PHYSICS 11

KINEMATICS

Kinematics is a branch of physics that studies the motion of objects without considering the forces that caused the motion.

- Kinematics of an objects are the features or properties of motion of that object
- Kinematics is a branch of mechanics

Motion of an object can be described using words, diagrams, graphs, equations, vectors, and/or numbers with appropriate units.

Kinematics Quantities:

Name	Symbol	Base unit	S = scalar/V=vector

Displacement

- Displacement describes how far and where an object is from the reference point or from its initial position.
- Displacement is a vector quantity.
- When an object moves without changing direction the magnitude of the displacement is distance.
- When an object moves while changing its direction the magnitude of the displacement vector may be very different from the distance covered.
- Displacement can be positive, negative or zero.

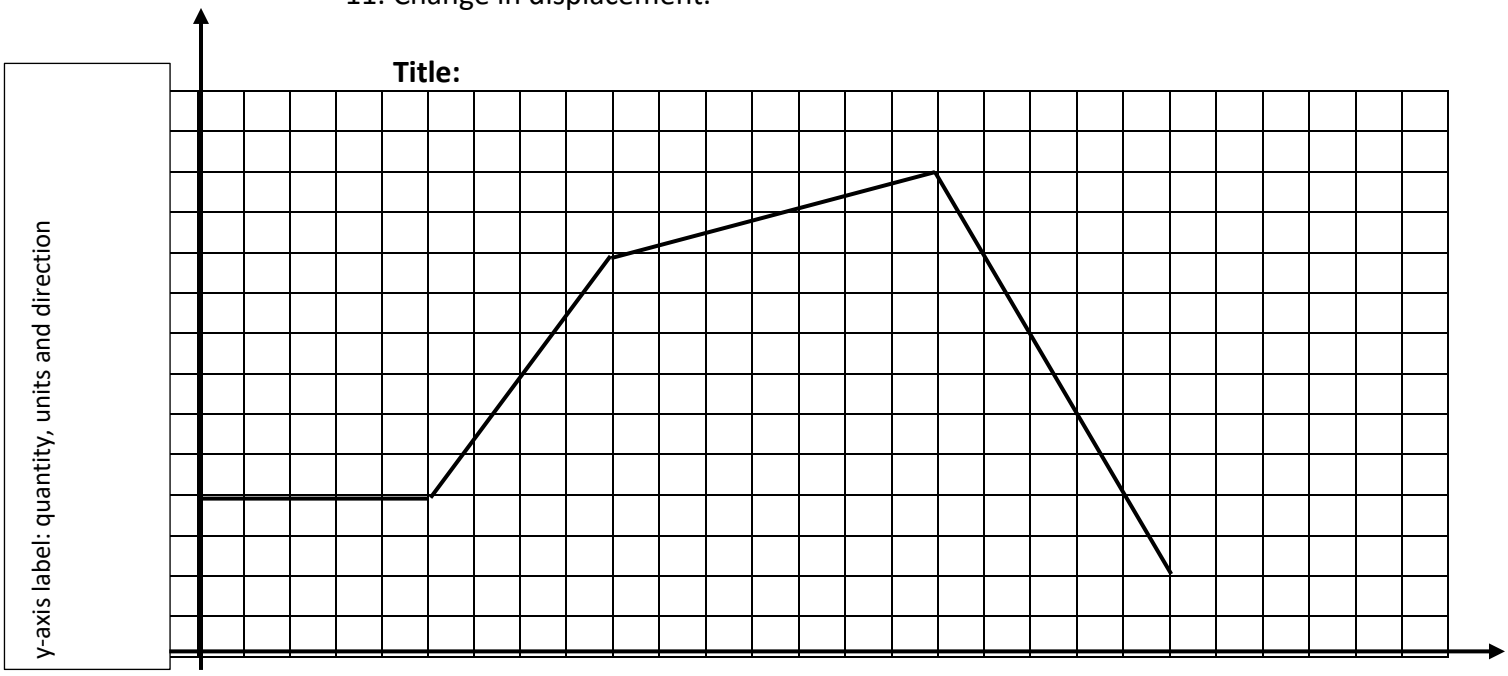
To calculate (change in) displacement:

Positive displacement	Negative displacement	Zero displacement

Displacement versus Time Graphs (d/t graphs)

- Displacement of an object often changes over time.
- Displacement versus Time or Position versus Time graphs are often used to describe the motion of an object.
- When describing the motion of an object using a graph focus on the following:
    1. Units associated with the horizontal axis (time)
    2. Units associated with the vertical axis (displacement)
    3. Direction of the positive vertical axes (North - N, South - S, West - W, East -E, down - D, up - U, right - R, left - L).
    4. Scale on the horizontal axis.
    5. Scale on the vertical axis.
    6. Initial = starting position of the object = how far and at what direction from the origin (or another reference point) was the object at the beginning of the time interval.
    7. Final = end position of the object = how far and at what direction from the origin (of another reference point) was the object at the end of the time interval.
    8. The length of the time interval:

9. Any possible changes in the direction of motion.
10. Any possible changes in the steepness of the line: flat line = no motion, steep line = fast motion, shallow line = slow motion.
11. Change in displacement.



Descriptor	Value	Descriptor	Value
Initial displacement		Velocity for the first 5 s	
Final displacement		Velocity for t=(5,9]s	
Initial time		Velocity for t=(9,16]s	
Final time		Velocity for t=(16,21]s	
Change in displacement		Object at rest.	
Time interval		Object moves in positive direction.	
		Object moves in negative direction	

Velocity

- **Velocity is the rate of change in displacement**.
- Velocity is a vector quantity.
- Magnitude of the velocity vector is speed.
- Velocity can be positive, negative or zero (zero displacement = object at rest).

To calculate change in velocity:

To calculate final velocity:

To calculate initial velocity:

- Velocity is slope of the line in a displacement versus time graph.
  - Recall:
  - In kinematics:

AVERAGE VELOCITY

- Average velocity is the slope of the secant line on the displacement vs. time graph
- When describing average velocity, it must be clear over what time interval was the average calculated

INSTANTANEOUS VELOCITY

- Instantaneous velocity is the slope of a tangent line on the displacement vs. time graph at a particular point (=time).
- Instantaneous velocity is measured at a particular instant in time.
- When describing instantaneous velocity, it must be clear what at what time was the instantaneous velocity measured.