IDX G9 Physics S
Study Guide Issue S1 Midterms
By Yenny, Edited by Claire

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Chapter 3:

Free Fall

- What is Free Fall?
    - The motion of a falling object when air resistance is negligible and the action can be considered due to gravity alone
- History
    - Aristotle: a heavier object falls faster than a lighter object
    - - Galileo argued that neglecting the effect of air resistance, all objects in free fall have the same constant acceleration.
- Acceleration due to gravity
    - The acceleration of an object in free fall that results from the influence of **Earth's gravity**

        - No matter what the falling object is made of, weighed, positioned, dropped down, or threw up

    - On earth, g = 9.8 m/s_2

    - On moon, g = ⅙ of Earth (About 1.63 m/s_2)

    - Direction points towards the center of the planet, downward

    - Small variations in g at different places on earth

- About Free fall

    - Falling downward: initial velocity is 0 m/s (If down is +, vi is larger than 0m/s)

    - Throwing upward: initial velocity is not 0 m/s (If up is +, vi is smaller than 0m/s)

- Thrown Upward

    - Upward is +

    - Acceleration is same all along (rise+fall)

    - Initial velocity is +, initial distance is 0

    - When it is at highest position, v=0, displacement is the largest

    - If the object is above initial position, displacement is +

    - If the object is below initial position, displacement is -

    - Rising: velocity is +, displacement is +

    - Falling: velocity is -, displacement is +

- When it returns to original position, v=-vi, displacement is 0

Chapter 4:

Introduction of Forces

- What is a force?
  - A force is a push or pull. A force cannot be seen but it can show how a force affects on an object
- Effect of Force
  - Cause acceleration
    - a is not 0
    - Increase, decrease, change direction
  - Deformation (Change in dimension, shape)
- System and the external world
  - System is to whom the force is exerted
  - The internal world is everything around the system that exerts force on the system
- Agents by whom the force is exerted
- System and agent has interaction between only 2 objects
- Contact forces and field forces

- Contact force: an object from the external world touches a system and thereby exerts a force on it
- Field force: exerted without contact (ex. gravitational force, electric force, magnetic force)

- Types of forces
  - a. Gravity: A field force due to gravitational attraction between two objects, generally Earth and the object
  - Direction: straight down towards the center of the Earth
  - Gravity=mg
  - Agent: Earth, System: object
  - b. Normal: a perpendicular contact force exerted by a surface on an object
  - Direction: perpendicular to the surface and away from the surface
  - Agent: Surface, System: object
  - c. Thrust: a general term for the forces that move objects such as rockets, planes, cars, and people
  - Direction: in the same direction as the acceleration of the object
  - Agent: Gas expelled by the engine, System: rocket
  - d. Tension: the pull exerted by a string, rope, or cable when attached to a body and pulled taut
  - Direction: away from the object and parallel to the string

- Agent: Rope, System: object
- e. Spring: a restoring force that is the push or pull a spring exerts on an object
- Direction: opposite the displacement of the object at the end of the spring
- Agent: spring, System: object attached to the spring
- f. Friction: the contact force that acts to oppose sliding motion between surfaces
- Direction: Parallel to the surface and opposite the direction of sliding
- Agent: ground, System: object

Free-body diagram

- Pictorial model:
  - First circle the system, find the contact with external world, identify contact force, and finally identify field forces
- Free-body diagram:
  - Apply the particle model to the pictorial model
  - Arrow to represent a force, label it (Mind direction, length)

Combining Forces in One Dimension

- Net force: the vector sum of all the forces on an object
- Combining forces in one dimension

- Same direction: F net = F1 + F2
- Opposite direction: F net = F1 - F2

Force and Acceleration

- One way to find out is by doing experiments
  - Controlled force exerted horizontally
  - Very smooth surface to reduce the resistance

Newton's Laws

- Galileo's Thought Experiment
  - If friction could be emitted,
    - Initial height equals final height
  - Thought experiment since it can't become reality
- First Law
  - Galileo concluded that in the ideal case of 0 resistance, horizontal motion would never stop
  - Newton: an object that is at rest will remain at rest, and an object that is moving will continue to move in a straight line with constant speed, if and only if the net force acting on that object is zero
- Inertia
  - Law of inertia = another name of Newton's first law

- Inertia is the tendency of an object to resist change
  - Not a force

- Equilibrium: The state when the net force o an object is zero
  - Two states of equilibrium: a = 0
    - At rest
    - Moving at a constant velocity
  - Net force = cause of velocity change
  - No net force = equilibrium
  - Newton's first law identifies a net force as something that disturbs a state of equilibrium

- Second Law
  - The acceleration of an object is equal to the sum of the forces acting on the object, divided by the mass of the object
  - F net = ma
  - Steps:
    - Identify all the forces acting on the object
    - Find the net force
    - Use Newton's second law to calculate the accleration

- Mass and Weight
    - Mass is the amount of matter that makes up an object
        - Mass of an object is always the same everywhere in the universe
        - Unit: kilograms
    - Weight is the force due to the pull of gravity on an object
        - The weight of an object will very depend on its location in the universe
        - Unit: Newtons