Reading
if haven't finished chp 4, finish

# FRICTION

## Static

$$F \leq \mu_s F_N$$

$$F_{max} = \mu_s F_N$$

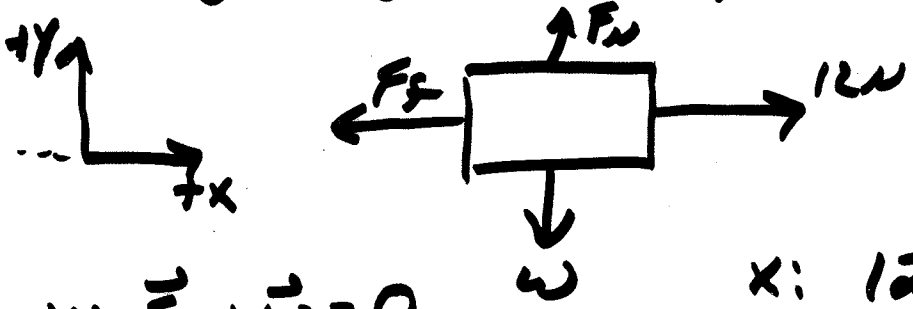
## KINETIC

$$F = \mu_k F_N$$

A 3.0 kg block is <u>at rest</u> on a horizontal floor. You push horizontally on the block with a force of 12 N and it <u>just starts</u> to move.

a) what is the coefficient of static friction

b) Place a 7 kg block on top. What force is required to just make blocks move?




y: $\vec{F}_N + \vec{w} = 0$

$F_N - w = 0$

$F_N = w = mg$

x: $12N - F_f = 0$

$12N - \underbrace{F_{f\,max}}_{\mu_s F_N} = 0$

$12N - \mu_s (mg) = 0$

$\mu_s = \frac{12N}{mg} = \boxed{.41}$

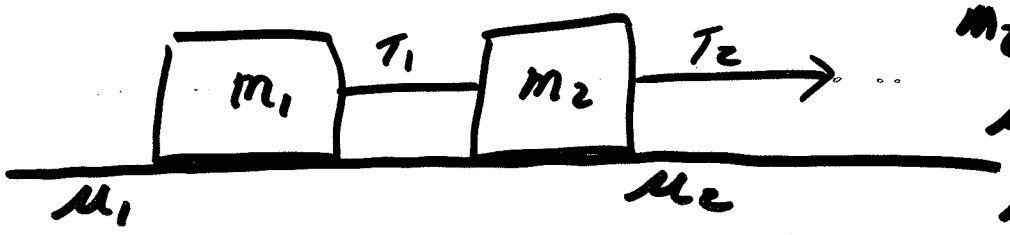
b) $F_{max} = \mu_s F_N$

$F_N = w = mg$


$m = 10kg$

$F_{max} = (.41)(10kg)(9.8m/s^2) = \underline{\boxed{40N}}$

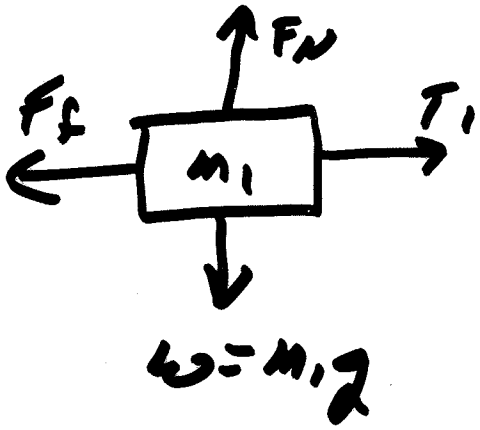
# Place sideways

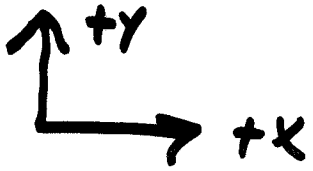



$m_1 = 2kg$
$m_2 = 3kg$
$\mu_1 = .2$
$\mu_2 = .1$

move at constant velocity.

what are tensions $T_1$ and $T_2$




$\xrightarrow{+}$

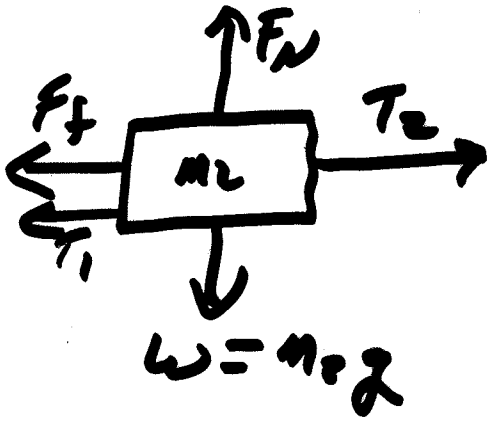
$X: \; T_1 - F_f = 0$

$Y: \; F_N - w = 0$

$F_N = w$

$X: \; T_1 = F_f = \mu_1 F_N = \mu_1 (m_1 g) = .2\,(2kg)(9.8 m/s^2)$

$= \underline{3.9 N}$




$X: \; T_2 - F_f - T_1 = 0$

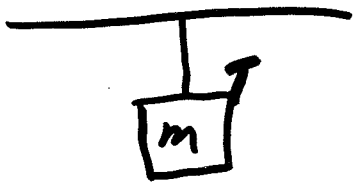
$T_2 = T_1 + F_f \qquad F_N = w$

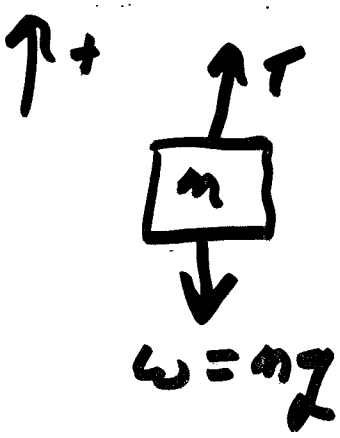
$= 3.9N + \mu_2 (m_2 g)$

$= 3.9N + (.1)(3kg)(9.8 m/s^2)$

$= \underline{6.8 N}$

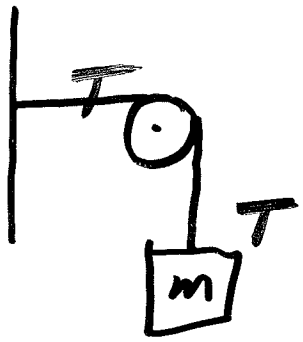
# Pulleys (massless frictionless)

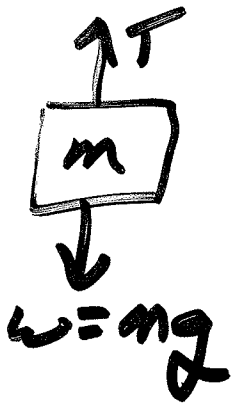



$T - mg = 0$

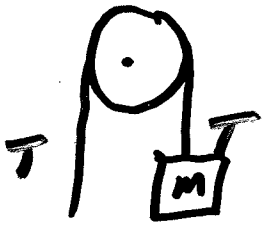
$T = mg$



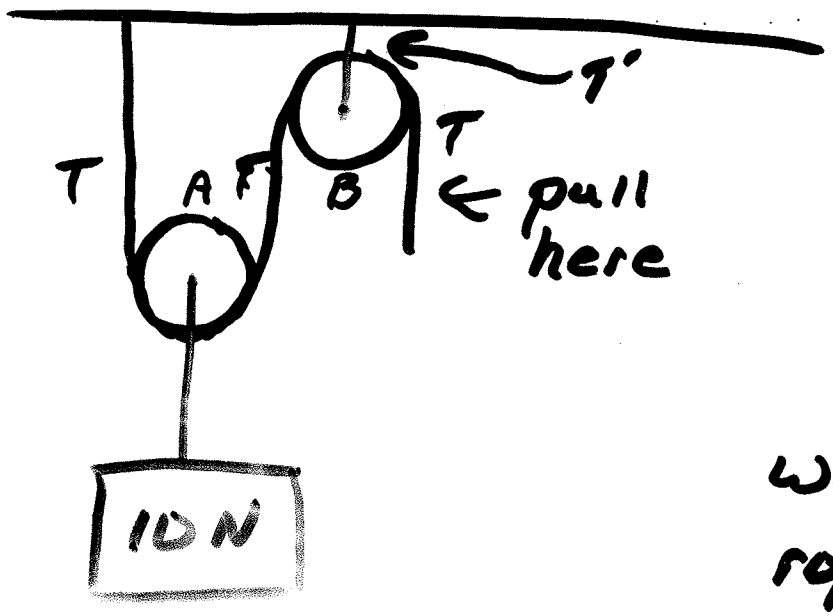




$T - mg = 0$

$T = mg$

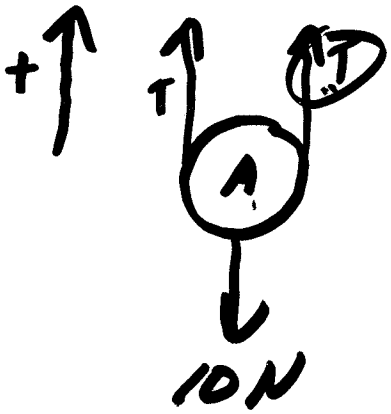


# 2 pulleys




what force is required to hold weight?

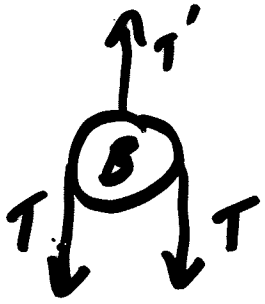
what is tension on rope holding pulley B?




$T + T - 10N = 0$

$2T = 10N$

$\underline{T = 5N}$




$T' - T - T = 0$

$T' - 2T = 0$

$T' = 2T$

$T' = 2.5N = \underline{10N}$

# Interactive Question

How does the tension in the string in Figure (a) compare with the tension in the string in Figure (b)?

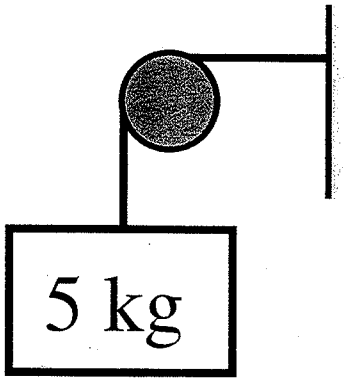



Figure (a)

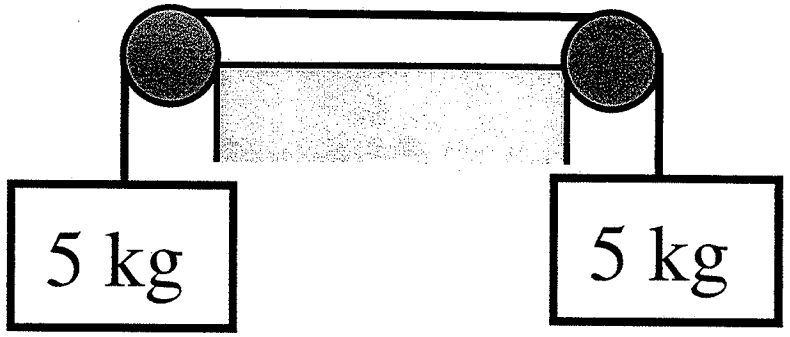



Figure (b)

A) They are the same
B) Figure (a) is greater
C) Figure (b) is greater
D) It is impossible to tell

# Newton's 2nd Law

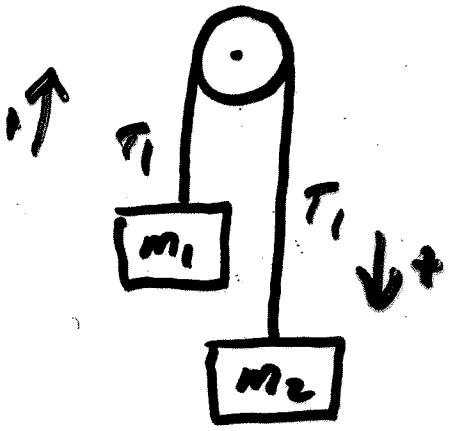
$$\vec{F}_{net} = m\vec{a}$$

Look at cases where $\vec{a} \neq 0$

## To solve

1) DRAW FREE Body Diagram
2) Add/subtract forces shown on FBD
3) Do NOT put #'s in until end of problem
4) make sure answer is reasonable

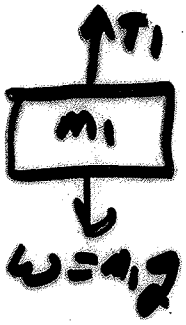
$\vec{F}_{net} = m\vec{a}$ $\quad \vec{a} \neq 0$

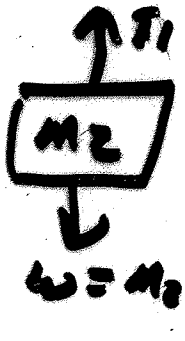



$m_1 = 10\,kg$

$m_2 = 14\,kg$

Determine $\vec{a}$




$T_1 - m_1 g = m_1 a$ $\qquad$ $-T_1 + m_2 g = m_2 a$

$T_1 = m_1 a + m_1 g$ $\qquad$ $T_1 = -m_1 a + m_2 g$