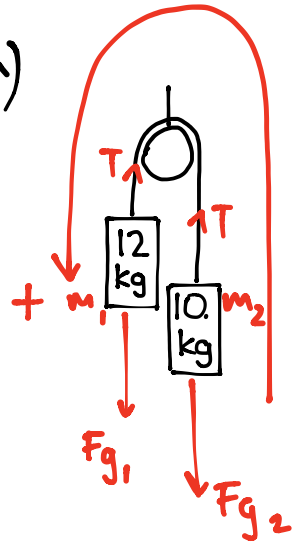
MULTI-BODY SYSTEMS - SOLUTIONS

1. a)



$$F_{NET} = Ma$$

$$F_{g_1} - T + T - F_{g_2} = Ma$$

$$F_{g_1} - F_{g_2} = Ma$$

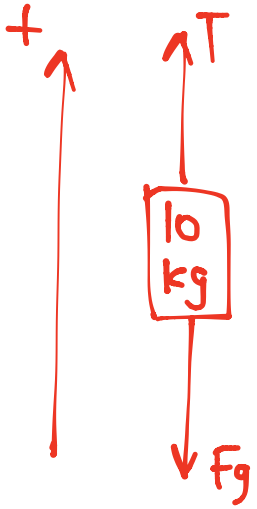
$$m_1 g - m_2 g = Ma$$

$$a = \frac{m_1 g - m_2 g}{M}$$

$$= \frac{(m_1 - m_2)}{M} g$$

$$= \frac{(12-10)}{22}(9.8)$$

$$= 0.89 \frac{m}{s^2} \text{ LEFT}$$



$$F_{NET} = ma$$

$$T - F_g = ma$$

$$T - mg = ma$$

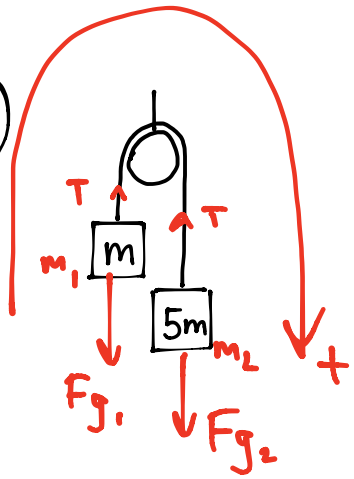
$$T = ma + mg$$

$$= m(a+g)$$

$$= 10(0.89 + 9.8)$$

$$= 110 \text{ N}$$

b)



$$F_{NET} = Ma$$

$$F_{g_2} - T + T - F_{g_1} = Ma$$

$$F_{g_2} - F_{g_1} = Ma$$

$$m_2 g - m_1 g = Ma$$

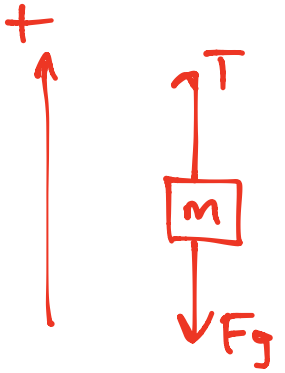
$$a = \frac{m_2 g - m_1 g}{M}$$

$$= \frac{m_2 - m_1}{M} g$$

$$= \frac{5m - m}{6m} (9.8)$$

$$= \frac{4m}{6m} (9.8)$$

$$= 6.5 \frac{m}{s^2} \text{ Right}$$



$$F_{NET} = ma$$

$$T - F_g = ma$$

$$T - mg = ma$$

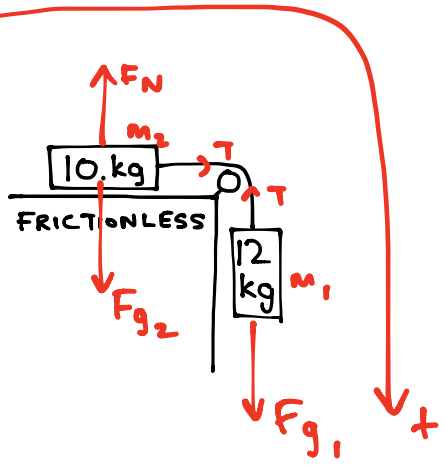
$$T = ma + mg$$

$$= m(a+g)$$

$$= m(6.5 + 9.8)$$

$$= 16.3m \text{ N}$$

c)



$$F_{NET} = Ma$$

$$F_{g_1} - T + T = Ma$$

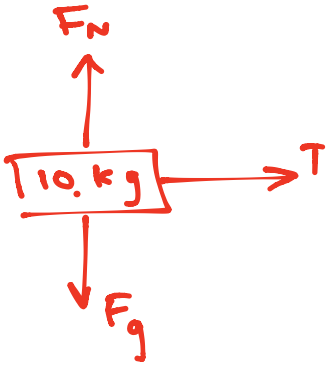
$$F_{g_1} = Ma$$

$$m_1 g = Ma$$

$$a = \frac{m_1 g}{M}$$

$$= \frac{12(9.8)}{22}$$

$$= 5.3 \frac{m}{s^2} \text{ Right}$$



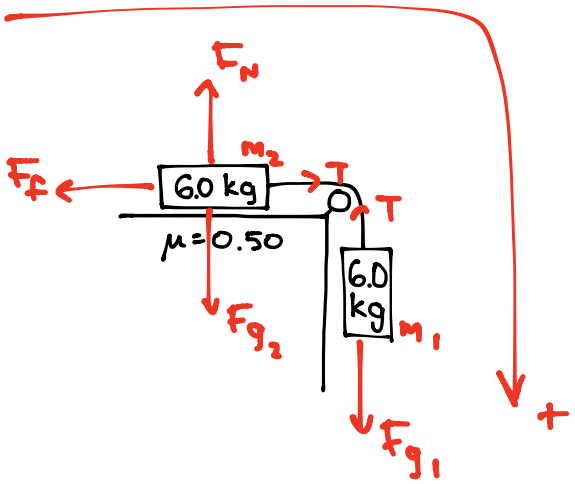
$$F_{NET} = ma$$

$$T = ma$$

$$= (10.)(5.3)$$

$$= 53 \text{ N}$$

d)



$$F_{NET} = Ma$$

$$F_{g_1} - T + T - F_f = Ma$$

$$F_{g_1} - F_f = Ma$$

$$m_1 g - \mu F_N = Ma$$

$$m_1 g - \mu m_2 g = Ma$$

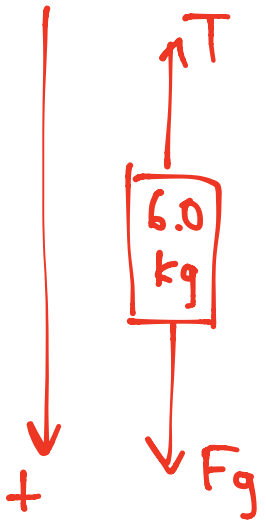
$$a = \frac{m_1 g - \mu m_2 g}{M}$$

$$= \frac{(6.0)(9.8) - (0.50)(6.0)(9.8)}{12.0}$$

$$= 2.5 \frac{m}{s^2} \text{ Right}$$

$F_N = F_{g_2}$

$= m_2 g$



$$F_{NET} = ma$$

$$F_g - T = ma$$

$$mg - T = ma$$

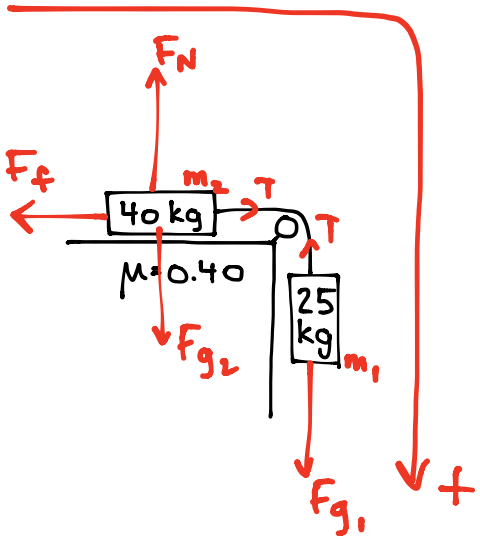
$$T = mg - ma$$

$$= m(g - a)$$

$$= 6.0(9.8 - 2.5)$$

$$= 44 \text{ N}$$

e)



$F_N = F_{g_2}$

$= m_2 g$

$F_{NET} = Ma$

$F_{g_1} - T + T - F_f = Ma$

$F_{g_1} - F_f = Ma$

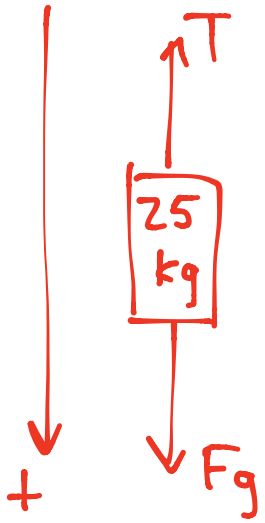
$m_1 g - \mu F_N = Ma$

$m_1 g - \mu m_2 g = Ma$

$a = \dfrac{m_1 g - \mu m_2 g}{M}$

$= \dfrac{(25)(9.8) - (0.40)(40)(9.8)}{65}$

$= 1.4 \frac{m}{s^2}$ RIGHT



$F_{NET} = ma$

$F_g - T = ma$

$mg - T = ma$

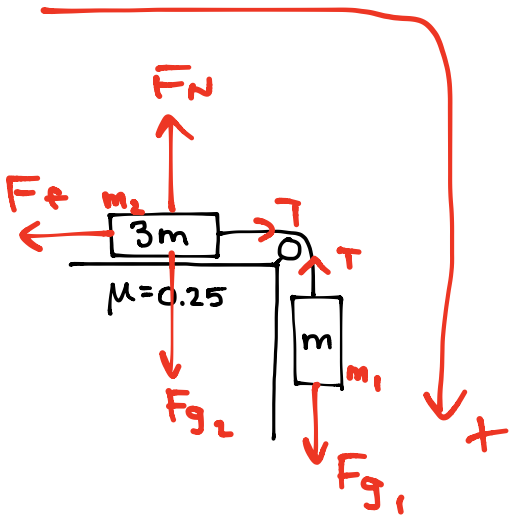
$T = mg - ma$

$= m(g - a)$

$= 25\,(9.8 - 1.4)$

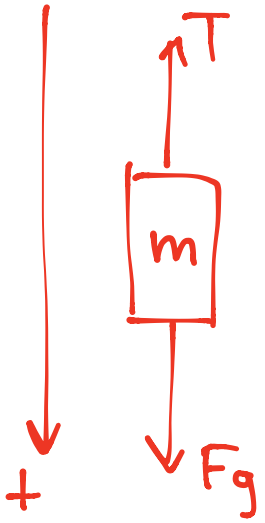
$= 210\,N$

f)



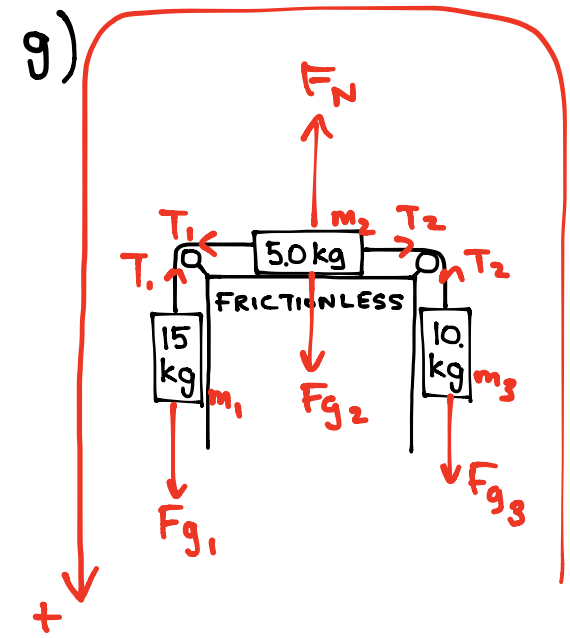
$$F_N = F_{g_2}$$
$$= m_2 g$$

$$F_{NET} = Ma$$
$$F_{g_1} - \cancel{T} + \cancel{T} - F_f = Ma$$
$$F_{g_1} - F_f = Ma$$
$$m_1 g - \mu F_N = Ma$$
$$m_1 g - \mu m_2 g = Ma$$
$$a = \frac{m_1 g - \mu m_2 g}{M}$$
$$= \frac{m(9.8) - (0.25)(3m)(9.8)}{4m}$$
$$= \frac{m(9.8 - 7.35)}{4m}$$
$$= 0.61 \ \frac{m}{s^2} \text{ RIGHT}$$



$$F_{NET} = ma$$
$$F_g - T = ma$$
$$mg - T = ma$$
$$T = mg - ma$$
$$= m(g - a)$$
$$= m(9.8 - 0.61)$$
$$= 9.2m \text{ N}$$

9)



$$F_{NET} = Ma$$

$$F_{g_1} - \cancel{T_1} + \cancel{T_1} - \cancel{T_2} + \cancel{T_2} - F_{g_3} = Ma$$

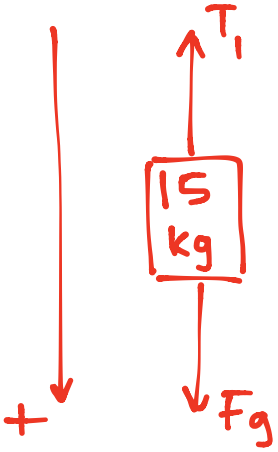
$$m_1 g - m_3 g = Ma$$

$$a = \frac{m_1 g - m_3 g}{M}$$

$$= \frac{m_1 - m_3}{M} g$$

$$= \frac{15 - 10}{30}(9.8)$$

$$= 1.6 \frac{m}{s^2} \text{ LEFT}$$



$$F_{NET} = ma$$

$$F_g - T_1 = ma$$

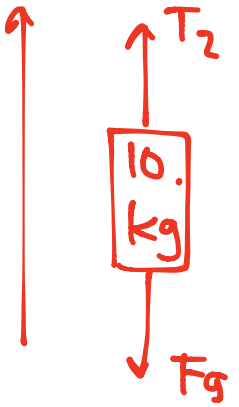
$$mg - T_1 = ma$$

$$T_1 = mg - ma$$

$$= m(g - a)$$

$$= 15(9.8 - 1.6)$$

$$= 120 \text{ N}$$



$$F_{NET} = ma$$

$$T_2 - F_g = ma$$

$$T_2 - mg = ma$$

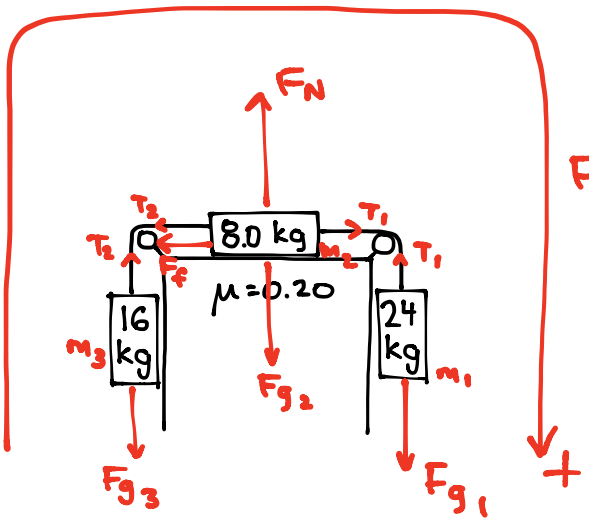
$$T_2 = ma + mg$$

$$= m(a + g)$$

$$= 10.(1.6 + 9.8)$$

$$= 110 \text{ N}$$

h)



$$F_{NET} = Ma$$

$$F_{g_1} - T_1 + T_1 - F_f - T_2 + T_2 - F_{g_3} = Ma$$

$$m_1 g - \mu F_N - m_3 g = Ma$$

$$m_1 g - \mu m_2 g - m_3 g = Ma$$

$$a = \frac{m_1 g - \mu m_2 g - m_3 g}{M}$$

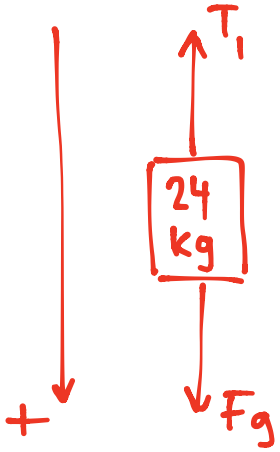
$$= \frac{m_1 - \mu m_2 - m_3}{M} g$$

$$= \frac{24 - (0.2)(8.0) - 16}{48}(9.8)$$

$$= 1.3 \frac{m}{s^2} \text{ RIGHT}$$

$$F_N = F_{g_2}$$

$$= m_2 g$$



$$F_{NET} = ma$$

$$F_g - T_1 = ma$$

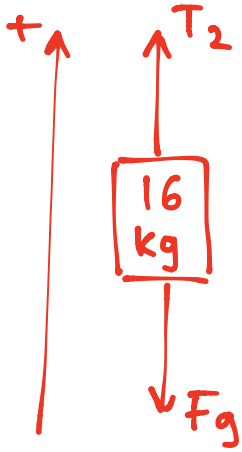
$$mg - T_1 = ma$$

$$T_1 = mg - ma$$

$$= m(g - a)$$

$$= 24(9.8 - 1.3)$$

$$= 2.0 \times 10^2 \text{ N}$$



$$F_{NET} = ma$$

$$T_2 - F_g = ma$$

$$T_2 - mg = ma$$

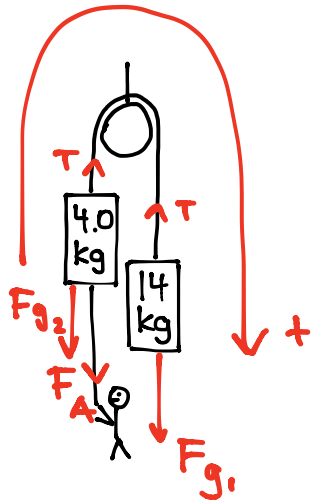
$$T_2 = ma + mg$$

$$= m(a + g)$$

$$= 16(1.3 + 9.8)$$

$$= 180 \text{ N}$$

2.



$$F_{NET} = Ma$$

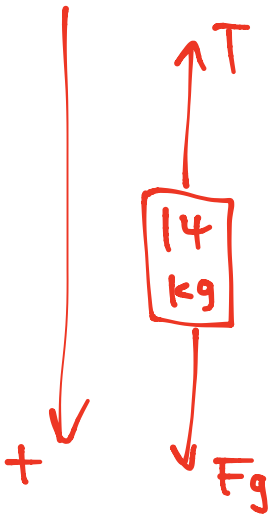
$$F_{g_1} - T + T - F_{g_2} - F_A = Ma$$

$$F_{g_1} - F_{g_2} - F_A = Ma$$

$$m_1 g - m_2 g - F_A = Ma$$

$a = 0$ IF HE WANTS TO KEEP IT AT REST

$$F_A = m_1 g - m_2 g$$
$$= (m_1 - m_2) g$$
$$= (14 - 4.0)(9.8)$$
$$= 98\ N$$



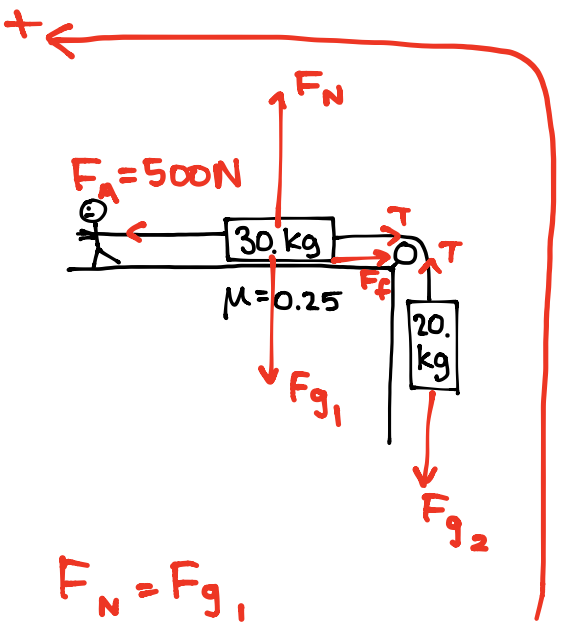
$$F_g - T = ma$$

$$mg - T = ma$$

$a = 0$ AT REST

$$T = mg$$
$$= (14)(9.8)$$
$$= 140\ N$$

3.



$F_N = F_{g_1}$

$= m_1 g$

$F_{NET} = Ma$

$F_A - F_f - \cancel{T} + \cancel{T} - F_{g_2} = Ma$

$F_A - F_f - F_{g_2} = Ma$

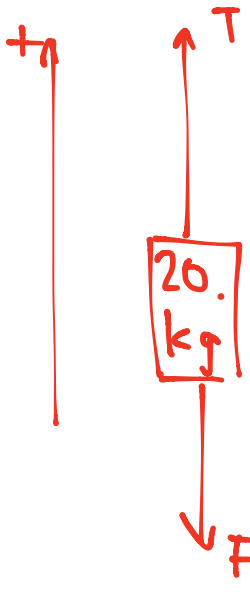
$F_A - \mu F_N - m_2 g = Ma$

$F_A - \mu m_1 g - m_2 g = Ma$

$a = \dfrac{F_A - \mu m_1 g - m_2 g}{M}$

$= \dfrac{500 - (0.25)(30.)(9.8) - (20.)(9.8)}{50.}$

$= 4.6 \ \frac{m}{s^2}$ LEFT



$F_{NET} = ma$

$T - F_g = ma$

$T - mg = ma$

$T = ma + mg$

$= m(a+g)$

$= 20.(4.6 + 9.8)$

$= 290 \ N$