It's Friday night and Skyler has been assigned the noble task of baby-sitting Casey, his 2-year old brother. He puts a crash helmet on Casey, places him in the red wagon and takes him on a stroll through the neighborhood. As Skyler starts across the street, he exerts a $52\ N$ forward force on the wagon. There is a $24\ N$ resistance force and the wagon and Casey have a combined weight of $304\ N$. Construct a free body diagram depicting the types of forces acting upon the wagon. Then determine the net force, mass and acceleration of the wagon.

Solution.
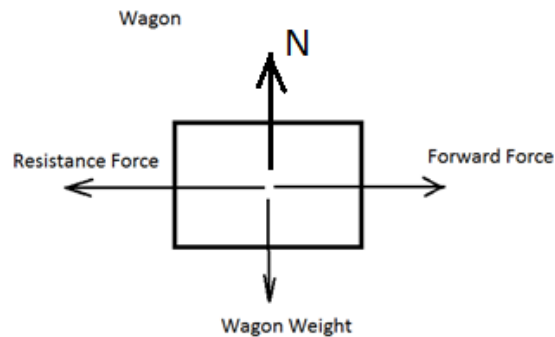
N – normal force

Net Force:

$$F_{net} = F_{forw} - F_{res} = 52 - 24 = 28\ N$$

F_{forw} - forward force; F_{res} - resistance force

$$(m_1 + m_2)a = F_{net}$$

m_1 - mass of wagon; m_2 - mass of Casey; a – acceleration

$$a = \frac{F_{net}}{m_1 + m_2} = \frac{28}{304/9.8} = 0.9\ m/s^2$$

$$m_1 a = F_{forw} - F_{res1}$$

F_{res1} - resistance force for wagon

$$F_{res1} = \mu m_1 g$$

μ - friction coefficient

$$\mu = \frac{F_{res}}{(m_1 + m_2)g} = \frac{24}{304} = 0.079$$

$$m_1 = \frac{F_{forw}}{a + \mu g} = \frac{52}{0.9 + 0.079 \cdot 9.8} = 31 \; kg$$

Answer provided by