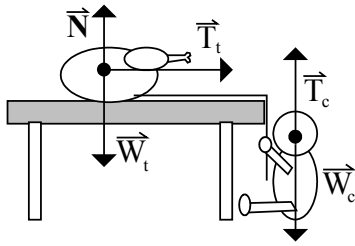


Chapter 5 Problem 18 †



**Given**

$$m_c = 12 \text{ kg}$$

$$m_t = 6.8 \text{ kg}$$

$$\Delta x = 60 \text{ cm} = 0.60 \text{ m}$$

**Solution**

a) Find the acceleration of the turkey.

Newton's 2<sup>nd</sup> law applied to the turkey is

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

$$\vec{N} + \vec{T}_t + \vec{W}_t = m_t \vec{a}$$

Choose the coordinate system with the x coordinate begin horizontal. The acceleration of the turkey is in the +x direction.

$$N\hat{j} + T\hat{i} - m_t g\hat{j} = m_t a\hat{i}$$

The x-component of this equation is

$$T = m_t a$$

The y-component of this equation is

$$N - m_t g = 0$$

Newton's 2<sup>nd</sup> law applied to the child is

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

$$\vec{T}_c + \vec{W}_c = m_c \vec{a}$$

Choose the coordinate system with the x coordinate being horizontal. The acceleration of the child is in the -y direction.

$$T\hat{j} - m_c g\hat{j} = -m_c a\hat{j}$$

The y-component of this equation is

$$T - m_c g = -m_c a$$

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†Problem from Essential University Physics, Wolfson

Take the x-component equation for the turkey and substitute it into the y-component equation for the child and solve for acceleration.

$$m_t a - m_c g = -m_c a$$

$$m_t a + m_c a = m_c g$$

$$a = \frac{m_c g}{m_t + m_c} = \frac{(12 \text{ kg})(9.8 \text{ m/s}^2)}{6.8 \text{ kg} + 12 \text{ kg}} = 6.25 \text{ m/s}^2$$

b) Find the time for the turkey to go over the edge.

Begin with the following kinematic equation.

$$r = r_0 + v_0 t + \frac{1}{2} a t^2$$

Displacement is  $r - r_0$  and the initial velocity is 0, so

$$r - r_0 = \frac{1}{2} a t^2$$

Solving for  $t$  gives

$$\frac{2(r - r_0)}{a} = t^2$$

$$t = \sqrt{\frac{2(r - r_0)}{a}} = \sqrt{\frac{2(0.60 \text{ m})}{6.25 \text{ m/s}^2}}$$

$$t = 0.438 \text{ s}$$