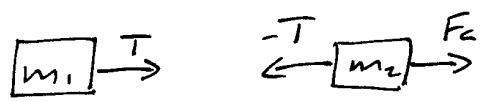
Tension, Pulleys + Ramps Practice

1 (a) $-\longleftrightarrow+$



$\Sigma F_1 = m_1 a$ $\quad$ $\Sigma F_2 = m_2 a$

$T = m_1 a$ $\quad$ $-T + F_a = m_2 a$

(b)
$$\begin{aligned} T &= m_1 a \\ +\ -T + F_a &= m_2 a \end{aligned}$$

$$F_a = (m_1 + m_2)\, a$$

$$\frac{F_a}{m_1 + m_2} = a$$

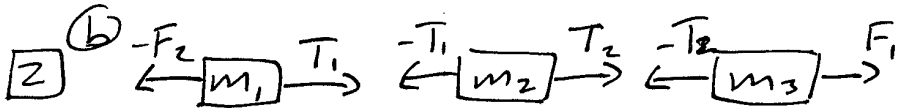
$$\frac{10\,N}{4\,kg + 10\,kg} = \boxed{a = 0.714\ m/s^2}$$

(c) $T = m_1 a$

$T = (4\,kg)(0.714\ m/s^2)$

$\boxed{T = 2.857\,N}$

2 (b)



(a) $\Sigma F_1 = m_1 a$ $\quad$ $\Sigma F_2 = m_2 a$ $\quad$ $\Sigma F_3 = m_3 a$

$-F_2 + T_1 = m_1 a$ $\quad$ $-T_1 + T_2 = m_2 a$ $\quad$ $-T_2 + F_1 = m_3 a$

$T_1 = m_1 a + F_2$ $\quad$ $T_2 = F_1 - m_3 a$

$$-T_1 + T_2 = m_2 a$$

$$-(m_1 a + F_2) + F_1 - m_3 a = m_2 a$$

$$-F_2 + F_1 = m_2 a + m_3 a + m_1 a$$

$$\frac{-F_2 + F_1}{m_2 + m_3 + m_1} = a$$

$$\frac{-19.6 + 9.8}{3 + 2 + 8} = \boxed{-0.754\ m/s^2 = a}$$

(c) $T_1 = m_1 a + F_2$ $\quad$ $T_2 = F_1 - m_3 a$

$T_1 = (3\,kg)(.754\ m/s^2) + 19.6\,N$ $\quad$ $T_2 = 9.8\,N - (8\,kg)(0.754\ m/s^2)$

$\boxed{T_1 = 17.3\,N}$ $\quad$ $\boxed{T_2 = 15.83\,N}$

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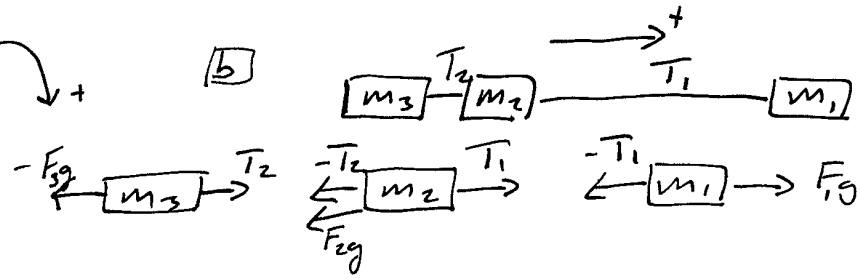
(a) (b)



(c)

$\Sigma F_3 = m_3 a$ | $\Sigma F_2 = m_2 a$ | $\Sigma F_1 = m_1 a$

$T_2 - F_{3g} = m_3 a$ | $-T_2 + T_1 - F_{2g} = m_2 a$ | $-T_1 + F_{1g} = m_1 a$

$T_2 - m_3 g = m_3 a$ | $-T_2 + T_1 - m_2 g = m_2 a$ | $-T_1 + m_1 g = m_1 a$

can also set it up

$-F_{g\,m_1,m_2} \leftarrow [\,m_3 + m_2\,] \rightarrow T_1$

$T_2 = m_3 (g + a)$ | $T_1 = m_1 (g - a)$

$-(m_3 (g+a)) + m_1 (g-a) - m_2 g = m_2 a$

$-m_3 g - m_3 a + m_1 g - m_1 a - m_2 g = m_2 a$

$-m_3 g + m_1 g - m_2 g = (m_2 + m_3 + m_1) a$

$$a = \frac{-m_3 g + m_1 g - m_2 g}{m_2 + m_3 + m_1} = \frac{9.8(-2\,kg + 6\,kg - 3\,kg)}{2\,kg + 6\,kg + 3\,kg} = \frac{9.8\,(1)}{11}$$

$a = 0.8909\ m/s^2$

(d)

$T_2 = m_3 (g + a)$

$T_2 = 2\,kg\,(9.8 + 0.8909)$

$T_2 = 21.3818$

$T_2 = 20\,N$

$T_1 = m_1 (g + a)$

$T_1 = 6\,kg\,(9.8 - 0.8909)$

$T_1 = 52.385$

$T_1 = 50\,N$

→ +

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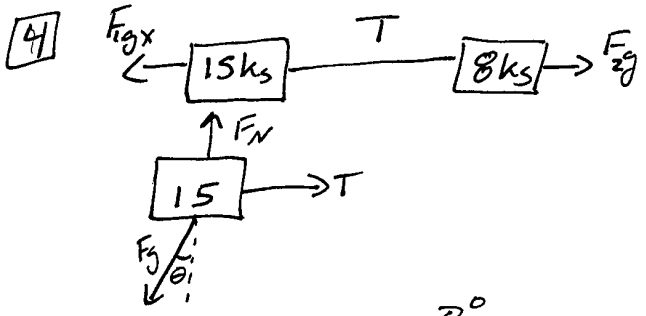


$$\Sigma F_x = T - F_{gx} = ma^{\circ}$$

$$T - F_g \sin\theta = 0$$

$$T = 15\,kg\, g \sin\theta$$

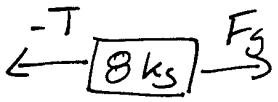
$$\sin\theta = \frac{T}{(15\,kg)(9.8\,m/s^2)}$$

$$\theta = \sin^{-1}\left(\frac{T}{m_{15}\, g}\right)$$

$$\theta = \sin^{-1}\left(\frac{78.4\,N}{(15\,kg)(9.8\,m/s^2)}\right)$$

$$\theta = 32.23^{\circ}$$

$$\boxed{\theta = 30^{\circ}}$$



$$\Sigma F = ma^{\circ}$$

$$-T + F_g = 0$$

$$F_g = T$$

$$8\,kg\, g = T$$

$$8\,kg\,(9.8\,m/s^2) = T$$

$$78.4 = T$$