Ex

A 70 kg climber finds himself dangling over the edge of an ice cliff. Fortunately he is roped to a 940 kg rock located 51 m from the edge of the cliff. Ignore friction. Assume that the climber accelerates downward. What is acc.? How much time does he have before the rock goes over the edge?

$m_r = 940\ kg$

$m_c = 70\ kg$

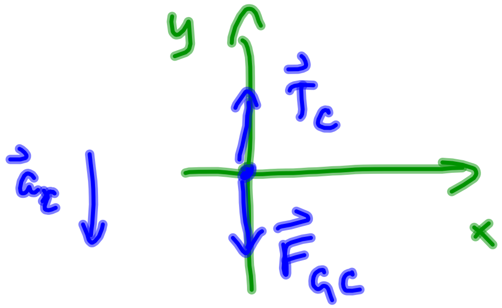
$L = 51\ m$

$a = ?$

$t = ?$

$$\sum \vec{F} = m\vec{a}$$

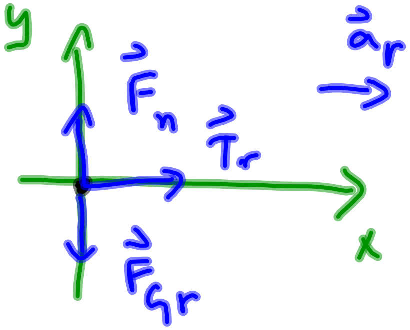
climber



y: $\sum F_y = ma$ $(\vec{T}_c + \vec{F}_{gc} = m\vec{a})$

$$\boxed{T - m_c g = -ma}$$

rock



$\sum \vec{F} = m\vec{a}$

$\sum F_y = ma_y$

y: $\boxed{F_n - m_r g = 0}$

$\sum F_x = ma_x$

x: $\boxed{T = m_r a}$

$|\vec{T}_r| = |\vec{T}_c| = T$; $|\vec{a}_c| = |\vec{a}_r| = a$

$$m_r a - m_c g = - m_c a$$

$$(m_r + m_c) a = m_c g$$

$$a = \frac{m_c}{m_r + m_c} g = 0.679 \, m/s^2$$

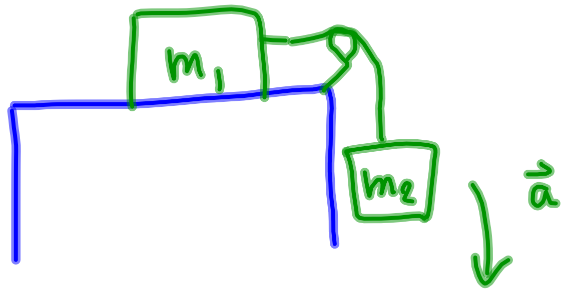
$$x = \cancel{x_0} + \cancel{v_0 t} + \frac{1}{2} a t^2 \longrightarrow t = \sqrt{\frac{2x}{a}} = 12 \, s$$

$$x = 51 m$$

4 equations for constant acceleration

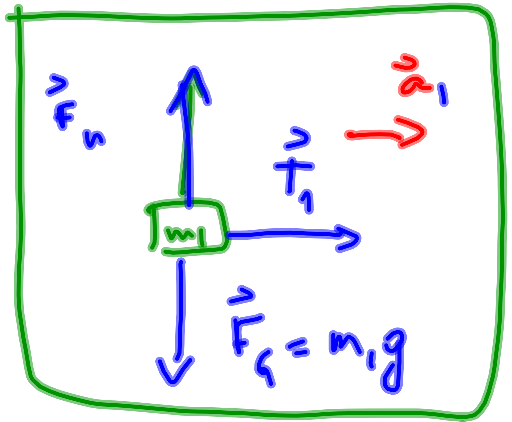
$x = x_0 + v_0 t + \frac{1}{2}at^2$	x, a, t	no v
$x = x_0 + \frac{1}{2}(v_0 + v)t$	x, v, t	no a
$v = v_0 + at$	v, a, t	no x
$v^2 = v_0^2 + 2a(x - x_0)$	x, v, a	no t

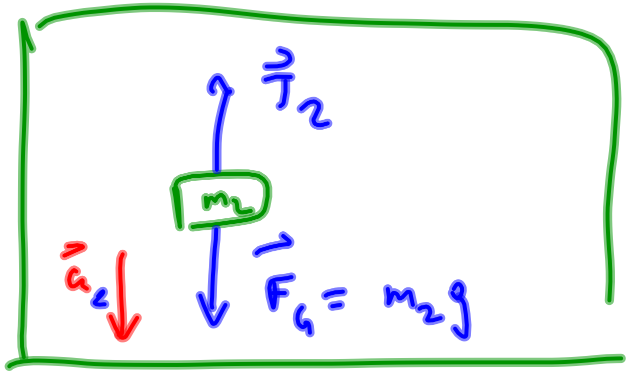
A block hangs by a massless string (no friction). Find a & T (tension).



$a = ?$

$T = ?$





$\sum \vec{F} = m\vec{a}$

$|\vec{a}_1| = |\vec{a}_2| = a$

$|\vec{T}_1| = |\vec{T}_2| = T$

$F_n - m_1 g = 0$

$\boxed{T = m_1 a}$

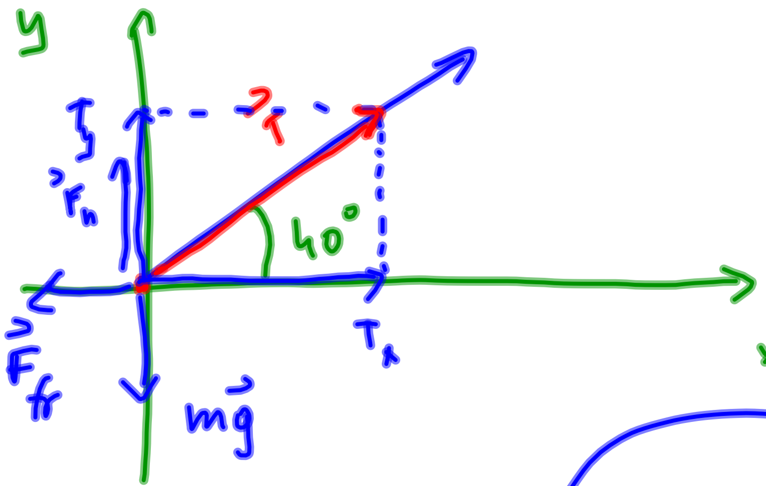
$\boxed{T - m_2 g = -ma}$

$a = \dfrac{m_2}{m_1 + m_2} g$

$T = \dfrac{m_1 m_2}{m_1 + m_2} g$

2 children are pulled on a sled over snow covered ground. The sled is pulled by a rope that makes an angle of 40° with the horizontal.

The kids have combined mass of 45 kg & sled has a mass of 5 kg. The coefficients of static & kinetic friction are $\mu_s = 0.2$ and $\mu_k = 0.15$. Find $\vec{F}_{fr}$ & accel. if $T_1 = 100$ N
$T_2 = 140$ N



$T_x = T\cos\theta = 76.6\,N$

$T_y = T\sin\theta = 64.3\,N$

$\sum \vec{F} = m\vec{a}$

In y direction $F_n + T_y - mg = 0$

$m = 50\,kg$ a) $T = 100\,N$ $F_n = 426\,N$

in x direction $T_x - F_{fr} = ma$

$T_x - F_{fr} = ma$

assume

$F_{fr} = \mu_s F_N$

$76.6 - 85.2$

assume

$F_{fr} = \mu_k F_N$

the tension force is not big enough to pull the sleds

b) $T = 140\,N$ $\quad T_y = 90\,N$ $\quad F_n = 400\,N$

$T_x = 107\,N$ $\quad F_{fr_{max}} = 80\,N$

$$F_{friction} = \mu_k \cdot F_n = 60\,N$$

$$T_x - \mu_k F_n = m \cdot a$$

$$a = 0.94\,m/s^2$$