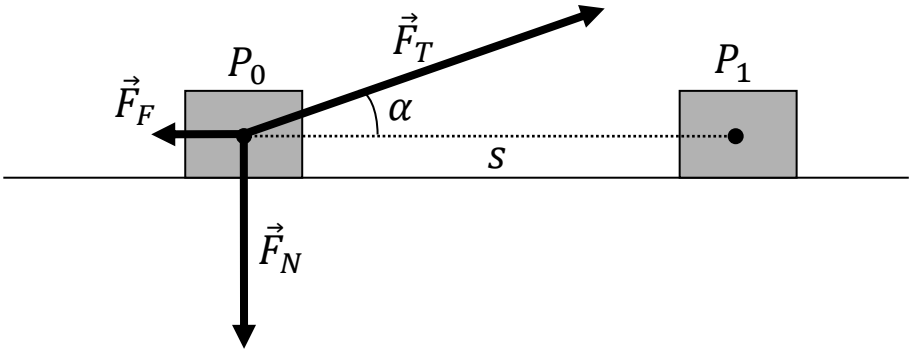
Answer on Question #63514, Physics / Mechanics | Relativity

Question:

Susan's 11.0 kg baby brother Paul sits on a mat. Susan pulls the mat across the floor using a rope that is angled 30° above the floor. The tension is a constant 30.0 N and the coefficient of friction is 0.180.

Use work and energy to find Paul's speed after being pulled 3.10 m.

Solution:



Let us assume that the weight of the mat is negligibly small. To use work and energy we must consider horizontal components of forces acting on Paul.

$F_T^x = F_T \cdot \cos\alpha$

$F_F^x = kF_N = kmg,$ where k is the coefficient of friction, m is the mass of Paul and g is the gravitational acceleration.

The resultant force $F_{res} = F_T \cdot \cos\alpha - kmg$

The work of this force $W = (F_T \cdot \cos\alpha - kmg) \cdot s$

Kinetic energy at the point P_1 is calculated as $E_k = \frac{mv^2}{2}$, and according to the law of conservation of energy $W = E_k$ or $(F_T \cdot \cos\alpha - kmg) \cdot s = \frac{mv^2}{2}$.

Then the speed $v = \sqrt{\frac{2s \cdot (F_T \cdot \cos\alpha - kmg)}{m}}$.

$v = \sqrt{\frac{2 \cdot 3.1 \cdot (30.0 \cdot \cos 30° - 0.18 \cdot 11.0 \cdot 9.81)}{11.0}} = 1.9\ m/s$

Answer:

$1.9\ m/s$

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