Name _____

Equilibrium (p. 211 – 217)

I. The Center Of Mass

p. 211

1. Define the term center of mass.

Center Of Mass – point on an object that moves in the same way that a point particle would move

2. List the steps to find the center of mass of an object.

p. 211 Bottom

1. Suspend object from any point (C.O.M. along vertical line down)
2. Suspend object from another point (Draw second line)
3. Point of intersection = Center Of Mass

Males Vs. Females – Chair DEMO

3. Where is the location of the center of mass of a human (standing stationary)?

Few centimeters below navel (midway between front + back)

female → 1 inch lower + further back

4. Why doesn't a ballet dancer's head move much during a leap?

Raising arms + legs moves center of mass closer to her head p. 212 Top

II. Center Of Mass & Stability

1. Explain how a refrigerator can tip over (in terms of force, torque, and center of mass).

T_F exerted on refrigerator gradually overcomes T_W (weight on fridge) until center of mass exceeds base

Rotate the refrigerator's center of mass around the axis of rotation until it is no longer above the base of the box

p. 212 Bottom

2. The broader the base of an object, the ~~less~~ more stable the object is.

Circle One : True (False)

Ex. Basketball Stance

Balancing Pop Can p. 213

3. The lower the location of an object's center of mass, the greater its stability.

Circle One : (True) False

Ex. Football Lineman

4. How does standing on tip-toes affect a person's center of mass?

Center of mass shifts ~~to~~ above balls of feet (very little stability)

Egg Balancing vs Quarter Balancing

5. Which of the following statements is false concerning center of mass?

a. To remain stable, the center of mass of an object must be within the base of the object.
b. If the center of mass is above the base of an object, it is stable.
c. Lowering the center of mass of an object increases the objects stability.
d. Tall, narrow objects ~~cannot~~ achieve stability.
→ But, easy to tip over!

Name _____

III. Conditions For Equilibrium

1. **Static equilibrium occurs when an object has zero velocity and angular velocity.**

   Circle One : (True) False

   or constant

2. **What two conditions must occur in order to achieve static equilibrium?**

   1. Transitional Equilibrium (Net force on object = zero)
   2. Rotational Equilibrium (Net torque on object = zero)

IV. Rotating Frames Of Reference

1. **List three examples of rotating frames of reference.**

   p. 216

   1. Merry-Go-Round 2. Ferris Wheel 3. Earth

2. **Newton's laws are only valid in inertial and ~~accelerated~~ non-accelerated frames.**

   Circle One : True (False)

   → Rotating frames of reference = accelerated

V. Centrifugal "Force"

1. **Define the term centrifugal force.**

   Centrifugal Force – apparent force that seems to pull on a moving object (observed only in rotating frames of reference)

2. **Why is centrifugal force not considered a real type of force?**

   Ex. Spinning Kids by arms

   No physical outward push or pull on the object.

3. **A person on a merry-go-round produces what type of motion (viewed from ground)?**

   Circular (Object accelerated toward center)

VI. The Coriolis "Force"

1. **Define the term Coriolis "force".**

   p. 216

   Coriolis Force – apparent force that seems to deflect a moving object from its path (observed only in rotating frames of reference)

2. **Why is the Coriolis force not considered to be a real force?**

   Deflection of horizontal motion only seen in rotating frame of reference.

3. **Where does a projectile launched due north of the equator land?** (assume high velocity)

   Balloon DEMO p. 217

   East of the target (Earth rotate East to West)

4. **In the northern hemisphere, what direction do winds rotate due to the Coriolis Effect?**

   Counterclockwise around low pressure areas

   Storms = SW wind (leaves overturn)