

Single Body Analysis #4

$$m_1 g - \cancel{T_{1,2}} = m_1 a$$

$$\cancel{T_{1,2}} + m_2 g - \cancel{T_{2,3}} = m_2 a$$

$$\cancel{T_{2,3}} - \cancel{T_{3,4}} = m_3 a$$

$$\cancel{T_{3,4}} = m_4 a$$

$$m_1 g + m_2 g = m_1 a + m_2 a + m_3 a + m_4 a$$

$$m_1 g + m_2 g = (m_1 + m_2 + m_3 + m_4) a$$

$$\frac{m_1 g + m_2 g}{m_1 + m_2 + m_3 + m_4} = a$$

$$a = \frac{m_1 g + m_2 g}{m_1 + m_2 + m_3 + m_4}$$

$$T_{3,4} = m_4 a$$

Single Body Analysis #4 (continued)

$$m_1 g - T_{1,2} = m_1 a$$

$$(-T_{1,2}) = m_1 a - m_1 g$$

$$T_{1,2} = -(m_1 a - m_1 g)$$

$$T_{1,2} + m_2 g - T_{2,3} = m_2 a$$

$$T_{1,2} + m_2 g = m_2 a + T_{2,3}$$

$$T_{1,2} + m_2 g - m_2 a = T_{2,3}$$

$$T_{2,3} = T_{1,2} + m_2 g - m_2 a$$

Single Body Analysis #4 (continued)

Var	Given value	Units	Description
g	10	$\frac{\text{m}}{\text{s}^2}$	Acceleration due to gravity
m_1	45	kg	Mass 1
m_2	20	kg	Mass 2
m_3	25	kg	Mass 3
m_4	30	kg	Mass 4
a		$\frac{\text{m}}{\text{s}^2}$	Acceleration
$T_{1,2}$		N	Tension 1
$T_{2,3}$		N	Tension 2
$T_{3,4}$		N	Tension 3

$$\begin{aligned}
 a &= \frac{m_1 g + m_2 g}{m_1 + m_2 + m_3 + m_4} \\
 &= \frac{(45 \text{ kg}) \left(10 \frac{\text{m}}{\text{s}^2}\right) + (20 \text{ kg}) \left(10 \frac{\text{m}}{\text{s}^2}\right)}{(45 \text{ kg}) + (20 \text{ kg}) + (25 \text{ kg}) + (30 \text{ kg})}
 \end{aligned}$$

Single Body Analysis #4 (continued)

$$= \boxed{5.42 \frac{\text{m}}{\text{s}^2}} \quad \checkmark$$

$$T_{3,4} = m_4 a$$

$$= (30 \text{ kg}) \left(5.416666667 \frac{\text{m}}{\text{s}^2} \right)$$

$$= \boxed{162.5 \text{ N}} \quad \checkmark$$

$$T_{1,2} = -(m_1 a - m_1 g)$$

$$= -\left((45 \text{ kg}) \left(5.416666667 \frac{\text{m}}{\text{s}^2} \right) - (45 \text{ kg}) \left(10 \frac{\text{m}}{\text{s}^2} \right) \right)$$

$$= \boxed{206.3 \text{ N}} \quad \checkmark$$

Single Body Analysis #4 (continued)

$$T_{2,3} = T_{1,2} + m_2 g - m_2 a$$

$$= (206.2\text{N}) + (20\text{kg})\left(10 \frac{\text{m}}{\text{s}^2}\right) - (20\text{kg})\left(5.416666667 \frac{\text{m}}{\text{s}^2}\right)$$

$$= \boxed{297.9\text{N}} \quad \checkmark$$