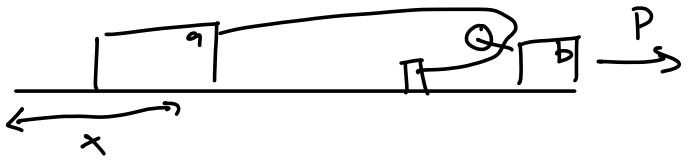
HW 05

$W_a = 16N$
$W_b = 4N$
no $f_{s/k}$

(588)



$w = mg \Rightarrow m = \frac{w}{g}$ $\quad m_a = \frac{16N}{9.8 m/s^2} = 1.6 kg = m_a$

$m_b = \frac{4N}{9.8 m/s^2} \Rightarrow m_b = .4 kg$

$[x_a = 2t^3]'' \Rightarrow a_a = 12t$

FBD – Pulley

$\uparrow T_s$
$\uparrow T_a$
$\downarrow T_b$

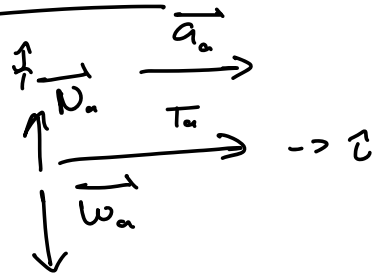
$T_s + T_a = T_b$

$T_s = T_a$ $\quad 2T_a = T_b$

$a_a = 2a_b$

$a_b = 6t$

FBD-A

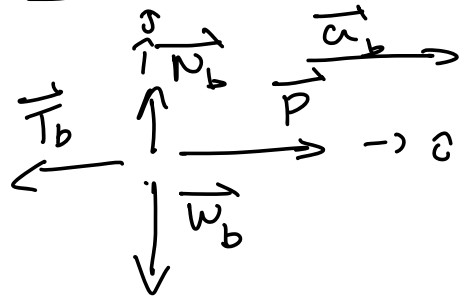


	$\hat{i}$	$\hat{j}$
$\vec{w}_a$	0	$-16N$
$\vec{N}_a$	0	N_a
$\vec{T}_a$	T_a	0
$\vec{a}_a$	$m_a a_a$	0

$N_a = 16N$

$m_a a_a = T_a$

FBD - B



	$\hat{i}$	$\hat{j}$
$\vec{w}_b$	0	$-4N$
$\vec{N}_b$	0	N_b
$\vec{P}$	P	0
$\vec{T}_b$	$-T_b$	0
$\vec{a}_b$	$m_b a_b$	0

$P = 2T_a + m_b a_b$

$P = 2 m_a a_a + m_b a_b$

$P = 2 m_a a_a + m_b + a_b$

$a_a = 2 a_b$ so $= (4 m_a + m_b) m_b$

$m_b a_b = P - T_b$

&

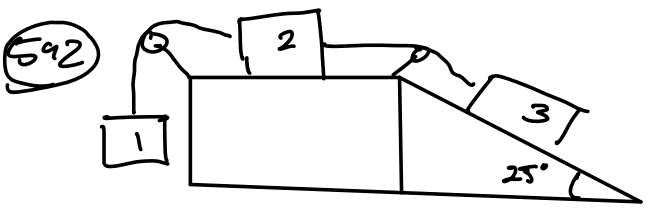
$m_a a_a = T_a$

$m_b a_b = P - T_b \Rightarrow m_b a_b = P - 2T_a \Rightarrow P = m_b a_b + 2T_a$

$P = m_b a_b + 2 m_a a_a \Rightarrow P = a_b(m_b + 4m_a)$

$P = a_b\left(\frac{w_b + 4w_a}{g}\right) \Rightarrow P = 6(5)\left(\frac{4 + 4(16)}{9.81}\right) \Rightarrow \boxed{P = 208\,N}$

6.92



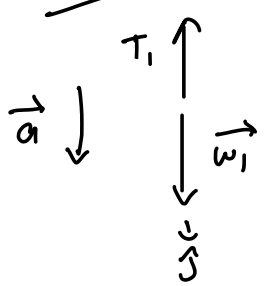
$m_1 = 10.0\,kg$

$m_2 = 5.0\,kg$

$m_3 = 3.0\,kg$

$a = 2.35\,m/s^2$ ←

FBD-1



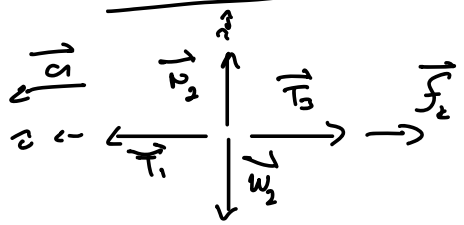
	$\hat{j}$
$\vec{w}_1$	$m_1 g$
$\vec{T}_1$	$-T_1$
$\vec{a}$	$m_1 a$

$m_1 a = m_1 g - T_1$

$T_1 = m_1 g - m_1 a$

$\boxed{T_1 = 74.5\,N}$

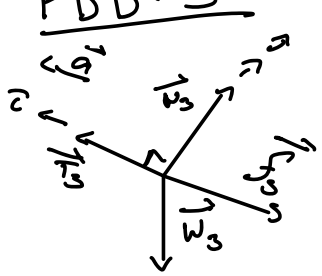
FBD-2



	$\hat{i}$	$\hat{j}$
$\vec{w}_2$	0	$-m_2 g$
$\vec{N}_2$	0	$m_2 g$
$\vec{T}_1$	T_1	0
$\vec{T}_3$	$-T_3$	0
f_k	$-\mu_k m_2 g$	0
$\vec{a}$	$m_2 a$	0

$m_2 a = T_1 - T_3 - \mu_k m_2 g$

FBD-3



	$\hat{i}$	$\hat{j}$
$\vec{W}_3$	$-m_3 g \sin 25$	$-m_3 g \cos 25$
$\vec{N}_3$	0	N_3
$\vec{T}_3$	T_3	$\cdot$
$\vec{f}_s$	$-\mu_k N_3$	0
$\vec{a}$	$m_3 a$	0

$\sin 25 = \frac{x}{w}$

$N_3 = m_3 g \cos 25$

$f_s = -\mu_k m_3 g \cos 25$

$m_3 a = T_3 - m_3 g \sin 25 - \mu_k m_3 g \cos 25$

+

$m_2 a = T_1 - T_3 - \mu_k m_2 g$

$a(m_3 + m_2) = T_1 - m_3 g \sin 25 - \mu_k m_2 g - \mu_k m_3 g \cos 25$

$a(m_3 + m_2) - T_1 + m_3 g \sin 25 = -\mu_k (m_2 g + m_3 g \cos 25)$

$$\mu_k = - \frac{a(m_3 + m_2) - T_1 + m_3 g \sin 25}{m_2 g + m_3 g \cos 25}$$

$$\mu_k = - \frac{2.35 m/s^2 (8.0 kg) - 74.5 N + 3.0 kg (9.8 m/s^2) \sin 25}{5.0 kg (9.8 m/s^2) + 3.0 kg (9.8 m/s^2) \cos 25}$$

$\mu_k = .57$

$m_2 a = T_1 - T_3 - \mu_k m_2 g \Rightarrow T_3 = T_1 - \mu_k m_2 g - m_2 a$

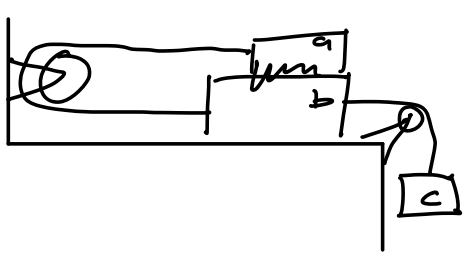
$T_3 = 74.5N - .57(5.0kg(9.8m/s^2)) - 5.0kg(2.35m/s^2)$

$T_3 = 34.7N$

(a) $T_1 = 74.5N$ $\quad T_3 = 34.7N$

(b) $\mu_k = .57$

5.93



(a)

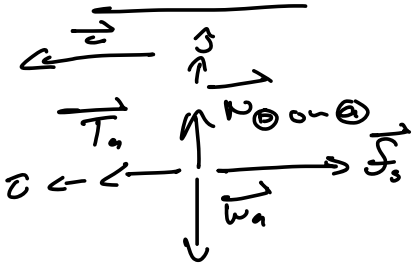
$m_a = 2kg$

$m_b = 3kg$

$m_c = 10kg$

$\mu_k = .30$

FBD – A



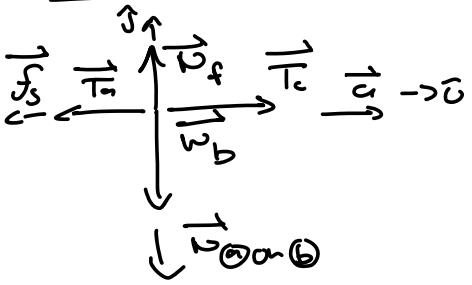
	$\hat{i}$	$\hat{j}$
$\vec{w}_a$	0	$-m_a g$
$\vec{N}_{\textcircled{B} \text{ on } \textcircled{A}}$	0	$N_{\textcircled{B} \text{ on } \textcircled{A}}$
$\vec{T}_a$	T_a	0
$\vec{f}_s$	$-\mu_k N_{\textcircled{B} \text{ on } \textcircled{A}}$	0
$\vec{a}$	$m_a a$	0

$N_{\textcircled{B} \text{ on } \textcircled{A}} = m_a g$

$f_s = -\mu_k m_a g$

$m_a a = T_a - \mu_k m_a g$

FBD - B

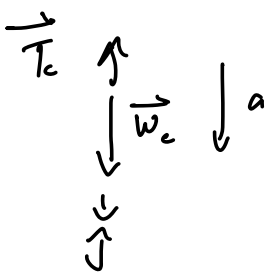


	$\hat{i}$	$\hat{j}$
$\vec{w_b}$	0	$-m_b g$
$\vec{N}_{@a on b}$	0	$-m_a g$
$\vec{N_f}$	0	N_f
$\vec{T_a}$	$-T_a$	0
$\vec{T_c}$	T_c	0
$\vec{f_s}$	$-\mu_k m_a g$	0
$\vec{a}$	$m_b a$	0

$N_f = g(m_a + m_b)$

$m_b a = T_c - T_a - \mu_k m_a g$

FBD - C



	$\hat{j}$
$\vec{w_c}$	$m_c g$
$\vec{T_c}$	$-T_c$
$\vec{a}$	$m_c a$

$m_c a = m_c g - T_c$

$m_a a = T_a - \mu_k m_a g$

+

$m_b a = T_c - T_a - \mu_k m_a g$

$\Rightarrow a(m_a + m_b) = T_c - 2\mu_k m_a g$

+

$m_c a = m_c g - T_c$

$\Rightarrow a(m_a + m_b + m_c) = m_c g - 2\mu_k m_a g$

$\Rightarrow a = \dfrac{m_c g - 2\mu_k m_a g}{m_a + m_b + m_c} \Rightarrow a = \dfrac{10kg(9.8 m/s^2) - 2(.30(2kg(9.8 m/s^2)}{2kg + 3kg + 10kg}$

(b)

$\boxed{a = 5.75 m/s^2}$

(c) $m_a a = T_a - \mu_k m_a g \Rightarrow T_a = m_a a + \mu_k m_a g$

$T_a = 2kg(5.75 m/s^2) + .30(2kg)(9.8 m/s^2) \Rightarrow T_a = 17.4 N$

$\boxed{T_a = 17N}$

$m_c a = m_c g - T_c \Rightarrow T_c = m_c g - m_c a \Rightarrow T_c = m_c(g - a)$

$T_c = 10kg(9.8 m/s^2 - 5.75 m/s^2) \Rightarrow T_c = 40.5 N \Rightarrow \boxed{T_c = 40 N}$