Unit 4 Lessons 9 – 13 Study Guide

Unit 4 Lesson 9-13 Vocabulary:

Lesson:	Term	Definition
9	Friction	
9	Inertia	
10	Mass	
10	Weight	
13	Buoyancy	
13	Buoyant Force	

Lesson 9: Newton's First Law of Motion

Motion and Force

- Unbalanced forces cause an object to start or change motion
- Balanced forces cause no change in motion

Newton's First Law of Motion:

- A body at _____ unless acted on by an external, unbalanced force.
- A body _____ unless acted on by an external, unbalanced force.
- **Example: An object will keep doing what it is doing (moving or sitting still) unless some other force makes it do something else**

Objects at Rest and in Motion:

- **Inertia:** the quality of an object that resists a change in motion or resists a change in the resting state
    - The more massive an object, the more _____ it has … the harder it is to change its motion
    - **Example: Golf Ball and Bowling Ball**
        - Golf Ball: has a smaller mass and less inertia compared to bowling ball
        - Bowling Ball: has a larger mass and more inertia compared to a golf ball

Putting the First Law to Use:

Inertia Forces:

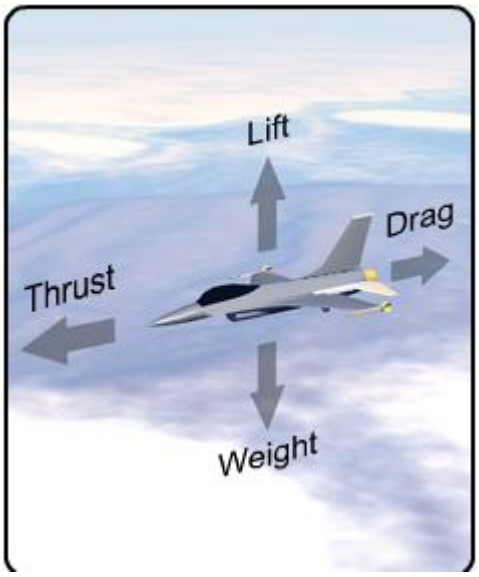
- Example #1: You are sitting on a stopped bus.
    - When the bus starts moving, you feel you are being pushed backward… that's inertia!
- Example #2: You are riding a dirt bike over a hilly road
    - You would fly off the bike if you hit a large bump or rock on the road. That's inertia!

Friction: A force that resists motion between two objects that are in contact

- If you slide a book across the floor, eventually it stops (it doesn't slide forever!)
  - This is friction at work

Think about this airplane…

- If the airplane is in flight:
  - Thrust force = 10,000 N
  - Drag Force = 10,000 N
  - **Is the plane going to speed up, slow down or stay the same? Why?**
    - _____
      _____



- If this airplane is in flight:
  - Thrust force = 11,000 N
  - Drag force = 10,000 N
  - **Is the plane going to speed up, slow down, or stay the same? Why?**
    - _____
      _____

Lesson 10: Mass and Weight

Mass and Weight

- Mass: the amount of _____ in an object
  - The greater the _____, the more force that is needed to change its velocity
    - Measured in grams (g) or kilograms (kg)
    - THINK! It is easier to throw a golf ball than a bowling ball!
- Weight: a measure of the gravitational force exerted on an object
  - Weight is a _____ so it is measured in Newtons (N)

Mass and Inertia:

- The greater the object's mass, the greater its inertia
  - This means that a more massive object is harder to move from rest, or to change the motion of, than a less massive object

How Do You Measure Mass?

- Balance: works by measuring the object compared to a set of know masses.
- The mass of an object is the same no matter where in the universe it is measured. Why?
  - This is because the amount of matter in an object DOES NOT change by just moving it.

How Do You Determine Weight?

- Scale: uses a _____ scale that stretches a certain amount according to the force of gravity acting on the object
- Weight of objects change depending on the gravity
    - You would weigh LESS on the moon because the moon has LESS gravity compared to Earth.

Weight is a Force … Mass is NOT a Force

- Weight (w) = Mass (m) x Acceleration due to Gravity (g)
    - w = m x g
    - w = weight (N)
    - m = mass
    - g = acceleration due to gravity
        - On Earth, g = 9.8 m/s/s

- Example: What is the weight of a 70 kg person on Earth?
    - Weight (w) = Mass (m) x Acceleration due to Gravity (g)
    - w = m x g
        - w = what you are solving for
        - m = 70 kg
        - g = 9.8 m/s/s
    - w = 70 kg x 9.8 m/s/s
        - w = 686 N

Lesson 11: Newton's Second Law of Motion

Newton's Second Law of Motion:

- When an _____ force acts on an object, the object will be accelerated. The acceleration is proportional to the force and will be in the same direction of the force.
- **Example: If a force acts on an object, it will be accelerated (it will speed up). It will speed up in the same direction as the force that acted on it**

Acceleration Depends on Force and Mass:

- Force →
    - _____ the force of the push/pull on an object increases its acceleration
    - Decreasing the force of the push/pull on an object decreases its acceleration
- Mass →
    - A force push/pull acting on a smaller mass produces a _____ acceleration
    - A force push/pull acting on a larger mass produces a smaller acceleration

Force as a Formula

- Force = Mass x Acceleration
- F = m x a
    - F = force (N)
    - m = mass (kg)
    - a = acceleration (m/s/s)

- Example: You want to push a box of books across your floor. What amount of force must be applied to a box with a mass of 2 kg so that it will accelerate to 3 m/s/s?
    - Force = Mass x Acceleration
    - F = m x a
        - F = what you are solving for
        - m = 2 kg
        - a = 3 m/s/s
    - F = 2 kg x 3 m/s/s
    - F = 6 N
    - Force = 6 N

Lesson 12: Newton's Third Law of Motion

Remember!

- A force is a _____ or a _____
- An unbalanced force changes an object's motion
- Objects have _____ and resist forces that try to change their motion
- Friction is the force between two _____ that _____ motion
- Unbalanced forces cause objects to accelerate according to the equation: F = m x a

Newton's Third Law of Motion:

- In one object exerts a force on a second object, the second object exerts a force on the first object that is _____ in magnitude (size) and _____ in direction.
- **Example: For every action there is an EQUAL and OPPOSITE reaction!**
    - **If I push on you, you push on me back!**

Acceleration Formula:

- Acceleration = Force ÷ Mass
- a = F ÷ m
    - a = acceleration (m/s/s)
    - F = Force (N)
    - m = mass (kg)

- **Example:** You are jumping on a trampoline. Your mass is 60 kg. How much will you accelerate when the trampoline applies a force of 90 N?
    - Acceleration = Force ÷ Mass
    - a = F ÷ m
        - a = what you are solving for
        - F = 90 N
        - m = 60 kg
    - a = 90 N ÷ 60 kg
    - a = 1.5 m/s/s
    - Acceleration = 1.5 m/s/s

Lesson 13: Buoyant Forces

Buoyancy: the tendency of an object to float

Buoyant Force: the upward force on an object which is immersed in a fluid

Buoyant Force and Weight:

- In order for an object to float in a fluid, its weight (which is a force) must be LESS than the buoyant force exerted by the fluid.
- **Example:** a rubber ducky and a rock in a swimming pool
    - Rubber Ducky = the weight is LESS than the buoyant force of the water, so the duck floats
    - Rock = the weight is GREATER than the buoyant force of the water, so the rock will sink

Archimedes' Principle:

- When an object is placed in a fluid, the buoyant force acting on it is equal to the weight of the fluid that the object displaces

Density: is a measure of how tightly the mass of an object is packed.

- If the density of an object is less than the density of a fluid, it will float in the fluid
- If the density of an object is greater than the density of the fluid, it will sink in the fluid.