

Single Body Analysis #3

Var	Given value	Units	Description
g	10	$\frac{\text{m}}{\text{s}^2}$	Acceleration due to gravity
m_1	11	kg	Mass 1
m_2	22	kg	Mass 2
m_3	999	kg	Mass 3
m_4	30	kg	Mass 4
a		$\frac{\text{m}}{\text{s}^2}$	Acceleration
T_1		N	Tension 1
T_2		N	Tension 2
T_3		N	Tension 3

$$m_1 g - T_1 = m_1 a$$

$$T_1 + m_2 g - T_2 = m_2 a$$

$$T_2 - T_3 = m_3 a$$

$$T_3 = m_4 a$$

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

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

Single Body Analysis #3 (continued)

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

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

$$= \frac{(11 \text{ kg}) \left(10 \frac{\text{m}}{\text{s}^2}\right) + (22 \text{ kg}) \left(10 \frac{\text{m}}{\text{s}^2}\right)}{(11 \text{ kg}) + (22 \text{ kg}) + (999 \text{ kg}) + (30 \text{ kg})}$$

$$= \boxed{0.3107344633 \frac{\text{m}}{\text{s}^2}} \quad \checkmark$$

$$T_3 = m_4 a$$

$$= (30 \text{ kg}) \left(0.3107344633 \frac{\text{m}}{\text{s}^2}\right)$$

$$= \boxed{9.322033899 \text{ N}} \quad \checkmark$$

Single Body Analysis #3 (continued)

$$m_1 g - T_1 = m_1 a$$

$$(-T_1) = m_1 a - m_1 g$$

$$T_1 = -(m_1 a - m_1 g)$$

$$= -\left((11 \text{ kg})\left(0.3107344633 \frac{\text{m}}{\text{s}^2}\right) - (11 \text{ kg})\left(10 \frac{\text{m}}{\text{s}^2}\right)\right)$$

$$= \boxed{106.5819209 \text{ N}} \quad \checkmark$$

$$T_1 + m_2 g - T_2 = m_2 a$$

$$T_1 + m_2 g = m_2 a + T_2$$

$$T_1 + m_2 g - m_2 a = T_2$$

$$T_2 = T_1 + m_2 g - m_2 a$$

$$= (106.5819209 \text{ N}) + (22 \text{ kg})\left(10 \frac{\text{m}}{\text{s}^2}\right) - (22 \text{ kg})\left(0.3107344633 \frac{\text{m}}{\text{s}^2}\right)$$

Single Body Analysis #3 (continued)

$$= 319.7457627 \text{ N}$$

