①

$\xleftarrow{\hspace{1cm}} \boxed{M_2} \xrightarrow{\hspace{1cm}} F$

$T = 28N$

$\boxed{m_1} \rightarrow T = 28N$

$F - T = m_2 a$

$F = m_2 a + T$

$= 17(1.12) + 28$

$= 47.0 \ N$

$T = m_1 a$

$a = \dfrac{T}{m_1} = \dfrac{28N}{25 kg}$

$a = 1.12 \ m/s^2$

②

$\boxed{m_1} \rightarrow T$

$T = m_1 a$
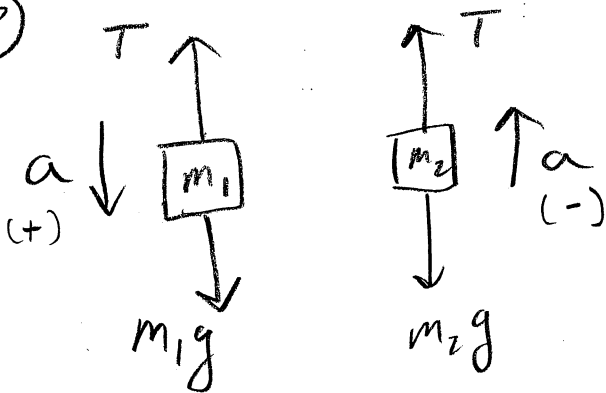
$= 20(1.71)$

$= 34.1 \ N$

$\boxed{m_1 + m_2} \rightarrow F$
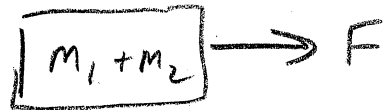
$F = (m_1 + m_2) a$

$a = \dfrac{F}{m_1 + m_2} = \dfrac{58}{20 + 14}$

$a = 1.71 \ m/s^2$

③

$-T + m_1 g = m_1 a$

$-T + m_2 g = -m_2 a$
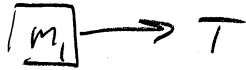
$\dfrac{-T + m_1 g}{m_1} = \dfrac{-T + m_2 g}{-m_2}$

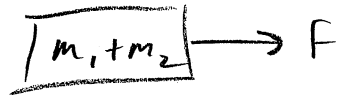$T m_2 - m_1 m_2 g = -T m_1 + m_1 m_2 g$

$T m_1 + T m_2 = 2 m_1 m_2 g$

$T = \dfrac{2 m_1 m_2 g}{m_1 + m_2} = \dfrac{2(16)(5)(10)}{16 + 5}$
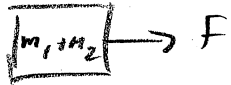
$T = 76.2 N \qquad (74.7) \ \text{for } g = 9.8$

④

$$\boxed{m_1} \rightarrow T$$

$$T = m_1 a$$
$$= 21(1.18)$$
$$= 24.8 \, N$$

$$\boxed{m_1 + m_2} \rightarrow F$$

$$F = (m_1 + m_2) a$$

$$a = \frac{F}{(m_1 + m_2)} = \frac{39}{21 + 12}$$

$$a = 1.18 \, m/s^2$$

⑤

$$\boxed{m_1 + m_2} \rightarrow F$$

$$F = (m_1 + m_2) a$$
$$F = (26 + 22) 1.13$$
$$= 54.2 \, N$$

$$\boxed{m_1} \rightarrow T$$
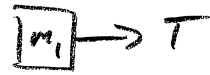
$$T = m_1 a$$

$$a = \frac{T}{m_1} = \frac{29.3}{26} = 1.13 \, m/s^2$$

⑥

$$+a \downarrow \boxed{m_1} \uparrow \text{-}T$$
$$\downarrow +m_1 g$$

$$\boxed{m_2} \uparrow \text{-}T \downarrow \text{-}a$$
$$\downarrow +m_2 g$$
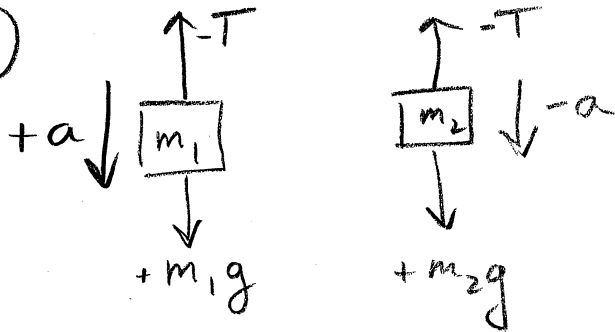
$$-T + m_1 g = m_1 a$$
$$-T + m_2 g = -m_2 a$$
$$T = m_1 g - m_1 a$$
$$T = m_2 g + m_2 a$$

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

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

if $m_1 = m_2$ then

$$a = 0$$

⑦ down is positive for ☐1
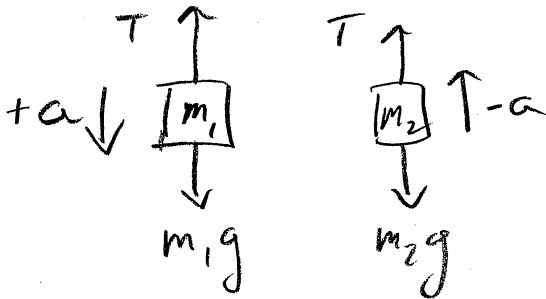
$d = 6.3m$

$v = 0.97 \text{ m/s}$

$a = \underline{\quad}$

$t = ?$

$-T + m_1 g = m_1 a$

$-T + m_2 g = -m_2 a$

$T = m_1 g - m_1 a$

$T = m_2 g + m_2 a$

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

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

$a = \dfrac{(m_1 - m_2) g}{m_1 + m_2}$

$d = v_i t + \frac{1}{2} a t^2$

$6.3 = .97 t + \frac{1}{2}(2) t^2$

$t^2 + .97 t - 6.3 = 0$

$t = \dfrac{-.97 \pm \sqrt{(.97)^2 - 4(1)(-6.3)}}{2(1)}$

$= \dfrac{(27 - 18) \, 10}{(27 + 18)}$

$a = 2 \text{ m/s}^2 \quad (\text{down})$

$\underline{t = 2.1 \ s}$

⑧
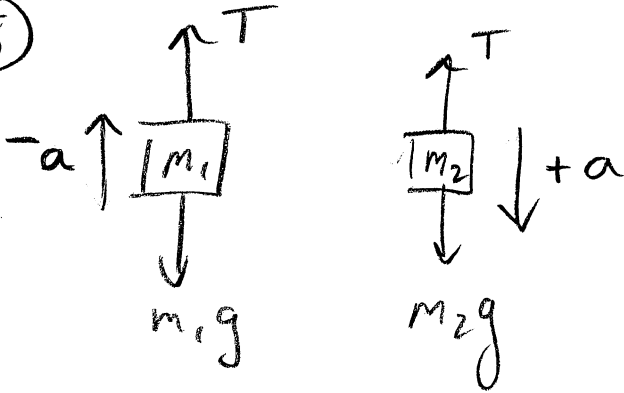
$-T + m_1 g = -m_1 a$

$-T + m_2 g = m_2 a$

$\dfrac{-T + m_1 g}{-m_1} = \dfrac{-T + m_2 g}{m_2}$

$-T m_2 + m_1 m_2 g = T m_1 - m_1 m_2 g$

$T(m_1 + m_2) = -2 m_1 m_2 g$
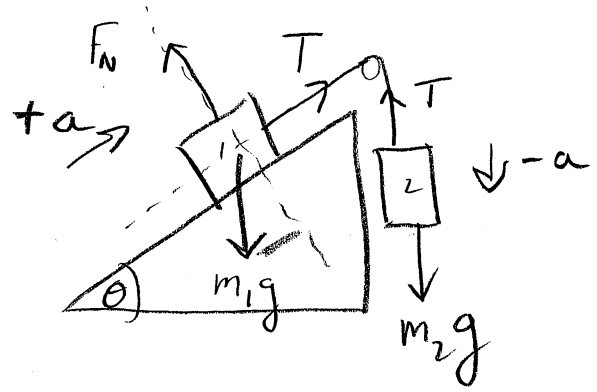
$T = \dfrac{-2 m_1 m_2 g}{m_1 + m_2}$

$= \dfrac{-2(13)(23) \, 10}{13 + 23}$

$T = -166 \, N$

(negative in direction as defined)

$T = 166 \, N \qquad (163 N) \; g = 9.8$

(9)

Block 2

$$T - m_2 g = -m_2 a \qquad T = m_2 g - m_2 a$$

Block 1

$$T - m_1 g \sin\theta = m_1 a \qquad T = m_1 g \sin\theta + m_1 a$$

$$m_2 g - m_2 a = m_1 g \sin\theta + m_1 a$$

$$m_1 = m_2 - 5$$

$$m_2 g - m_2 a = (m_2 - 5) g \sin\theta + (m_2 - 5) a$$

$$m_2 g - m_2 a = m_2 g \sin\theta - 5g \sin\theta + m_2 a - 5a$$

$$m_2 g - m_2 a - m_2 g \sin\theta - m_2 a = -5g \sin\theta - 5a$$

$$m_2 = \frac{-5g \sin\theta - 5a}{g - g \sin\theta - 2a} = \frac{-5(10)\sin 27 - 5(5.91)}{10 - 10 \sin 27 - 2(5.91)} = \frac{-52.249}{-6.3599}$$

$$\underline{m_2 = 8.2 \text{ kg}} \quad (8.0 \text{ kg}) \quad g = 9.8$$

(10) $V_i = 0$

$V_f = 6.6 \text{ m/s}$

$a = $ ___
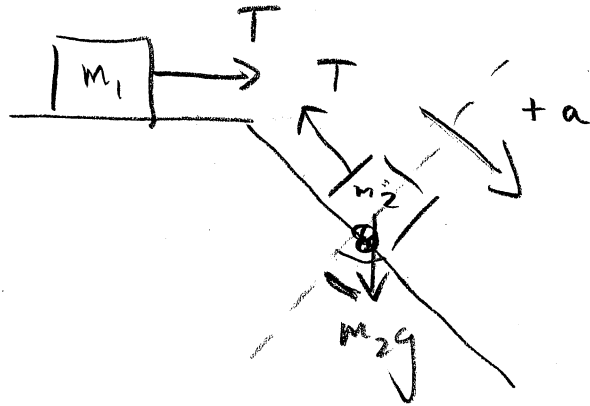
$t = ?$

$V_f = \cancel{V_i} + at$

$t = \dfrac{V_f}{a}$

$= \dfrac{6.6}{3.3}$

$t = 2 \text{ s}$

Block 1

$T = m_1 a$

Block 2

$-T + m_2 g \sin\theta = m_2 a$

$T = m_2 g \sin\theta - m_2 a$

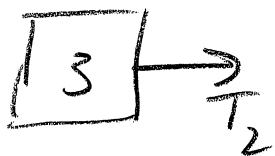$m_1 a = m_2 g \sin\theta - m_2 a$

$(m_1 + m_2) a = m_2 g \sin\theta$

$a = \dfrac{m_2 g \sin\theta}{m_1 + m_2}$
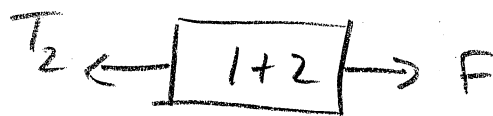
$= \dfrac{36(10) \sin 39}{(33 + 36)}$

$= 3.3 \text{ m/s}^2$ $(3.2) g = 9.8$

(11)

$$\boxed{3} \xrightarrow{\quad} T_2 \qquad T_2 \xleftarrow{} \boxed{1+2} \xrightarrow{} F$$

$$T_2 = m_3 a \qquad\qquad F - T_2 = (m_1 + m_2)a$$

$$\frac{T_2}{m_3} = a \qquad\qquad \frac{F - T_2}{m_1 + m_2} = a$$

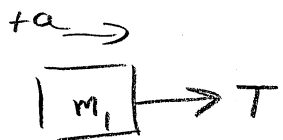$$\frac{T_2}{m_3} = \frac{F - T_2}{m_1 + m_2}$$

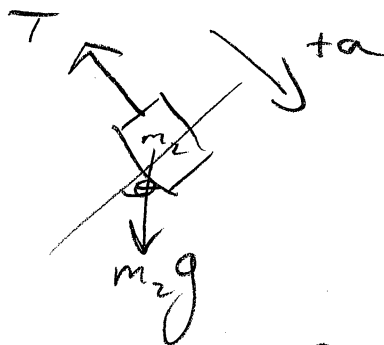$$T_2 m_1 + T_2 m_2 = F m_3 - T_2 m_3$$

$$T_2 (m_1 + m_2 + m_3) = F m_3$$

$$T_2 = \frac{F m_3}{(m_1 + m_2 + m_3)}$$

$$= \frac{130(11)}{(20 + 20 + 11)}$$

$$T_2 = 28 \, N$$

(12)

$+a \rightarrow$

$\boxed{m_1} \rightarrow T$

$T \nwarrow \quad \searrow +a$

$\boxed{m_2}$

$\downarrow m_2 g$

$T = m_1 a$

$-T + m_2 g \sin\theta = m_2 a$

$T = m_2 g \sin\theta - m_2 a$

$m_1 a = m_2 g \sin\theta - m_2 a$

$a(m_1 + m_2) = m_2 g \sin\theta$

$a = \dfrac{m_2 g \sin\theta}{m_1 + m_2} = \dfrac{44(10)\sin 42}{(39 + 44)}$

$a = 3.5 \ m/s^2$

(13) $V_i = 0$
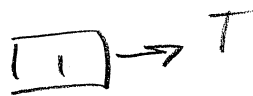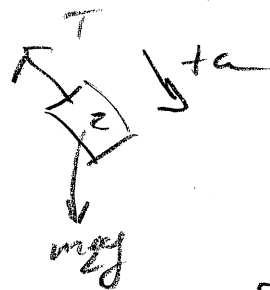
$V_f = 1.77 m/s$

$a = \underline{\quad}$

$t = ?$

$\boxed{1} \rightarrow T$

$T = m_1 a$

$\nwarrow \searrow +a$

$\boxed{2}$

$\downarrow m_2 g$

$-T + m_2 g \sin\theta = m_2 a$

$T = m_2 g \sin\theta - m_2 a$

$V_f = V_i + at$

$t = \dfrac{V_f}{a}$

$= \dfrac{1.77}{1.23}$

$a = \dfrac{m_2 g \sin\theta}{m_1 + m_2} = \dfrac{50(10)\sin 14}{(48 + 50)}$

$a = 1.23 \ m/s^2$

$t = 1.4 s$

(14) $V_i = 0$

$V_f = 4.81 \, m/s$

$a = \underline{}$

$t = ?$

$V_f = V_i + at$

$t = \dfrac{V_f}{a}$

$= \dfrac{4.81}{1.82}$

$t = 2.6 \, s$

$\boxed{1} \xrightarrow{T}$

$T = m_1 a$

$T \nwarrow \boxed{2} \searrow^{+a}$

$\downarrow m_2 g$
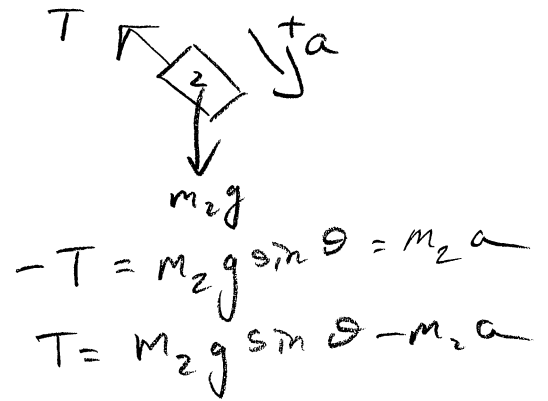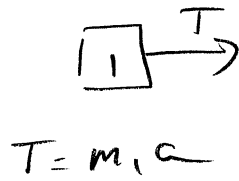
$-T = m_2 g \sin\theta = m_2 a$

$T = m_2 g \sin\theta - m_2 a$

$a = \dfrac{m_2 g \sin\theta}{(m_1 + m_2)} = \dfrac{38(10)\sin 19}{(30 + 38)}$

$a = 1.82 \, m/s^2$

---

(15) $\xrightarrow{+a} \quad \nearrow^{T}$

$\boxed{}$

$\downarrow m_1 g$

$T - m_1 g \sin\theta = m_1 a$

$T = m_1 g \sin\theta + m_1 a$

$\uparrow^{T} \boxed{2} \downarrow -a$
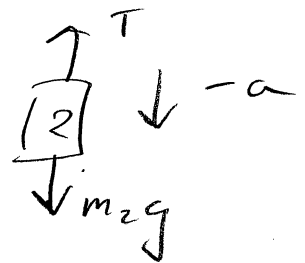
$\downarrow m_2 g$
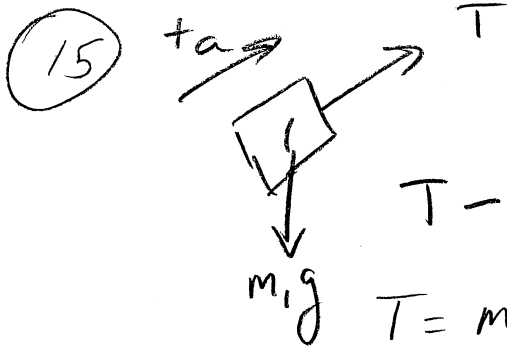
$T - m_2 g = -m_2 a$

$T = m_2 g - m_2 a$

$m_1 g \sin\theta + m_1 a = m_2 g - m_2 a$

$a(m_1 + m_2) = m_2 g - m_1 g \sin\theta$

$a = \dfrac{m_2 g - m_1 g \sin\theta}{m_1 + m_2}$
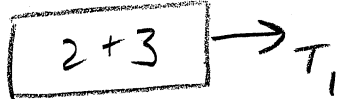
$= \dfrac{12(10) - 7(10)\sin 45}{(7 + 12)}$

$a = 3.7 \, m/s^2$

(16)

$\boxed{2+3} \rightarrow T_1$

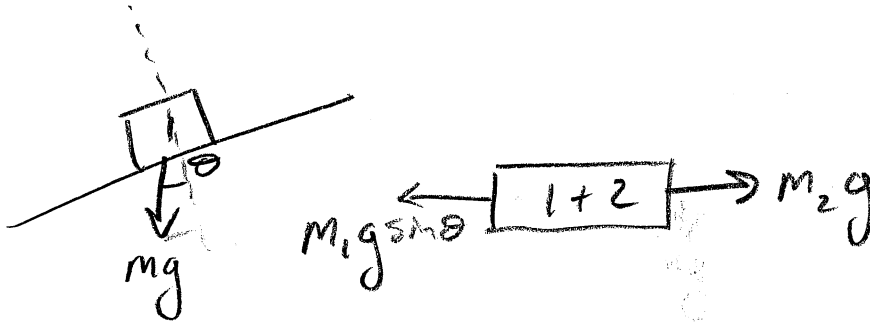$T_1 = (m_2 + m_3)a$

$= (29+17)\,2.05$

$T_1 = 94.3\,N$

$\boxed{1+2+3} \rightarrow F$

$F = (m_1 + m_2 + m_3)a$

$a = \dfrac{F}{m_1 + m_2 + m_3}$

$a = \dfrac{174}{29 + 29 + 17} = 2.05$

(17)

$m_1 g \sin\theta \leftarrow \boxed{1+2} \rightarrow m_2 g$

mg

$\Sigma F = ma$

$-m_1 g \sin\theta + m_2 g = (m_1 + m_2)a$

$a = \dfrac{-m_1 g \sin\theta + m_2 g}{m_1 + m_2}$

$= \dfrac{-(12.45)\,10\,\sin 14 + 15(10)}{(12.45+15)} = 4.37\,m/s^2$

down is positive.

$d = 0.29\,m$

$a = 4.37\,m/s^2$

$V_i = 0$

$t = ?$

$d = V_i t + \frac{1}{2}at^2$

$t = \sqrt{\dfrac{2d}{a}} = \sqrt{\dfrac{2(.29)}{4.37}}$

$t = 0.36\,s$

(18)

$\boxed{3} \rightarrow T_2$

$\boxed{1+2+3} \rightarrow F$
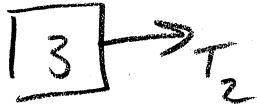
$T_2 = m_3 a$

$F = (m_1 + m_2 + m_3) a$

$= 18(2.37)$

$a = \dfrac{F}{m_1 + m_2 + m_3}$

$T_2 = 42.7 \, N$

$= \dfrac{161}{27 + 23 + 18} = 2.37 \, m/s^2$

(19)

T

$+a \downarrow \quad \boxed{1}$

$\xleftarrow{a}$

$m_1 g$

$\xleftarrow{} \boxed{1+2} \rightarrow m_2 g$

$m_1 g$

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

$V_i = 0.36 \, m/s$

$a = \dfrac{(m_1 - m_2) g}{m_1 + m_2}$

$d = 11 m$

$a = \underline{\quad}$

$= \dfrac{(29 - 10)}{(29 + 10)} 10$

$t = ?$
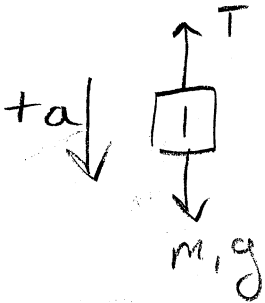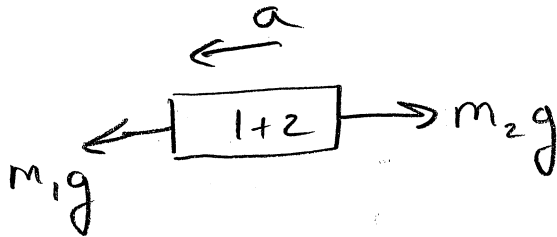
$a = 4.87 \, m/s^2$

$d = v_i t + \frac{1}{2} a t^2$

$11 = .36 t + \frac{1}{2}(4.87) t^2$

$2.435 t^2 + .36 t - 11 = 0$

$t = \dfrac{-.36 \pm \sqrt{(.36)^2 - 4(2.435)(-11)}}{2(2.435)}$

$t = 2.1 \, s$

(20)

$$\boxed{2+3} \rightarrow T_1$$

$$T_1 = (m_2 + m_3)\, a$$

$$= (29 + 13)\, 2.56$$

$$T_1 = 107.5\ N$$

$$\boxed{1+2+3} \rightarrow F$$

$$F = (m_1 + m_2 + m_3)\, a$$

$$a = \frac{F}{m_1 + m_2 + m_3}$$

$$= \frac{161}{21 + 29 + 13}$$

$$= 2.56\ m/s^2$$