is released from rest and takes 1.026s to fall 1.5m to the floor. What is the mass of block A?

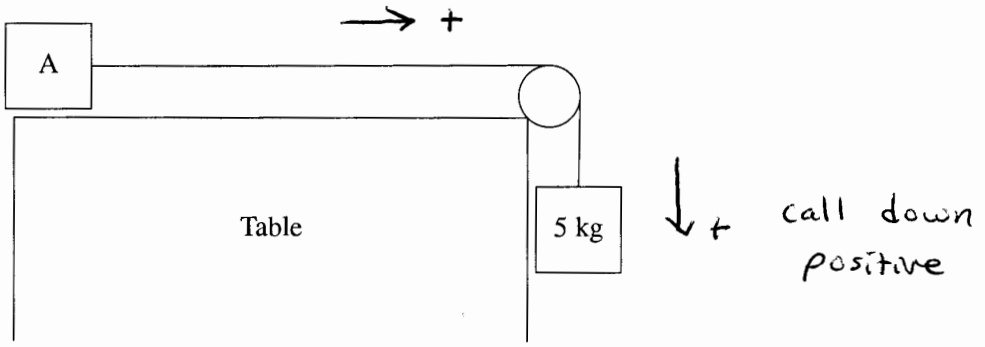


Physics 131-02
Test 1
March 1, 2002

Name: SOLUTIONS

Be sure to show your work **clearly** and **draw a box around your answer**. If any question is unclear, please ask immediately. All answers must have the correct units.

1. (35 pts.) Two blocks are connected by a massless string as shown in the figure. The pulley is frictionless, but the table top has a coefficient of kinetic friction of 0.3. The 5 kg block is released from rest and takes 1.026s to fall 1.5m to the floor.



a. (10 pts.) What is the acceleration of the 5 kg block?

$y = y_0 + v_0 t + \frac{1}{2} a t^2$ For 5kg block,

$1.5 = 0 + 0 + \frac{1}{2} a (1.026)^2$

$a = \frac{2(1.5)}{(1.026)^2} = \boxed{2.85\ m/s^2}$

b. (10 pts.) What is the tension in the string?

$\Sigma F = ma$

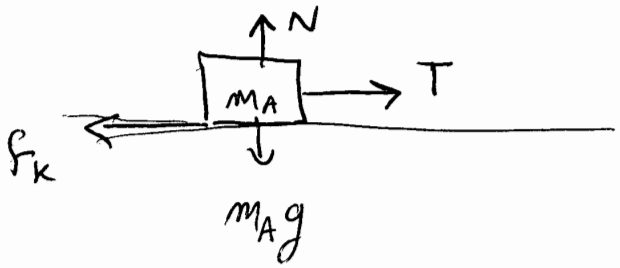
$mg - T = ma$

$T = m(g-a)$

$= 5(9.8 - 2.85)$

$T = 34.75\ N$

c. (15 pts.) What is the mass of block A?



$\Sigma F_y = m a_y$

$N - mg = 0$

$N = mg$

$\Sigma F_x = m a_x$

$T - f_k = ma$

$T - \mu_k N = ma$

$T - \mu_k mg = ma$

$T = m(a + \mu_k g)$

but $T = 34.75\ N$

$a = 2.85\ m/s^2$

$\mu_k = 0.3$

$m = \dfrac{T}{a + \mu_k g} = \boxed{6.00\ kg}$