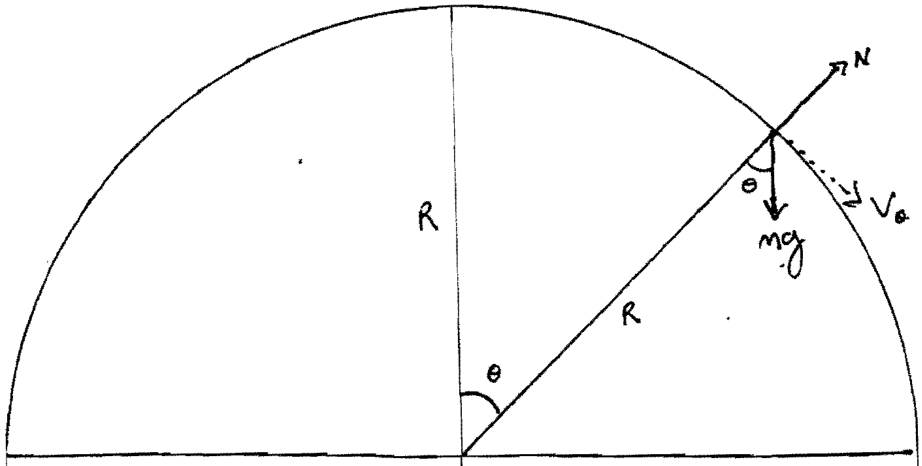
1.87) Dis 6A 7.1



N → 0 as particle leaves surface

$$mg\cos\theta - N = m\frac{v_\theta^2}{R}$$

$$mg\sin\theta = m\frac{dV_\theta}{dt}$$

$$\frac{dV_\theta}{dt} = \frac{d(R\theta)}{dt}\frac{dV_\theta}{d(R\theta)} \qquad R = \text{constant}$$

$$mgR\sin\theta = mV_\theta\frac{dV_\theta}{d\theta}$$

$$mgR\int_0^\theta \sin\theta\, d\theta = \frac{1}{2}mV_\theta^2 - 0$$

$$\frac{d}{d\theta}\sin\theta = \cos\theta$$

$$\frac{d}{d\theta}\cos\theta = -\sin\theta$$

$$\Rightarrow mgR(1-\cos\theta) = \frac{1}{2}mV_\theta^2$$

$$mg\cos\theta = m\frac{V_\theta^2}{R}$$

$$2mg(1-\cos\theta) = m\frac{V_\theta^2}{R}$$

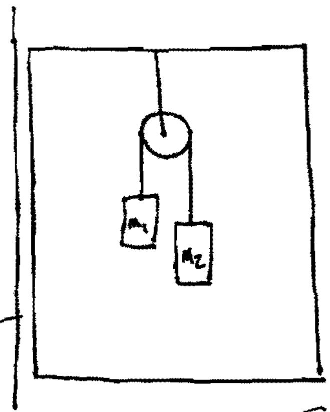
$$\Rightarrow \boxed{\cos\theta = \frac{2}{3}}$$

$$\boxed{\sqrt{\frac{2}{3}gR} = V_\theta}$$

→ velocity just before it leaves.

DB 6A 7.2

1.71)



$\uparrow w_0$

$m_1 > m_2$

effectively decreases gravity

$$\begin{cases} m_1 g - m_1 w_0 - T = m_1 w_1 \\ T - m_2 g + m_2 w_0 = m_2 w_2 \end{cases}$$

only true in accelerating frame

$w' = w_1 = w_2$ by continuity

$w = w_0 + w'$ → acceleration relative to car

w is acceleration with respect to wall

$$m_1 g + m_1 w_0 - [m_2 w_0 + m_2 g + m_2 w'] = m_1 w'$$

$$\frac{(m_1 - m_2)[g - w_0]}{m_1 + m_2} = w'$$

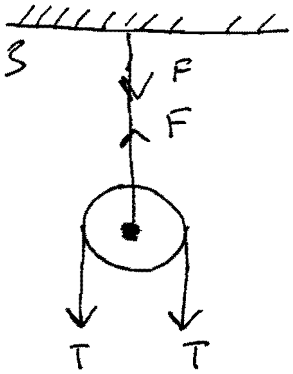
$$w = \left(\frac{m_1 - m_2}{m_1 + m_2}\right) g + \left[\frac{-(m_1 - m_2) + m_1 + m_2}{m_1 + m_2}\right] w_0$$

a) $$w = \frac{(m_1 - m_2) g + 2 m_2 w_0}{m_1 + m_2}$$

$$w' = \frac{(m_1 - m_2)(g - w_0)}{m_1 + m_2}$$

DiB 6A 7.3

1.71)



$$F = 2T$$

$$T = m_2 w' + m_2 g - m_2 w_0$$

$$= m_2 \left[\frac{m_1 - m_2}{m_1 + m_2} (g - w_0) + (g - w_0) \right]$$

$$= \frac{2 m_1 m_2}{m_1 + m_2} (g - w_0)$$

$$\boxed{F = \frac{4 m_1 m_2}{m_1 + m_2} (g - w_0)}$$