Acceleration Practice Problems: Answers

$$a = \frac{v_f - v_i}{\Delta t}$$

1. A speedy rabbit is hopping to the right with a velocity of 4.0 m/s when it sees a carrot in the distance. The rabbit speeds up to its maximum velocity of 13 m/s with a constant acceleration of 2.0 m/s2 rightward. How many seconds did it take the rabbit to speed up from 4.0 m/s to 13 m/^{2}?

$$a = \frac{V_f - V_i}{t}$$

$$at = V_f - V_i$$

$$t = \frac{V_f - V_i}{a}$$

$$t = \frac{13\frac{m}{s} - 4\frac{m}{s}}{2\,m/s^2}$$

$$t = \frac{9m}{s} \times \frac{1}{2}\frac{s^2}{m}$$

$$t = 4.5\,s$$

2. A sailboat is traveling to the right when a gust of wind causes the boat to accelerate leftward at 2.5 m/s^2 for 4 seconds. After the wind stops, the sailboat is traveling to the left with a velocity of 3.0 m/s. Assuming the acceleration from the wind is constant, what was the initial velocity of the sailboat before the gust of wind?

1 $a = \frac{V_f - V_i}{t}$

2 $\frac{-2.5m}{s^2} = \frac{\frac{-3.0m}{s} - V_i}{4s}$

3 $-10\frac{m}{s} = -3.0\frac{m}{s} - V_i$

4 $-7\,m/s = -V_i$

5 $7\frac{m}{s} = V_i$

3. A racecar starts from rest and speeds up uniformly to the right until it reaches a maximum velocity of 60 m/s in 15 seconds. What is the acceleration of the racecar?

$a = \frac{V_f - V_i}{\Delta t}$

$a = \frac{60\,m/s - 0}{15s}$

$a = 4\,m/s^2$

4. A canoe is drifting left toward a hungry hippo with a velocity of 7 m/s. The canoe rider starts paddling frantically, causing the canoe to travel to the right with a constant acceleration of 6.0 m/s2. After 4 seconds, what is the velocity of the canoe?

The equation for acceleration a is:

$$a = \frac{v_f - v_i}{\Delta t}$$

Rearranging the equation to solve for the final velocity v_f gives:

$$v_f = v_i + a\Delta t$$

We can calculate the final velocity from the initial velocity v_i, time interval Δt, and acceleration a.

$$\begin{aligned} v_f &= v_i + a\Delta t \\ &= -7\,\frac{\text{m}}{\text{s}} + \left(6\,\frac{\text{m}}{\text{s}^2}\right)(4\,\text{s}) \\ &= 17\,\frac{\text{m}}{\text{s}} \end{aligned}$$

5. A baseball is pitched at 40 m/s in a major league game. The batter hits the ball on a line drive straight toward the pitcher at 50 m/s. Determine the acceleration of the ball if it was in contact with the bat for 1/30 seconds.

are indicated by algebraic sign. Every quantity that points away from the batter will be positive. Every quantity that points toward him will be negative. Thus, the ball comes in at −40 m/s and goes out at +50 m/s. If we didn't pay attention to this detail, we wouldn't get the right answer.

$v_0 = -40$ m/s

$v = +50$ m/s

$\Delta t = \frac{1}{30}$ s

$\bar{a} = ?$

$$\bar{a} = \frac{v - v_0}{\Delta t} = \frac{(+50\text{ m/s}) - (-40\text{ m/s})}{\frac{1}{30}\text{ s}}$$

$$\bar{a} = (+90\text{ m/s})(30\text{ s}^{-1}) = +2700\text{ m/s}^2$$

$\bar{\mathbf{a}} = 2700\text{ m/s}^2$ away from the batter