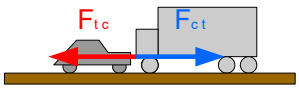
Chapter 5 Problem 54 [†]



Given
$m_c = 550\ kg$
$m_t = 2200\ kg$
$a_t = 10\ m/s^2$

Solution
Find the magnitude of the car's acceleration.

The force the truck exerts on the car is $\vec{F}_{tc}$. By Newton's 2nd law the effect of this force on the car is

$$\vec{F}_{tc} = m_c\vec{a}_c \qquad Eq.1$$

At the same time the car exerts a force on the truck of $\vec{F}_{ct}$. By Newton's 2nd law the effect of this force on the truck is

$$\vec{F}_{ct} = m_t\vec{a}_t \qquad Eq.2$$

By Newton's 3rd law the two forces described above are equal and opposite.

$$\vec{F}_{ct} = -\vec{F}_{tc}$$

Substitute in equations 1 and 2 gives

$$m_t\vec{a}_t = -m_c\vec{a}_c$$

Solving for the acceleration of the car gives

$$\vec{a}_c = -\frac{m_t\vec{a}_t}{m_c}$$

If the truck accelerates to the right, then the car accelerates to the left. Since we are only interested in the magnitude of the acceleration, we have

$$a_c = \frac{m_t a_t}{m_c} = \frac{(2200\ kg)(10\ m/s^2)}{550\ kg}$$

$$a_c = 40\ m/s^2$$

[†]Problem from University Physics by Ling, Sanny and Moebs (OpenStax)