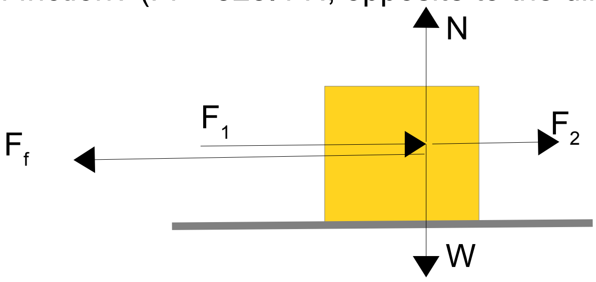
ANSWERS 16, 19, 22, 25

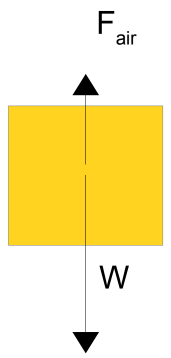
16. A large box moving across a floor at constant speed has two people moving it. One is pushing 236.1 N from behind while the other is pulling 89.3 N from the front. What is the force of friction? (Ff = 325.4 N, opposite to the direction of motion)



$F_{NET} = m \cdot a = 0$ (constant velocity)

$F_{NET} = (F_1 + F_2) – F_f \rightarrow 0 = (236{,}1\ N + 89{,}3\ N) – F_f \rightarrow F_f = 325{,}4\ N$

19. Moments after making the dreaded decision to jump out the door of the airplane, Darin's 82.5-kg body experiences 118 N of air resistance. Determine Darin's acceleration at this instant in time.(a= - 8.37 m/s2)



Let´s consider up direction as positive and down direction as negative

$$F_{NET} = F_{AIR} – W = F_{AIR} – m \cdot g$$

$$F_{NET} = 118\ N – 82{,}5\ kg \cdot 9{,}8\ N/kg = -690{,}5\ N$$

The negative sign of this force indicate that it is directed downwards.

We use Newton's Second Law:

$F_{NET} = m \cdot a \rightarrow a = F_{NET}/m = -690{,}5\ N / 82{,}5\ kg = -8{,}37\ m/s^2$

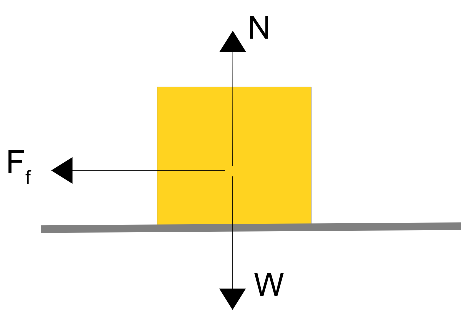
The negative sign indicates that acceleration is directed downwards.

22. Nicholas, Brianna, Dylan and Chloe are practicing their hockey on frozen Bluebird Lake. As Dylan and Chloe chase after the 0.162 kg puck, it decelerates from 10.5 m/s to 8.8 m/s in 14 seconds.

a. Determine the acceleration of the puck. (a= - 0.12 m/s2)

b. Determine the force of friction experienced by the puck. (Ffric= - 0.02 N)

c. Determine the coefficient of friction between the ice and the puck. (μ=0.012)



a. $a = \frac{v_f - v_0}{t} = \frac{8{,}8\ m/s - 10{,}4\ m/s}{14\ s} = -0{,}12\ m/s^2$

b. $F_{net} = F_f$ (it is the only force that is not balanced)

$F_{net} = m \cdot a$ (Newton´s 2nd Law)

$F_f = 0{,}162\ kg \cdot (-\ 0{,}12\ m/s^2) = -0{,}018\ N$

The negative sign indicates direction. In this case, as velocity is positive, friction force is negative (the same as acceleration)

c. $F_f = \mu \cdot N = \mu \cdot m \cdot g$ (normal force is equal to weight because it is a horizontal surface)

$$\mu = \frac{F_f}{m \cdot g} = \frac{0.018\,N}{0{,}162\,Kg \cdot 9{,}8\,N/kg} = 0{,}012$$

μ is always positive (it is not a vector quantity) In the formula we use the magnitude of the friction force, regardless of its direction.

25. The Cajun Cliffhanger at Great America was a ride in which occupants line the perimeter of a cylinder and spin in a circle at a high rate of turning. When the cylinder begins spinning very rapidly, the floor is removed from under the riders' feet. Determine the centripetal force acting upon a 40-kg child who makes 10 revolutions around the Cliffhanger in 29.3 seconds. The radius of the barrel is 2.90 meters. (F=531.2 N)

First, we need to calculate a_c . It can be calculated as

$a_c = \frac{v^2}{R}$ or $a_c = \omega^2 \cdot R$

We will use the second one because it is easier to find ω

$$\omega = \frac{\Delta \Theta}{\Delta t} = \frac{10\,rev}{29{,}3\,s} = 0{,}34\,\frac{rev}{sec} \cdot \frac{2\pi\,rad}{rev} = 2{,}14\,\frac{rad}{s}$$

$$a_c = (2{,}14\,rad/s)^2 \cdot 2{,}90\,m = 13{,}23\,m/s^2$$

$$F_c = m \cdot a_c = 40\,kg \cdot 13{,}23\,m/s^2 = 529\,N$$