

# 2-4-09 DSQ

- ▶ What happens when two forces act in the same direction?
- ▶ TODAY
  - Friction and Gravity
    - Read p. 42 – 50 with the recording
    - Workbook p. 20–23
  - Finish WB p. 18–19 if not finished


# Chapter 2 Notes

Forces

# Section 2.2 Notes

»» Friction and Gravity


# Key Concepts

- ▶ What factors determine the strength of the friction force between two surfaces?
  - ▶ What factors affect the gravitational force between two objects?
  - ▶ Why do objects accelerate during free fall?
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# Friction

- ▶ What are examples of friction?
- ▶ Friction = the force that two surfaces exert on each other when they rub against each other.

# The Causes of Friction

- ▶ In general, \_\_\_\_\_ surfaces produce less friction than \_\_\_\_\_ surfaces.
  - ▶ **Strength** of the force of friction depend upon **two factors**:
    - How hard the surfaces push together
    - The types of surfaces involved
  - ▶ Friction acts in the direction opposite to the direction of the object's motion.
  - ▶ Four types of friction.
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# #1 Static Friction

- ▶ Friction that acts on objects that are not moving.



# #2 Sliding Friction

- ▶ Occurs when two solid surfaces slide over each other.



# #3 Rolling Friction

- ▶ When an object rolls across a surface.



- ▶ Easier to overcome than sliding friction.

# #4 Fluid Friction

- ▶ Occurs when a solid object moves through a fluid.
  - Fluids include:
    - Water
    - Oil
    - Air



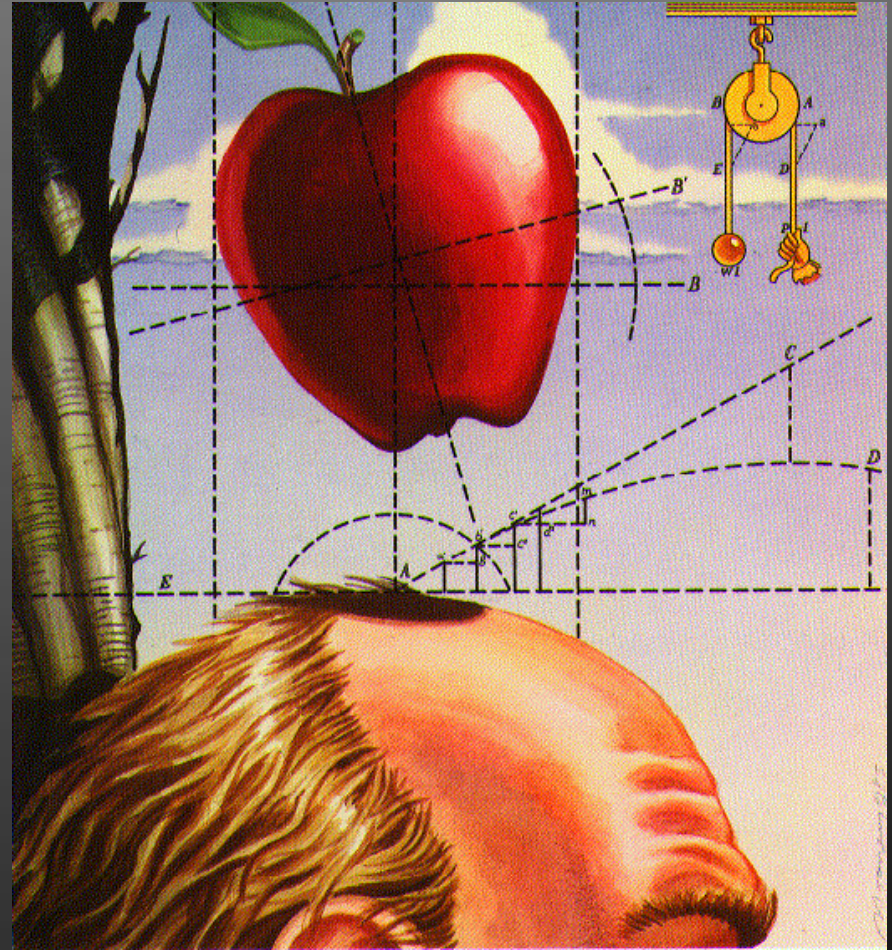
# Gravity

- ▶ Why do things fall down?
- ▶ Gravity is a force that pulls objects toward each other.
- ▶ Sir Isaac Newton first to describe gravity as a force.



# Universal Gravitation

- ▶ Where is gravity?
- ▶ Gravity acts everywhere!
  - Apple, moon, planets, and YOU!
- ▶ Law of Universal Gravitation = the force of gravity acts between all objects in the universe.



# Factors Affecting Gravity

- ▶ What affects gravity?
- ▶ Two factors affect the gravitational attraction between objects:
  1. Mass
  2. Distance
- ▶ Mass = the measure of the amount of \_\_\_\_\_ in an object.

# Factors Affecting Gravity

## ▶ MASS

- The more mass an object has the greater its gravitational force.

## ▶ DISTANCE

- The farther apart two objects are, the lesser the gravitational force between them.



# Gravity

- ▶ Two factors affect the gravitational attraction between objects: mass and distance.



The force of gravity acts between all objects.



If mass increases, the force of gravity increases.



If distance increases, the force of gravity decreases.

# Weight and Mass

Are weight and mass the same things?

## ▶ Mass

- Measure of the amount of matter in an object.

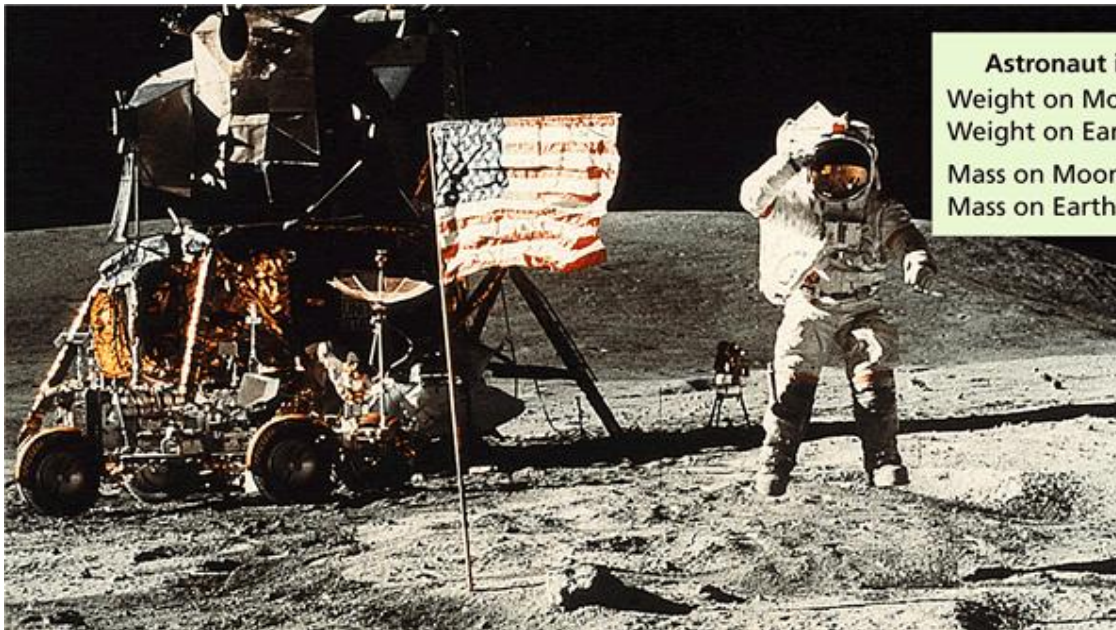
## ▶ Weight

- The force of gravity on a person or object at the surface of a planet.
- Weight on the Moon



# Gravity

- ▶ The force of gravity on a person or object at the surface of a planet is known as *weight*.



Astronaut in Spacesuit	
Weight on Moon =	270 N
Weight on Earth =	1,617 N
Mass on Moon =	165 kg
Mass on Earth =	165 kg

# Gravity and Motion

- ▶ Free Fall
  - ▶ Air Resistance
  - ▶ Projectile Motion
- 

# Free Fall

- ▶ When the only force acting on an object is gravity
- ▶ In free fall, the force of gravity is an unbalanced force which causes an object to accelerate.



# Free Fall

## Apollo 15 Free Fall Experiment

- ▶ How much does an object accelerate as it falls?
- ▶ 9.8 m/s
- ▶ Start = 0 m/s
- ▶ 1 s = 9.8 m/s
- ▶ 2 s = 19.6 m/s
- ▶ 3 s - \_\_\_\_\_ m/s
- ▶ All objects in free fall accelerate at the same rate regardless of their masses!

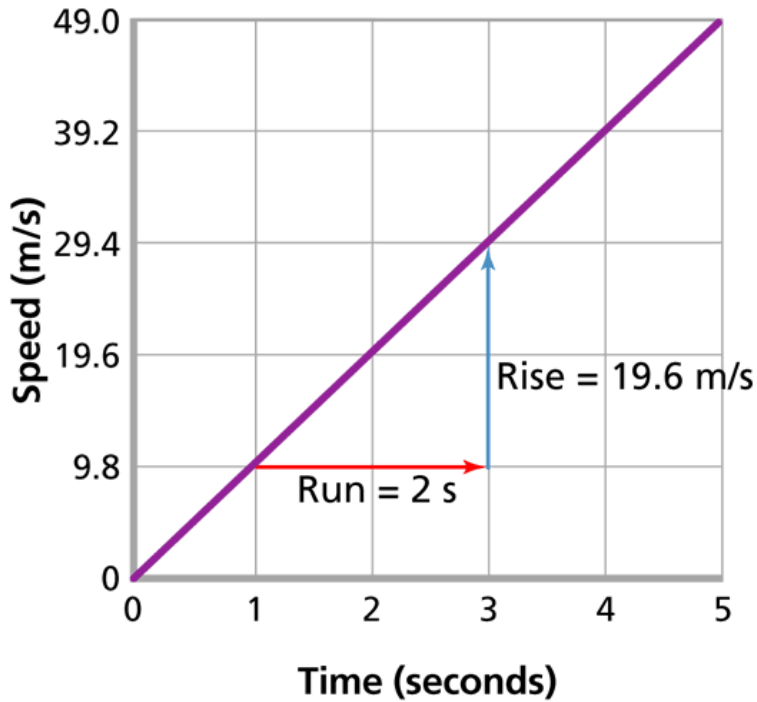
# Free Fall



- ▶ Click the Video button to watch a movie about free fall.

# Free Fall

**Motion of an Object in Free Fall**

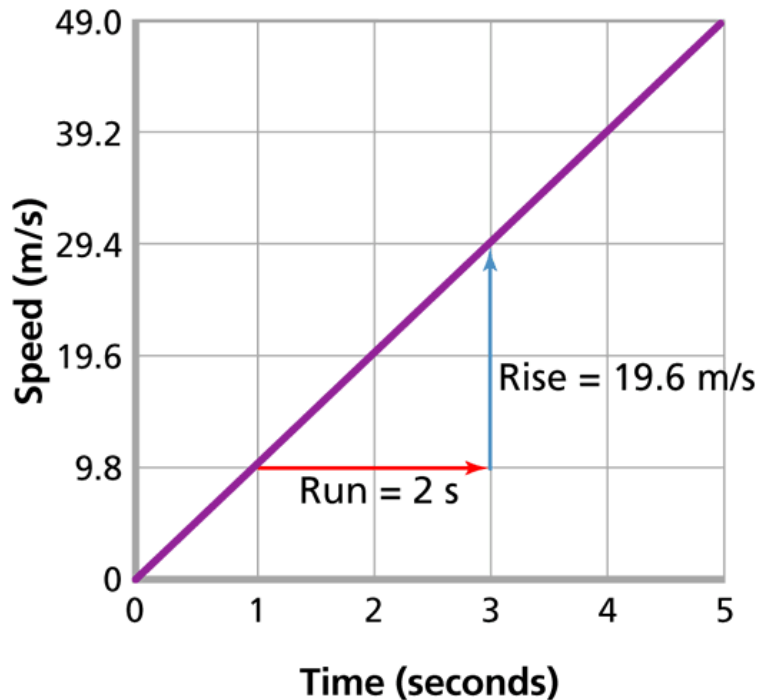


- ▶ Use the graph to answer the following questions.

**Math** Analyzing Data

# Free Fall

## Motion of an Object in Free Fall



Q.

### ▶ Interpreting Graphs:

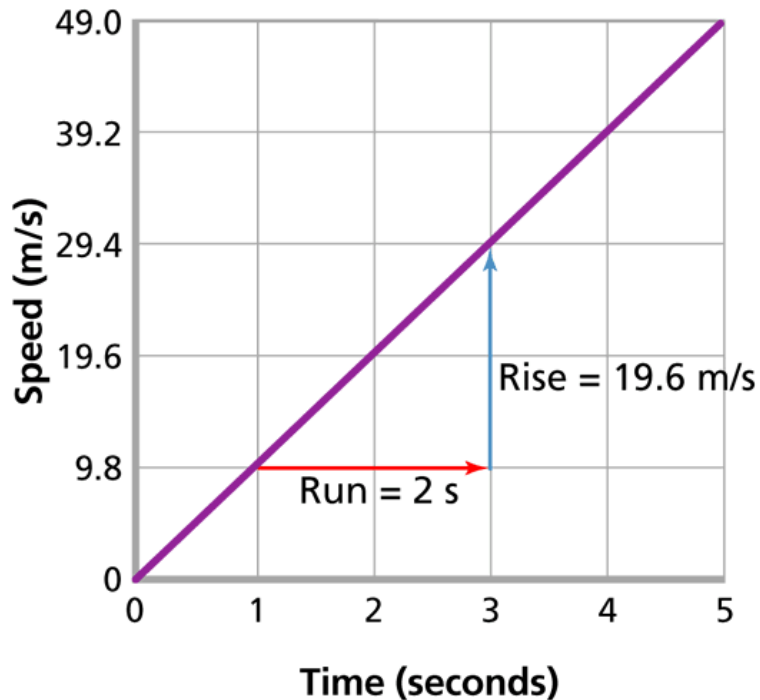
- What variable is on the horizontal axis? The vertical axis?

A.

- Time is on the horizontal axis, and speed is on the vertical axis.

# Free Fall

## Motion of an Object in Free Fall



### ▶ Calculating:

◦ Calculate the slope of the graph. What does the slope tell you about the object's motion?

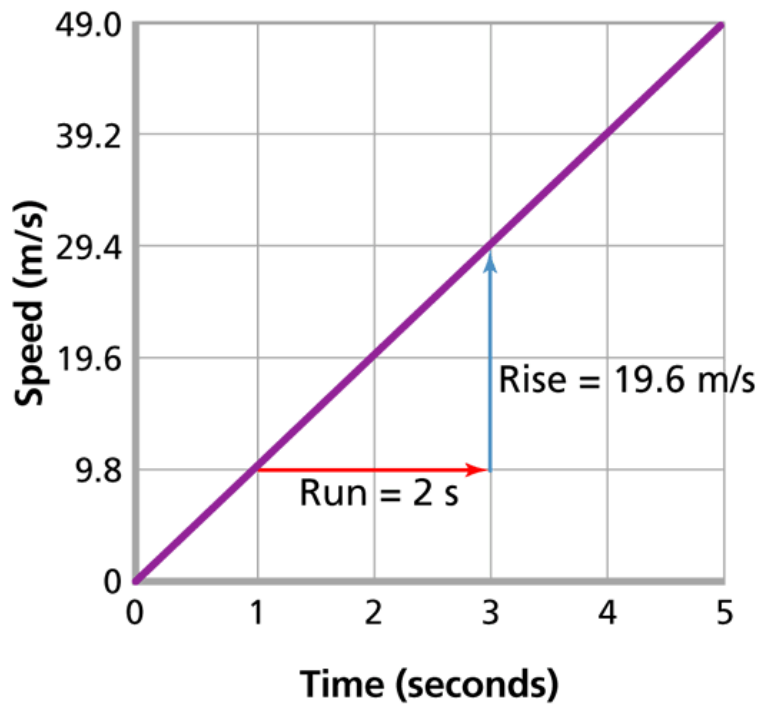


◦ The slope is 9.8. The speed increases by 9.8 m/s each second.

**Math** Analyzing Data

# Free Fall

## Motion of an Object in Free Fall



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► **Predicting:**

◦ What will the speed of the object be at 6 seconds?

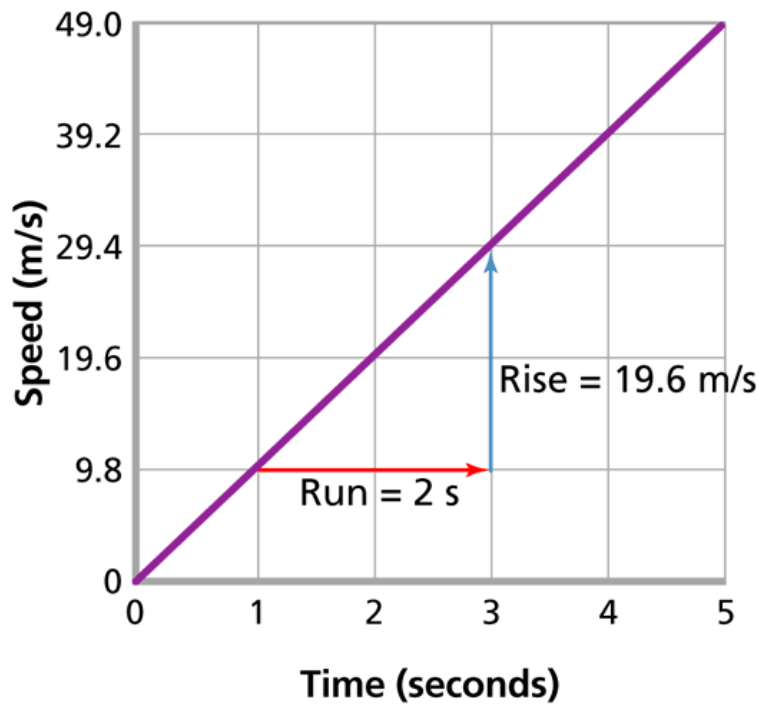
A.

◦ 58.8 m/s

**Math** Analyzing Data

# Free Fall

## Motion of an Object in Free Fall



Q.

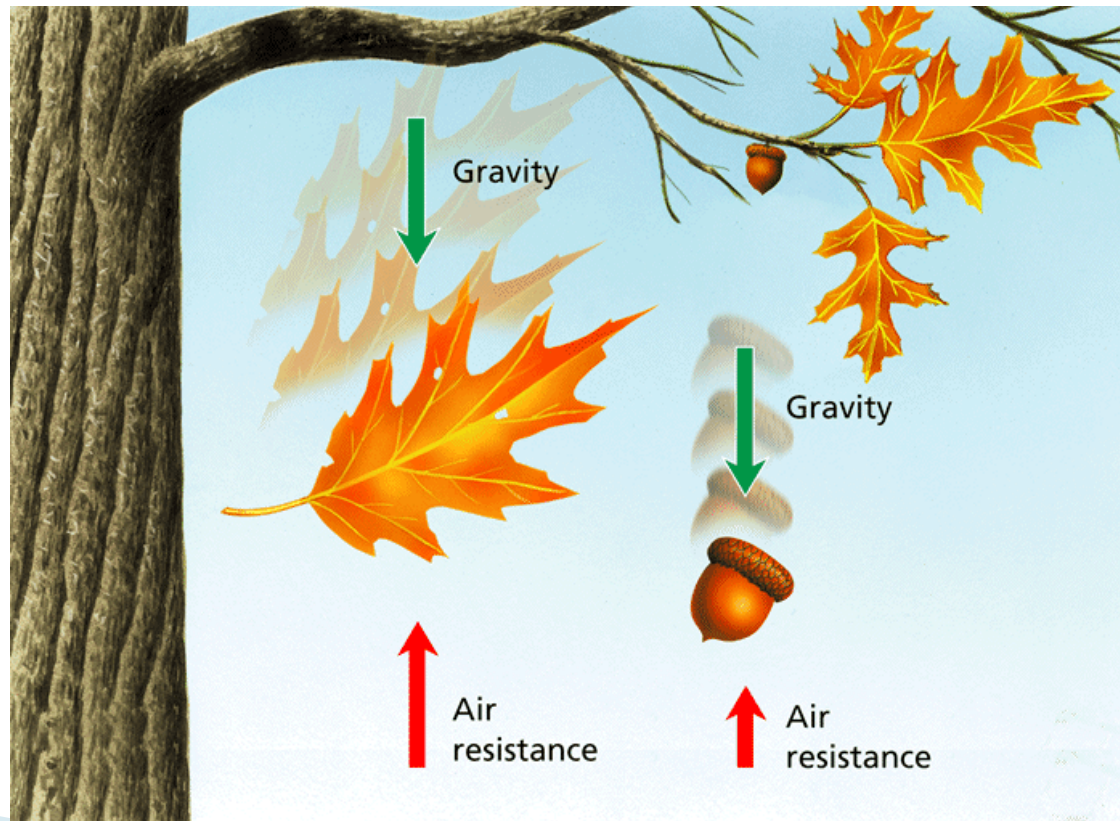
### Drawing Conclusions:

- Suppose another object of the same size but with a greater mass was dropped instead. How would the speed values change?
- The speed values would not change.

A.

# Air Resistance

- ▶ Falling objects with a greater surface area experience more air resistance.



# Air Resistance

- ▶ Is a type of fluid friction.
  - Pushes up
  - Objects with greater surface area experience more surface area.
- ▶ As a falling object speeds up, the force of air resistance becomes greater and greater.
- ▶ The greatest velocity a falling object reaches is called terminal velocity.
  - When the force of air resistance equals the weight of the object.

# Projectile Motion

- ▶ An object that is thrown is called a projectile.
- ▶ Will a projectile that is thrown horizontally land on the ground at the same time as an object that is dropped?
- ▶ Yes!

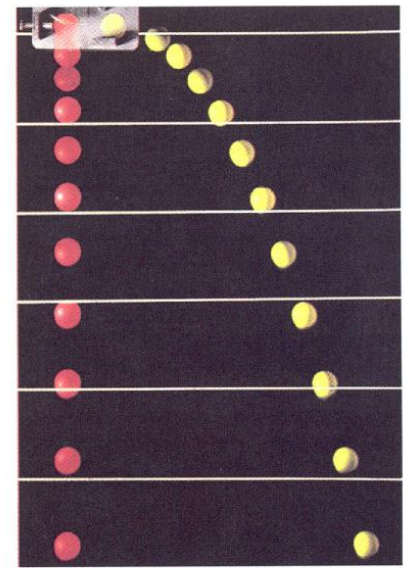


FIGURE 4-10 One ball is released from rest at the same time as another ball is thrown horizontally to the right. Their vertical motions are identical.



# Comparing and Contrasting

- ▶ As you read, compare and contrast friction and gravity by completing a table like the one below.

	Friction	Gravity
Effect on motion	Opposes motion	Pulls objects toward one another
Depends on	Types of surfaces involved, how hard the surfaces push together	Mass and distance
Measured in	Newtons	Newtons