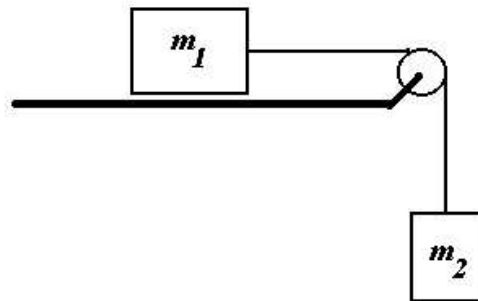


Physics 3 Quiz 4a

21Jul03

Consider the half-Atwood's machine shown in the figure. The rope is massless and the pulley is frictionless, but the interface between the sliding mass and the surface supporting it has a non-zero coefficient of kinetic friction μ . What is the acceleration a of the system (assuming it is capable of sliding)?

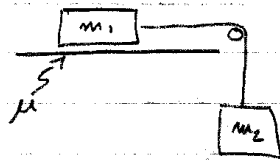


Two-point bonus: What coefficient of static friction μ_s , would be required to prevent sliding?

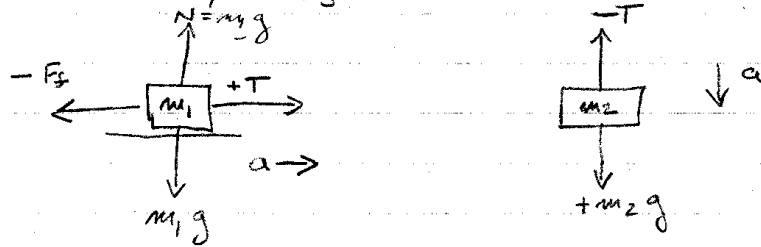
Quiz 4

21 Jul 03

YJB



Free-body diagrams



Equations of motion based on $\Sigma F = ma$

$$m_1 a = T - \mu m_1 g$$

$$m_2 a = -T + m_2 g$$

Eliminate T by adding

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

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

(2)

In the static case, $v=0$ which is constant, so $a=0$

In this case T is the weight of m_2 so

$$T = m_2 g$$

The friction force $F_f = T$ and

$$F_f = \mu_s m_1 g$$

$$F_f = \mu_s m_1 g = T = m_2 g$$

$$\mu_s = \frac{m_2}{m_1}$$