

# ACCELERATION



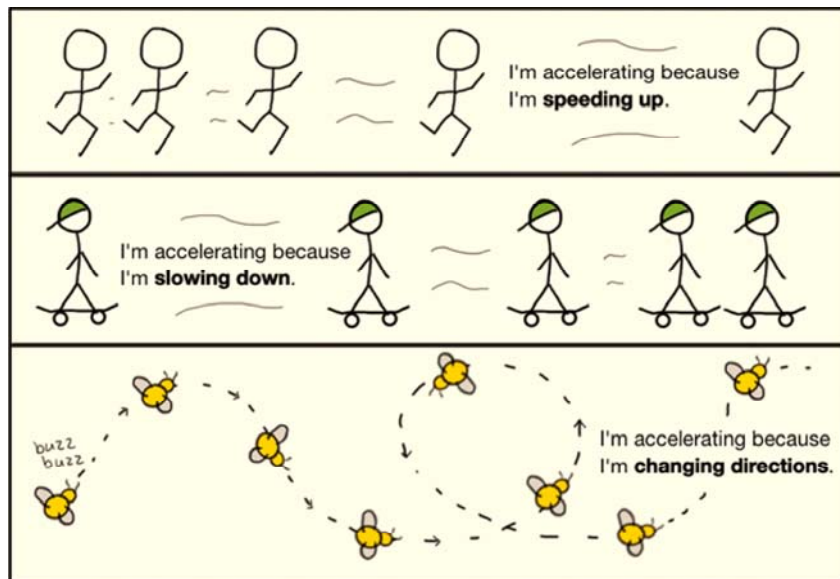
## Unit Introduction

In the last unit, you learned about average speed and velocity. In this unit, you will learn about another descriptor of motion that can impact speed and velocity: acceleration.

## Acceleration

**Acceleration** is the name given to any process that changes the velocity of an object. When an object's speed increases over time, this is known as **positive acceleration**. If an object's speed decreases over time, it is called negative acceleration, or **deceleration**. Since velocity is both a speed and a direction, if an object changes direction, this also produces a change in the object's acceleration. If an object has no acceleration, it can either be standing still or moving at a constant velocity.

In this unit you will work on problems that deal with uniform acceleration.



Average acceleration can be calculated by dividing the change in velocity by the time that has elapsed. The standard unit for acceleration is meters per second squared, or  $m/s^2$ . The formula for average acceleration is as follows:

$$\begin{aligned} \text{Average Acceleration, } \bar{a} \\ \bar{a} &= \frac{\text{Change in Velocity}}{\text{Time Interval}} \\ \bar{a} &= \frac{\Delta v}{\Delta t} = \frac{v_f - v_o}{t_f - t_o} \end{aligned}$$

Now, try to solve a problem using the formula for average acceleration.

A roller coaster car rapidly picks up speed as it rolls down a slope. As it starts down the slope, its speed is 4 m/s. But 3 seconds later, at the bottom of the slope, its speed is 22 m/s. What is its average acceleration?

Average acceleration = change in velocity/time interval

$$a = (22m/s - 4m/s)/3s$$

$$a = 18m/s/3s$$

$$a = 6m/s^2$$

The roller coaster's average acceleration is  $6m/s^2$ .



Read the following article to learn more about acceleration.



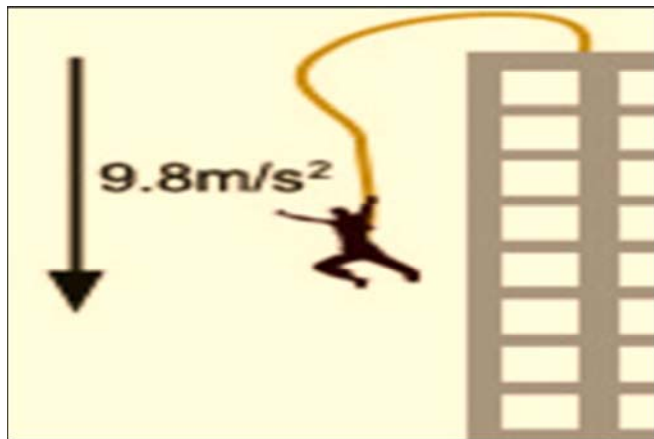
Since you now understand velocity and acceleration, watch the following video. Use the video notes to solve the problem along with the video clip. Submit your work as question #7 in the assessment portion of the unit.

Printable: [AIRBUS VIDEO NOTES](#)

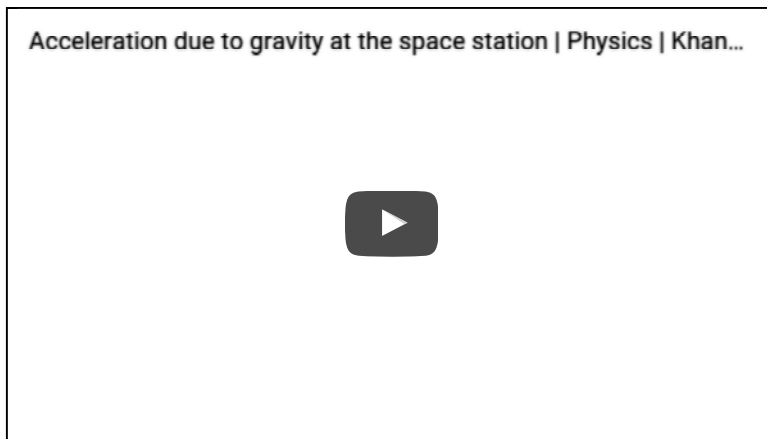


### Acceleration Due to Gravity

An object in freefall will accelerate at a rate of  $9.8\text{m/s}^2$  toward the Earth, which is due to the force of Earth's gravity on the object. This is known as *acceleration due to gravity*.



Here's a thought-provoking question. What factors can influence the acceleration due to gravity? If an object is in space or on or near another planet, the force of gravity will be different, due to the change in gravitational forces. Watch the following video clip on acceleration due to gravity at the international space station. This video is just to get you thinking. You are not responsible for the mathematics presented in this clip.



Try a practice problem for acceleration due to gravity.

An apple falls from the top of an apple tree. Its final velocity is 19.6m/s. How long did it take for the apple to hit the ground?

This problem assumes that you know the acceleration due to gravity, which is  $9.8\text{m/s}^2$ . Use that in the acceleration formula. You need to rearrange the formula to solve for time.

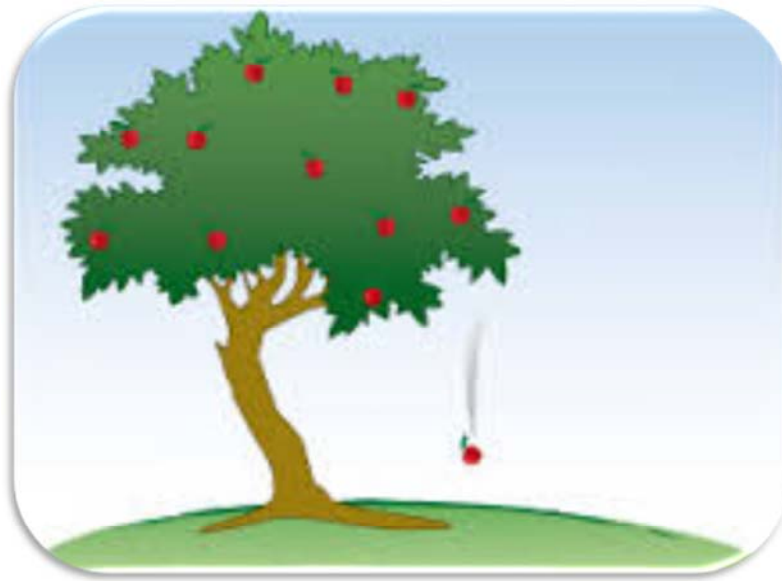
acceleration = change in velocity/time; change in velocity = acceleration x time; time = change in velocity/acceleration

$$t = (19.6\text{m/s} - 0\text{m/s}) / 9.8\text{m/s}^2$$

$$t = 19.6\text{m/s} / 9.8\text{m/s}^2$$

$$t = 2\text{s}$$

It took the apple 2 seconds to hit the ground.



Please complete the acceleration practice problems now. Submit your work as question #8 in the assessment portion of the unit.

Printable: [ACCELERATION PRACTICE PROBLEMS DOCUMENT](#)

### **Virtual Car: Acceleration**

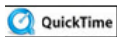
The virtual car at the following website demonstrates acceleration in a way that you can see and manipulate. Click “launch” and use the arrows to make the car speed up, slow down, and change direction, which are all ways of accelerating.

[https://westernreserve.pbslearningmedia.org/resource/phy03.sci.phys.mfw.accel/virtual-car-velocity-and-acceleration/#.WRX\\_5WgrKUk](https://westernreserve.pbslearningmedia.org/resource/phy03.sci.phys.mfw.accel/virtual-car-velocity-and-acceleration/#.WRX_5WgrKUk)

### **Discovery Education Video**

Review the concepts of velocity, acceleration, and deceleration as you watch the following video clip. Complete the guided notes and submit your work as question #9 in the assessment portion of the unit.

Printable: [Video Guided Notes](#)



Velocity, Acceleration, and Deceleration (03:41)

## **QUIZLET VOCABULARY**

**Quizlet**



Now answer questions 1 through 8.