Single Body Analysis #4

Var	Given value	Units	Description
g	10	$\frac{m}{s^2}$	Acceleration due to gravity
m_1	20	kg	Mass 1
m_2	17	kg	Mass 2
m_3	5	kg	Masss 3
m_4	72	kg	Mass 4
a		$\frac{m}{s^2}$	Acceleration
T_1		N	Tension 1
T_2		N	Tension 2
T_3		N	Tension 3

$$T_1 - m_1 g = m_1 a$$

$$T_2 - T_1 = m_2 a$$

$$T_3 - T_2 = m_3 a$$

$$m_4 g - T_3 = m_4 a$$

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

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

Single Body Analysis #4 (continued)

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

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

$$= \frac{(72\,\text{kg})\left(10\,\frac{\text{m}}{\text{s}^2}\right) - (20\,\text{kg})\left(10\,\frac{\text{m}}{\text{s}^2}\right)}{(20\,\text{kg}) + (17\,\text{kg}) + (5\,\text{kg}) + (72\,\text{kg})}$$

$$= \boxed{4.561403509\,\frac{\text{m}}{\text{s}^2}} \quad \checkmark$$

$$m_4 g - T_3 = m_4 a$$

$$m_4 g = m_4 a + T_3$$

$$m_4 g - m_4 a = T_3$$

$$T_3 = m_4 g - m_4 a$$

$$= (72\,\text{kg})\left(10\,\frac{\text{m}}{\text{s}^2}\right) - (72\,\text{kg})\left(4.561403509\,\frac{\text{m}}{\text{s}^2}\right)$$

Single Body Analysis #4 (continued)

$$= \boxed{391.5789474\,\text{N}} \quad \checkmark$$

$$T_3 - T_2 = m_3 a$$

$$T_3 = m_3 a + T_2$$

$$T_3 - m_3 a = T_2$$

$$T_2 = T_3 - m_3 a$$

$$= (391.5789474\,\text{N}) - (5\,\text{kg})\left(4.561403509\,\frac{\text{m}}{\text{s}^2}\right)$$

$$= \boxed{368.7719299\,\text{N}} \quad \checkmark$$

Single Body Analysis #4 (continued)

$$T_1 - m_1 g = m_1 a$$

$$T_1 = m_1 a + m_1 g$$

$$= (20\,\text{kg})\left(4.561403509\,\frac{\text{m}}{\text{s}^2}\right) + (20\,\text{kg})\left(10\,\frac{\text{m}}{\text{s}^2}\right)$$

$$= \boxed{291.2280702\,\text{N}}$$ ✓