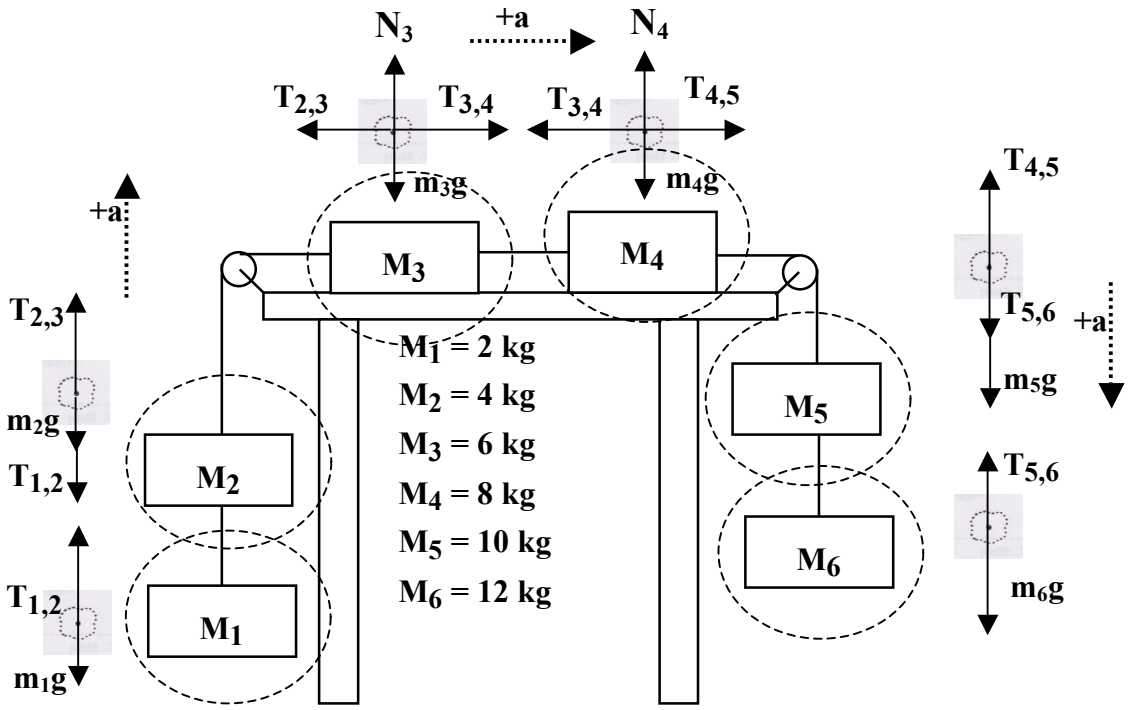
Single Body Analysis #7

N = $F_{surface,box\perp}$ = Normal Force, T = $F_{rope,box}$, Fearth, box = mg)



$T_{1,2} - m_1 g$	$= m_1 a$
$T_{2,3} - T_{1,2} - m_2 g$	$= m_2 a$
$T_{3,4} - T_{2,3}$	$= m_3 a$
$T_{4,5} - T_{3,4}$	$= m_4 a$
$T_{5,6} + m_5 g - T_{4,5}$	$= m_5 a$
$m_6 g - T_{5,6}$	$= m_6 a$

$$m_6 g + m_5 g - m_2 g - m_1 g = m_1 a + m_2 a + m_3 a + m_4 a + m_5 a + m_6 a$$

$$m_6 g + m_5 g - m_2 g - m_1 g = (m_1 + m_2 + m_3 + m_4 + m_5 + m_6) a$$

$$\boxed{a = \frac{m_6 g + m_5 g - m_2 g - m_1 g}{(m_1 + m_2 + m_3 + m_4 + m_5 + m_6)}}$$

$$a = \frac{(12\text{kg})\left(10\ \text{m/s}^2\right) + (10\text{kg})\left(10\ \text{m/s}^2\right) - (4\text{kg})\left(10\ \text{m/s}^2\right) - (2\text{kg})\left(10\ \text{m/s}^2\right)}{(2\text{kg}) + (4\text{kg}) + (6\text{kg}) + (8\text{kg}) + (10\text{kg}) + (12\text{kg})}$$

$$\boxed{a = 3.81\ \text{m/s}^2}$$

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

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

$$T_{1,2} = (2\text{kg})\left(3.81\ \text{m/s}^2\right) + (2\text{kg})\left(10\ \text{m/s}^2\right)$$

$$\boxed{T_{1,2} = 27.6\ \text{N}}$$

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

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

$$T_{2,3} = (4\text{kg})\left(3.81\ \text{m/s}^2\right) + (27.6\ \text{N}) + (4\text{kg})\left(10\ \text{m/s}^2\right)$$

$$\boxed{T_{2,3} = 82.8\ \text{N}}$$

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

$$T_{3,4} = m_3 a + T_{2,3}$$

$$T_{3,4} = (6\text{kg})\left(3.81\ \text{m/s}^2\right) + (82.8\ \text{N})$$

$$\boxed{T_{3,4} = 105.7\ \text{N}}$$

$$T_{4,5} - T_{3,4} = m_4 a$$

$$T_{4,5} = m_4 a + T_{3,4}$$

$$T_{4,5} = (8\text{kg})\left(3.81\ \text{m/s}^2\right) + (105.7\ \text{N})$$

$$\boxed{T_{4,5} = 136.2\ \text{N}}$$

$$T_{5,6} + m_5 g - T_{4,5} = m_5 a$$

$$T_{5,6} - T_{4,5} = m_5 a - m_5 g$$

$$T_{5,6} = m_5 a - m_5 g + T_{4,5}$$

$$T_{5,6} = (10\text{kg})\left(3.81\ \text{m/s}^2\right) - (10\text{kg})\left(10\ \text{m/s}^2\right) + (136.2\ \text{N})$$

$$\boxed{T_{5,6} = 74.3\ \text{N}}$$

$$m_6 g - T_{5,6} = m_6 a$$

$$-T_{5,6} = m_6 a - m_6 g$$

$$T_{5,6} = -(m_6 a - m_6 g)$$

$$T_{5,6} = 12\ kg\ 10\ \text{m/s}^2 - 12\ kg\ 3.81\ \text{m/s}^2$$

$$\boxed{T_{5,6} = 74.3N}$$