Assignment 2.03 - The Definition of Acceleration KEY

1. What is the definition of acceleration (in equation form)? Explain the difference between velocity and acceleration.

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

Velocity is how fast something is moving and in what direction. Acceleration measures how its velocity is changing. (Speeding up, slowing down, or changing direction.)

2. A car starts from a stop at a traffic light that has just turned green. The car accelerates at a rate of 3 m/s^2. How fast is the car traveling after 5 seconds?

$$a = \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{\Delta t} \Longrightarrow v_f = v_i + at = 0m/s + 3m/s^2 \cdot 5s = 15m/s$$

3. You are riding your bike at a speed of 4 m/s when you see a large dog behind you. In an effort to outrun the dog, you accelerate to 20 m/s over the course of the next 8 seconds. What was your rate of acceleration?

$$a = \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{\Delta t} = \frac{20m/s - 4m/s}{8s} = 2m/s^2$$

4. You are skydiving, and are falling at your terminal velocity of 60 m/s. You pull your parachute, and decelerate to a speed of 10 m/s, at a rate of 5 m/s^2. How long did it take you to reach your final velocity? Note: Acceleration is negative because it is opposite the direction of motion.

$$a = \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{\Delta t} \Longrightarrow \Delta t = \frac{v_f - v_i}{a} = \frac{10m/s - 60m/s}{-5m/s^2} = 10s$$

5. A car is driving on Lee Trevino at 20 m/s when the driver sees a red light. The driver slows the car to a stop over the next 8 seconds. What is the acceleration of the car?

$$a = \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{\Delta t} = \frac{0m/s - 20m/s}{8s} = -2.5m/s^2$$

6. Lauren is walking at 2 m/s when she is startled by Benny walking behind her. Over the next two seconds, she starts to run at 6 m/s. What was her acceleration?

$$a = \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{\Delta t} = \frac{6m/s - 2m/s}{2s} = 2m/s^2$$

7. A plane is traveling 250 m/s when it touches down on the runway while landing. It comes to a complete stop in 25 seconds. What is the acceleration of the plane?

$$a = \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{\Delta t} = \frac{0m/s - 250m/s}{25s} = -10m/s^2$$

8. Elijah is driving a car with a top acceleration of 12 m/s^2. If he starts from a stop, and accelerates for 3 seconds, what is the speed his car will be going?

$$a = \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{\Delta t} \Longrightarrow v_f = v_i + at = 0m/s + (12m/s^2)(3s) = 36m/s$$

9. Celina is marching forward at a speed of 1 m/s when she starts to march backward at a speed of 2 m/s. If she accelerates at 12 m/s^2, how much time will the change take? Note: Backward speed is negative. To accelerate backward, acceleration must be negative as well.

$$a = \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{\Delta t} \Longrightarrow \Delta t = \frac{v_f - v_i}{a} = \frac{-2m/s - 1m/s}{-12m/s^2} = 0.25s$$

10. A car is advertised to go from 0 to 60 mph [26.822 m/s] in 5.7 seconds. What is the acceleration of the car?

$$a = \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{\Delta t} = \frac{26.822m/s - 0m/s}{5.7s} \approx 4.706m/s^2$$