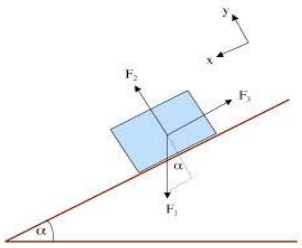
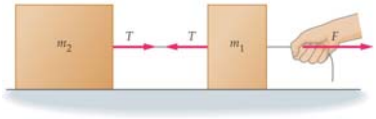
Free body diagram examples



Example #1



Physical picture

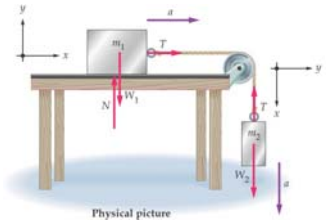
If F=100N, m_1=2kg and m_2=3kg, (a) what is the tension on the string that connecting the two boxes? (b) what is the acceleration of m1?

$F - T = m_1 a$, $T = m_2 a$ ⇒ $100 - T = 2a$, $T = 3a$ ⇒ $100 = 5a$ ⇒ $a = 20\ m/s^2$

⇒ $T = 60\ N$

Example #2

Assume m_1=20 kg, m_2=10 kg, and there is no friction. Find the acceleration and tension.

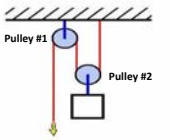


Physical picture

$T = m_1 a$, $m_2 g - T = m_2 a$ ⇒ $T = 20a$, $98 - T = 10a$ ⇒ $98 = 30a$

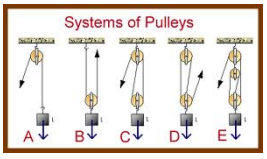
⇒ $a = 3.27\ \frac{m}{s^2}$ $T = 65.3\ N$

Assume that the mass of the box is 100 kg, what is the force needed to lift the box?



Do a free body diagram on Pulley #2.

$2T = mg$ ⇒ $2T = 980\ N$ ⇒ $T = 490\ N$



Find the tension on each string.

$T_3 = mg = 5.0 \times 9.8 = 49\ N$

$T_2 cos50° - T_1 cos40° = 0$ ⇒ $T_2 = 1.20T_1$

$T_2 sin50° + T_1 sin40° = T_3 = 49\ N$

⇒ $1.20T_1 \times 0.766 + T_1 \times 0.642 = 49\ N$

⇒ $T_1 = 31.4\ N$, $T_2 = 37.7\ N$

A 5.0-kg block is placed on top of a 10-kg block. A horizontal force of 45 N is applied to the 10-kg block, and the 5.0 kg block is tied to the wall. The coefficient of kinetic friction between the moving surfaces is 0.20. Find tension of the rope and the acceleration of the 10-kg block.