Problem Statement: An 18 kg child slides down a snow-covered slope from rest in a 5.0 kg sled. The slope is straight and inclined at an angle of 31 degrees with the horizontal. Determine the velocity of the child after sliding a distance of 95 m along the slope.

Note that this is a net-force problem in two dimensions combined with a dvat problem.

Given

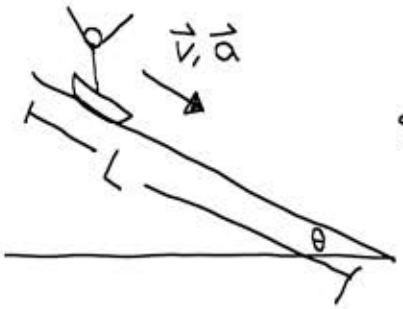
$m_c = 18\,kg$ $V_o = 0\,m/s$

$m_s = 5.0\,kg$

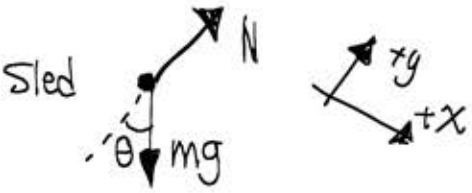
$\theta = 31°$

$L = 95\,m$

Diagram



Force diagram



Goal

To find the magnitude of V_f, when the sled reached the bottom

Equations

$F_{net\,x} = mg\sin\theta$

$\quad \llcorner F_{net\,x} = ma_x$

$ma_x = mg\sin\theta$

$a_x = g\sin\theta$

$F_{net\,y} = N - mg\cos\theta$

$\quad \llcorner F_{net\,y} = 0$

$N = mg\cos\theta$

(not relevant to solution)

$V_f^2 = V_o^2 + 2a_x d$

$\quad \hookrightarrow V_o^2 = 0$

$V_f = \pm\sqrt{2a_x d}$

$V_f = \pm\sqrt{2(g\sin\theta)L}$

Substitute

$V_f = \sqrt{2(9.8\,m/s^2)(\sin 31°)(95\,m)}$

$V_f = 31\,m/s$

Checks

sign V : + root is selected for V_f, is consitent with what +x was defined as

Unit V : $\sqrt{\frac{m^2}{s^2}} = m/s$

sense V : 31 m/s is 70 mi/h
That's a fast sled.