Constant Acceleration Particle Model LGT

By the end of this unit, students will be able to:

1. Define and provide examples for all vocabulary and concepts
2. Compare objects moving with constant velocity to objects moving with constant acceleration
3. Derive/identify the position-with-acceleration equation
4. Derive/identify the velocity-with-acceleration equation
5. Derive/identify the time-independent position-and-velocity-with-acceleration equation
6. Determine the units and significance of the **tangent line on a position-time graph**
7. Describe the relationship between **average velocity** and **instantaneous velocity**
8. Determine the units and significance of the **slope on a velocity-time graph**
9. Determine the units and significance of the **area underneath the curve of a velocity-time graph**
10. Determine the area of a rectangle and triangle
11. Determine the area of a trapezoid with at least two different methods
12. Use a **position-time graph** to
    - Describe the motion of an object accurately with precision (starting position, speeding up, slowing down, stopped, moving at constant velocity, changing direction, relative velocity)
    - Determine the relative velocity of objects over a time intervals
    - Draw a corresponding velocity-time graph
    - Draw an accurate motion map with position dots and velocity arrows
    - Determine displacement of specified time-intervals
    - Determine average velocity
    - Determine instantaneous velocity at a specific time
13. Use a **velocity-graph** to
    - Describe the motion of an object accurately (starting position, speeding up, slowing down, stopped, moving at constant velocity, changing direction, relative velocity)
    - Determine the relative velocity of objects over a time intervals
    - Draw a corresponding velocity-time graph
    - Draw an accurate motion map with position dots and velocity arrows
    - Determine displacement of specified time-intervals
    - Determine average velocity
    - Determine instantaneous velocity at a specific time
14. Use an **acceleration-time** graph to
    - Draw a corresponding velocity-time graph (given initial velocity)
    - Draw a corresponding position-time graph (given starting position)
    - Draw an accurate motion map with position dots, velocity and acceleration arrows
    - Determine displacement of specified time intervals
15. Use a motion map to
    - Describe the motion of an object accurately (starting position, speeding up, slowing down, stopped, moving at constant velocity, changing direction, relative velocity)
    - Draw a corresponding position-time graph
    - Draw a corresponding velocity-time graph
    - Draw a corresponding acceleration-time graph
16. Solve for unknown quantities for objects that uniformly accelerate
17. Solve for unknown quantities for objects in free fall (objects dropped, thrown upwards, thrown downwards)

Vocabulary and Concepts

Acceleration
Acceleration vector
Acceleration due to gravity
Area "under" the velocity-time curve
Area "under" the acceleration-time curve
Average acceleration
Deceleration* (not scientific terminology)
Decreasing speed
Free fall
Increasing speed
Instantaneous velocity
Magnitude
Meters
Meters per second
Meters per second per second
Meters per second squared
Motion map with acceleration
Position
Rate of change
Reference point
Relative velocity
Slope of position-time graph
Slope of velocity-time graph
Slowing down
Speeding up
Stacks of graphs
Tangent line to a curve
Trapezoid
Velocity

Textbook Reading and Questions

Read pg 54-59 (starting with Instantaneous Velocity)
(note that the textbook uses d_o and d to represent position whereas we use x_o and x)

Read pg 90-105

Answer questions on pg 61
#17-23

Answer questions on pg 108-114
#6,7, 9 , 12, 22, 24,25, 40, 44, 46-58, 64

Answer these questions only after learning about freefall
#66-71, 73-76

Conceptual Questions

1. What two controls on a car causes a change in speed? What three controls causes change in velocity? Explain why.
2. What physical quantity describes how quickly you change how fast you're traveling, or how quickly you change your direction?
3. Acceleration is the rate at which what happens?
4. What is the acceleration of a car that travels in a straight line at a constant speed of 100 km/hr?
5. What is the acceleration of a car that increases its velocity from zero to 100 m/s in 10 s?

6. Why does the unit of time enter twice in the unit of acceleration?
7. What is the difference between instantaneous velocity and average velocity?
8. Does the speedometer of a car read instantaneous speed or average speed?
9. At what point is the instantaneous velocity the same as the average velocity of some time interval?
10. If an object is “decelerating” does it mean the object has negative acceleration? Why or why not?
11. What does it mean when it is said an object is in freefall?
12. For a freely falling object dropped from rest, what is the instantaneous speed at the end of the fifth second of fall? sixth second? At the end of any elapsed time t?
13. For a freely falling object dropped from rest, what is the acceleration at the end of the fifth second of fall? sixth second?
14. If you throw a ball straight upward with a speed of 20 m/s and neglect air resistance, how fast will it be moving when you catch it? Why?
15. For an object thrown upwards, what is its instantaneous speed at the top of its path? Its acceleration? What proof do you have for your answers?
16. Toss a ball upward. What is the change in velocity each second on the way up? How does the change in velocity compare when the ball is on the way down?
17. What does the slope of the curve on a position-time graph represent?
18. What does the slope of the curve on a velocity-time graph represent?
19. Does air resistance increase or decrease the acceleration of a falling object?
20. Why is that an object can accelerate while traveling at constant speed but not at constant velocity?
21. Would the readings for the distance of a freely falling rock stay the same, increase with time, or decrease with time?
22. A ball is thrown straight up. What will be the instantaneous velocity at the top of its path? What will the acceleration be at the top

Derived Mathematical Models

Mastery Standards

The following standards are the basis of your grade in this unit. Each standard, unless noted is worth 4 points. The scoring system is as follows:

4= your work is perfect and free of all errors
3=your work contains one or a few minor errors in calculation
2=your work contains major errors in either calculation or concepts
1=your work shows little to no signs of mastery

A	I can continue to solve problems from the constant velocity particle model
B-1 **B-2** **B-3**	Given a position vs. time graph I can: a. Interpret the speed and velocity of the object b. Draw a velocity vs. time graph c. Draw a motion map with accurate velocity and acceleration vectors d. Determine if an object is speeding up or slowing down
C-1 **C-2** **C-3** **C-4** **C-5**	Given a velocity vs. time graph I can: a. Draw an acceleration vs. time graph b. Interpret the speed and velocity of the object c. Draw a position vs. time graph d. Draw a motion map with accurate velocity and acceleration vectors e. Determine the acceleration of the object f. Determine if an object is speeding up or slowing down
D-1 **D-2** **D-3**	Given a motion map I can: a. Draw an acceleration vs. time graph b. Draw a position vs. time graph c. Draw a motion map with accurate velocity and acceleration vectors
E	I can determine instantaneous velocity from a position-time graph
F	I can solve for unknown quantities for problems related to constant acceleration with correct units
G	I can solve for unknown quantities for problems related to objects in free fall with correct units