2013

(4) (a).

(i).

6kg : overall force upwards = $T - 6g$

- $T - 6g = 6a$.

7kg : overall force downwards = $7g - T$

- $7g - T = 7a$.

$$\cancel{T} - 6g = 6a$$
$$7g - \cancel{T} = 7a.$$
$$g = 13a$$

- $a = \frac{g}{13}$.

$$T = 6a + 6g$$
$$T = 6\left(\frac{g}{13}\right) + 6g$$
$$T = \boxed{\frac{84g}{13}} = 63.32$$

(ii)

6kg overall force upwards $= T - 6g$

$$T - 6g = 6\left(a + \frac{g}{8}\right)$$

↖ same direction!

7kg overall force downwards $= 7g - T$

$$7g - T = 7\left(a - \frac{g}{8}\right)$$

↖ opposite direction!

- $T - 6g = 6a + \frac{6g}{8}$

$$7g - T = 7a - \frac{7g}{8}$$

$$g = 13a - \frac{9}{8}$$

$$13a = g + \frac{9}{8}$$

$$104a = 8g + g = 9g$$

- $a = \frac{9g}{104}$

$$T = 6a + \frac{6g}{8} + 6g$$

$$T = 6\left(\frac{9g}{104}\right) + \frac{6g}{8} + 6g$$

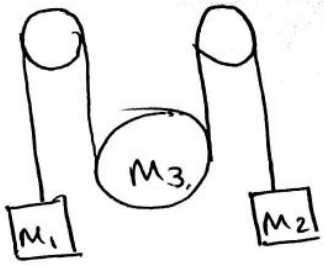
$$T = \frac{54g}{104} + \frac{6g}{8} + 6g$$

$$104T = 54g + 78g + 624g$$

$$T = \frac{756g}{104} = \boxed{\frac{189g}{26}} = 7.27g$$

$$= 71.24$$

(b)



M_1 : upwards $\Rightarrow$ $T - M_1 g = M_1 a_1$

M_2 : upwards $\Rightarrow$ $T - M_2 g = M_2 a_2$

M_3 : downwards $\Rightarrow$ $M_3 g - 2T = M_3\left(\frac{a_1 + a_2}{2}\right)$

- $a_1 M_1 = T - M_1 g$

$$a_1 = \frac{T}{M_1} - g$$

- $a_2 M_2 = T - M_2 g$

$$a_2 = \frac{T}{M_2} - g$$

- $M_3 g - 2T = \frac{M_3}{2}\left(\frac{T}{M_1} - g + \frac{T}{M_2} - g\right)$

$$= \frac{M_3}{2}\left(\frac{TM_2 - 2gM_1M_2 + TM_1}{M_1 M_2}\right)$$

$$\therefore 2m_1m_2m_3g - 4Tm_1m_2 = Tm_2m_3 - 2gm_1m_2m_3 + Tm_1m_3.$$

$$\Rightarrow Tm_1m_3 + Tm_2m_3 + 4Tm_1m_2 = 2m_1m_2m_3g + 2m_1m_2m_3g$$

$$\Rightarrow T(m_1m_3 + m_2m_3 + 4m_1m_2) = 4m_1m_2m_3g$$

$$\Rightarrow T = \boxed{\frac{4m_1m_2m_3g}{m_1m_3 + m_2m_3 + 4m_1m_2}}$$