IDX G9 Physics S
Study Guide Issue 1
By Yenny, Edited by Claire Kong

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Picturing Motion

• Picturing Motion

o Motion: Changing position over time to a frame of reference
o Motion Diagram is used to show the position of a moving object at equal time intervals
▪ Purpose to visualize displacement and velocity
▪ Direction represents the way object is moving
▪ Particle model is a simplified version of a motion diagram. Particle is used to represent the object when its size is smaller than the distance and when the internal motion of it is not crucial
Where and When

• Position represents 'where 'and time represents 'when'

o Position can be negative when it opposes from the positive value but time always stays positive

• Coordinate system: Demonstrates the position of the zero point and the direction of the variable's increase or decrease value

• Time interval is the difference between two times

o $\triangle t = t(final) - t(initial)$

• Vector describes both magnitude and direction while scalar only describes magnitude

o Vector: Displacement, velocity, acceleration, force

o Scalar: Distance, speed, time, interval, mass, volume, density, temperature, energy

• Vector is represented by a line and an arrow

o Use scale to represent the length as magnitude (ex. 1cm=10m) and arrows to represent directions

o Use the symbol of an letter with arrow drawn above

• Resultant vector is the conclusion of two or more vectors

o How to find: Move the tail (end of the arrow) of one vector to the tip (head of the arrow) of another vector without the change of magnitude and direction. Always remember head-tail

o Represent the result vector as letter R with an arrow above it

o Subtracting vectors are done with two ways:

▪ Method 1: Put tails of A and B together and find the opposing value which adds together

▪ Method 2: Add -B to A

• Distance, position, and displacement is different

o Distance: How far apart objects are with no direction

o Displacement: The object's overall change in position with direction

o Position: Where is an object at specific time with direction

Position-Time Graphs

• Position-time graph, also called p-t graph, is done with plotting the time on x axis and position on y axis

o When the object is at rest, the slope is a horizontal line parallel to x axis

o When the object is at uniform motion (no change in speed and direction) the slope is a slant straight line

• Information about object and its motion are shown

o y axis: instantaneous position (The position object is at a specific time)

o y intercept: initial position

o Position: Where

o Time: When

o Intersection of graph lines: where two objects meet

How Fast

• Velocity is position divided by time

o Average velocity is the change in disposition over change in time

▪ The slope of p-t graph indicates the average velocity

• Average speed is the absolute value of the slope of p-t graph

• Steeper slope means larger velocity

• Instantaneous velocity is the speed and direction of an object at a particular instant

• Motion diagram can be used to find average velocity

o Average velocity is the same direction as displacement and the proportional of displacement

o Distance equals the same of average velocity multiply time and initial displacement

Acceleration

• Acceleration: Rate at which object's velocity changes

o When the object is at uniform motion, the constant velocity is represented by a straight line.

o When the object is at nonuniform motion, the velocity changes with acceleration

o Large acceleration - large change in velocity and short time interval

o Small acceleration - small change in large time interval

• Velocity-Time graph represents displacement with the area

o Slant straight line: Uniformly accelerated motion

o Rising graph line: acceleration is positive

o Descending graph line: acceleration is negative

o Horizontal line: velocity is constant and acceleration is 0

o Steeper acceleration means larger absolute value of acceleration

• Average Acceleration: The change in velocity during some measurable time interval divided by that time interval

• Instantaneous Acceleration: The change in velocity at an instant of time by using the slope of the line or the tangent line

• Sign of the acceleration does not determine whether the object is speeding up or slowing down

o Positive acceleration: positive direction

o Negative acceleration: negative direction

o Speed up: same direction with initial velocity

o Slow down: opposite direction with initial velocity

Motion with Constant Acceleration

• Final velocity equals the sum of initial velocity and the multiple of average acceleration and change in time

• Position, velocity, and acceleration of d-t graph is considered when turning to v-t graph

• Formula to remember:

$$v_f = v_i + a\Delta t$$

$$\Delta d = \frac{(v_i + v_f)}{2}\Delta t = \bar{v} \times t$$

$$\Delta d = v_i t + \frac{1}{2}at^2$$

$$\Delta d = \frac{(v_f{}^2 - v_i{}^2)}{2\bar{a}}$$