Final Physics Review

December 2022

Authored for the Physical Science Curriculum of Semester 1, 2022

Chapter 2 - Newton's Laws

Separating component forces - using trigonometry to separate forces (Fx, Fy)

Net Force (Fnet) - a combination of all the forces on an object

- Balanced Forces - forces that act on an object to combine to a Fnet of 0
- Unbalanced Forces - forces that act on an object to combine to a Fnet ≠ 0

Newton's First Law

The Law of Inertia

- If **Fnet=0,** the motion of the object **does not change.**

  When Fnet=0:
  - An object at REST stays at REST
  - A moving object will move at a constant velocity

  Unbalanced forces cause:
  - Rest -> speeding up
  - Speed up // slow down
  - Change in direction (HMMM SOUNDS FAMILIAR)

- Inertia: the tendency of an object to resist changes in the motion

Newton's Second Law

- The **acceleration** of an object is equal to the **Fnet** acting on the object **divided** by the object's **mass.** The **direction** of the acceleration is in the same direction as the Fnet.

  Formula: $\mathbf{F = m \cdot a}$

  Gravitational Force: $\mathbf{Fg = 9.8 m/s^2}$
  - Deducted from Newton's Second Law and the Law of Universal Gravitation

  $\mathbf{Fg = G \cdot m_1 m_2 / d^2 = m \cdot a}$
  ($G = 6.6743 \times 10^{-11}\ N \cdot m^2/kg^2$)

Terminal Velocity

- the maximum velocity obtainable for an object falling through a fluid

- First, Vi = 0, Fg = $9.8 m/s^2$
- As the object falls, v increases, but f also increases, meaning a decreases
- Finally, a drops down to 0 and the object moves at constant velocity.

Newton's Third Law

- When one object exerts a force on a second object, the second object exerts an equal force in the opposite direction on the first object.
- **For every force, there is an equal and opposite reaction force** and these two forces are called a **force pair.**
- Force pairs DO NOT act on the same object.

Comparing Balanced and Action/Reaction Forces

	Balanced Forces	**Action and Reaction Force Pairs**
Similarity	Same Magnitude, Opposite Directions	Same Magnitude, Opposite Directions
Difference	Can be different types of forces	Must be the SAME type of forces
Difference	Act on the same object	Act on 2 different objects
Difference	Not always appear/disappear at the same time	Always appear/disappear at the same time

Momentum: Measure of how hard it is to stop a moving object

- $P = m \cdot V$ - unit: $kg \cdot m / s$
- Momentum is a vector, keeping the same direction as its velocity

The higher the momentum, the harder it is to stop, and the greater effect will occur if it is brought to rest by striking another.

- The total momentum of objects stays the same unless outside forces act on the objects
    - No matter if it's an elastic or inelastic collision!

        - **Elastic** - almost no deformation/restitution is fast, heat is not generated
            - E.g., ping pong ball, and paddle

        - **Inelastic** - deformation does not restitute, heat is generated.
            - E.g., car crash!!!!!!!

Chapter 4 - Fluidity and Solidity

Fluid - is any substance that can flow and takes the shape of its container.
- A phase of matter, containing gas and fluid

Pressure - **Magnitude** of the normal force exerted over an area
Formulas:

$P=F_N/A$

- P - Pressure, F_N - Normal Force, A - Area

P=pgh (for liquids that do not change their density with depth)

- P - Pressure, p - Density of the fluid, g - Gravitational Force, h - depth from the surface

Liquid Pressure

1. Pressure acts in **all directions**
    a. For a fluid at rest, no component forces are parallel to any solid surface (or else the fluid would flow)
    b. Therefore, a fluid applies pressure **PERPENDICULAR** to any solid surface in contact with it

2. Pressure **increases with depth**
    a. Pressure is the same in every direction in a fluid at a given depth
    b. Therefore, the deeper a fluid, the greater the weight above -> more pressure

c. Dam broader base: thicker wall for greater water pressure -> increasing depth
d. Measuring blood pressure: arms ~same height as heart

3. Pressure depends on the **density** of the liquid
    a. Absolute Pressure (ATA) - the total ambient pressure on the system

Pascal's Principle

- When pressure is applied to a fluid in a closed container, the pressure increases by the same amount everywhere in the container

  Formula: $P = F_1/A_1 = F_2/A_2$

- Therefore, an applied force can be amplified in a hydraulic system:

  $F_2 = F_1 (A_2/A_1)$

Gaseous Pressure

Atmospheric Pressure: The ratio of the weight of all the air above you divided by your surface area

Standard atmosphere (atm) = 101kPa = 760 mmHg = 1 atm

- Roughly equal to the mean sea-level atmospheric pressure on earth

- Air pressure gets lower as you rise up through the atmosphere

- Air pressure acts in all directions