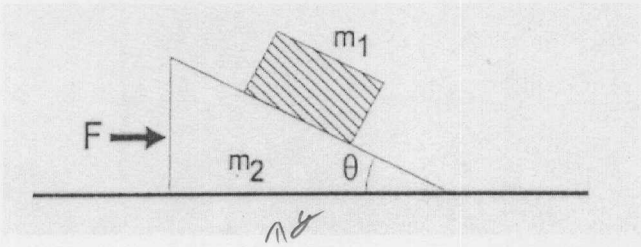
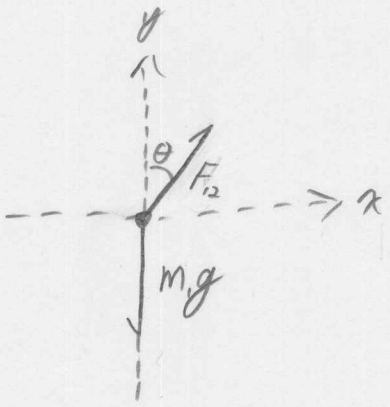
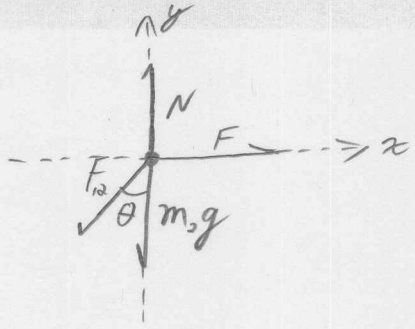
Test 2
Phys 111, Fall 2009, Section 1

In the figure shown below all surfaces are frictionless. Find an expression for the the force applied to block m_2 so that block m1 does not slide down the ramp.

$\theta = 30^\circ$
$m_1 = 2.0$ kg
$m_2 = 5.0$ kg







$x: F_{12}\sin\theta = m_1 a$ ①

$x: F - F_{12}\sin\theta = m_2 a$ ②

$y: F_{12}\cos\theta - m_1 g = 0$ ③

$y: N - F_{12}\cos\theta - m_2 g = 0$ ④

Replace $F_{12}\sin\theta$ in eq ② with $m_1 a$ from eq. ①

$$F - m_1 a = m_2 a$$

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

Now divide ① by ③ to eliminate F_{12} and solve for a:

$$\frac{F_{12}\sin\theta}{F_{12}\cos\theta} = \frac{m_1 a}{m_1 g} \Rightarrow \tan\theta = \frac{a}{g} \Rightarrow a = g\tan\theta$$

$$\boxed{F = (m_1 + m_2) g \tan\theta}$$

$$F = (7.0)(9.8)\tan(30) = \boxed{40^\circ}$$