Exercises on page 37

Exercise 1. The dolphin builds up speed and is then able to leap upward out of the ocean. The dolphin’s inertia causes it to continue moving upward. However gravity does slow the dolphin down and eventually falls back into the ocean.

Exercise 3. When you stamp your foot, your foot stops but the snow keeps going since it is only held loosely onto your shoes. This is an example of inertia. The snow has inertia so it keeps going in the same direction that it was moving. This is very similar to the example of shaking your hands to get the water off.

Exercise 4. The water is only held loosely on the toothbrush. The water has inertia so when you tap the brush the water flies off of it.

Exercise 6. When the car suddenly comes to a stop, the driver because of his inertia tends to keep going in the same direction – so he hits the steering wheel. The airbag is supposed to provide a cushion to prevent injury. We will discuss airbags later.

Exercise 7. A force must be applied to make the car turn to the right. Usually this is provided by the friction between the tires and the road. Items on the dash board usually are not tied down. When the car turns, the items on the dash because of their inertia, will continue moving in their original direction. They have no place to go but slide in the opposite direction. We will discuss this issue in more detail when we talk about objects moving in a circular path.

Problems on page 38

Problem 2. velocity = acceleration × time = a × t, so time t = velocity / acceleration
\[ t = \frac{v}{a} = \frac{24.6 \text{ m/s}}{4 \text{ m/s}^2} = 6.15 \text{ s}. \]

Problem 3. For problems involving free fall, for an object that falls from rest (dropped), velocity = acceleration due to gravity × time,\[ v = g \times t = 3.71 \text{m/s}^2 \times 3 \text{ s} = 11.13 \text{ m/s}. \]

Problem 4. the distance an object falls = (1/2) × acceleration due to gravity × (time)² \[ \text{distance} = \frac{1}{2} g \times t^2 = \frac{1}{2} \times 3.71 \times 3^2 = 16.7 \text{ m}. \]

Problem 6. If you leap up with a velocity v, then you get up to a height, h, given by height, h = v² / 2g. If we know the height then the formula for getting the velocity is v = square root of (2 g h), or \[ v = \sqrt{2gh} = \sqrt{2 \times 9.8 \times 0.5} = \sqrt{9.8} = 3.13 \text{m/s}. \]

Problem 7. The basketball player jumps up and then comes back down. It takes the same time to go up as it does to fall down. If you fall down from a height h it takes a time
\[ t = \sqrt{\frac{2h}{g}} = \sqrt{\frac{2 \times 0.5}{9.8}} = \sqrt{\frac{1}{9.8}} = \sqrt{0.102} = 0.32\, \text{s}, \] the total time up and then is then \( 0.32\, \text{s} + 0.32\, \text{s} = 0.64\, \text{s}. \)

**Problem 8.** The sprinter's acceleration \( a = \frac{v}{t} = \frac{(10 \, \text{m/s})}{(1 \, \text{s})} = 10\, \text{m/s}^2 \)

**Problem 10.** Weight = mass \( \times \) acceleration due to gravity,
\[
 w = m \cdot g = 60\, \text{kg} \times 10\, \text{m/s}^2 = 600\, \text{Newton} (N)
\]

**Problem 11.** If you jump upward with a speed \( v \), then it takes a time \( t = \frac{v}{g} \) to get to the top of your jump (where you stop rising). So \( t = \frac{(2 \, \text{m/s})}{9.8} = 0.2\, \text{s} \).