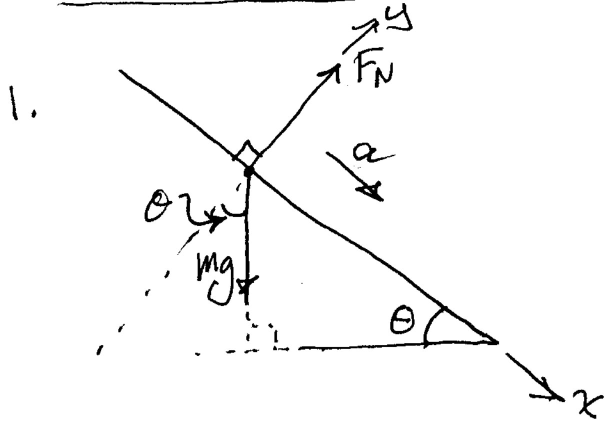
Solutions to F=ma Problems

1.



$$\Sigma F_x = ma_x$$
$$\cancel{m}g\sin\theta = \cancel{m}a$$
$$a = g\sin\theta$$
(independent of m)

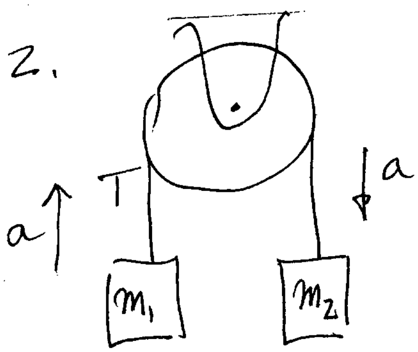
we know if $\theta = 0$, a must be zero (horiz. plane)

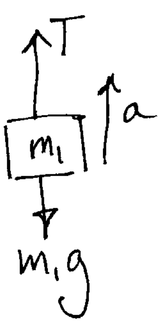
check: $a = g\sin 0 = 0$ ✓

If $\theta = 90°$, expect $a = g$ (freely falling)

check: $a = g\sin 90° = g(1) = g$ ✓

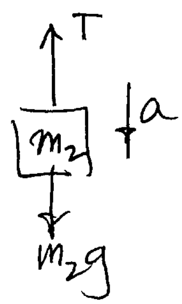
2.





$\uparrow + \Sigma F = ma$

$$\boxed{T - m_1 g = m_1 a} \quad (1)$$



$+\downarrow \Sigma F = ma$

$$\boxed{m_2 g - T = m_2 a} \quad (2)$$

Adding (1) & (2):

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

check: If $m_1 = 0$, expect $a = g$

$$a = \frac{m_2 - 0}{m_2 + 0} g = g \checkmark$$

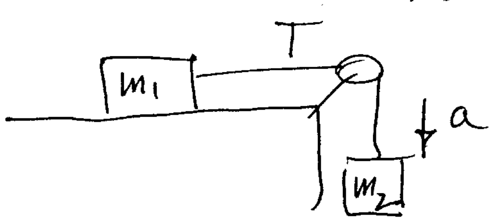
If $m_2 = 0$, expect $a = -g$ ✓

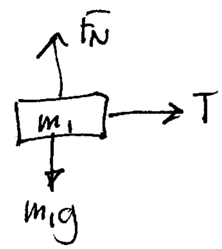
check: $$a = \frac{0 - m_1}{0 + m_1} g = -g \checkmark$$

If $m_1 = m_2$, expect $a = 0$

$$a = \frac{m_2 - m_1}{m_2 + m_1} g = (0) g = 0 \checkmark$$

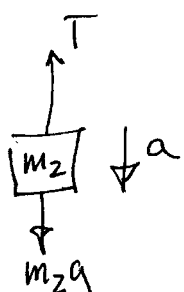
3.





$\overset{+}{\rightarrow} \Sigma F_x = m a_x$

$$\boxed{T = m_1 a} \quad (1)$$



$a \downarrow \Sigma F = ma$

$$\boxed{m_2 g - T = m_2 a} \quad (2)$$

Adding (1) & (2), we get:

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

$$\boxed{a = \frac{m_2}{m_1 + m_2} g}$$

If $m_1 = 0$, expect $a = g$

check: $$a = \frac{m_2}{0 + m_2} g = g \checkmark$$

If $m_2 = 0$, expect $a = 0$

check: $$a = \frac{0}{m_1 + 0} g = 0 \checkmark$$