Study Guide

AP Physics C **Mr. Butler**

2D-3D Kinematics

The student should know or be able to do the following:

1. **Distinguish between position, velocity and acceleration unit vectors and identify the *x*, *y*, and *z* components of each unit vector.**
2. **Determine the displacement between two points in 2D or 3D space from a given set of position vectors expressed in unit vector notation.**
3. **Determine the direction of the average velocity from the displacement and the direction of the average acceleration from the direction change in velocity.**
4. **Distinguish between average and instantaneous unit vector quantities of velocity and acceleration and apply calculus methods to determine the average and instantaneous velocity and acceleration as unit vector functions of time.**
5. **Identify the direction of an object's instantaneous velocity and acceleration for any curved path and their components in 2D or 3D space.**
6. **Determine and express the magnitude components of instantaneous velocity and acceleration from unit vector functions and calculate the speed of an object's instantaneous velocity.**
7. **Distinguish the velocity and acceleration vectors for an object moving between two points along a curved path and note the difference between the rate of change of its speed with the magnitude of its vector acceleration.**
8. **Identify and calculate the parallel (tangential) and perpendicular (radial) components of acceleration for an object moving along a curved path and identify the correct orientation of these components for increasing, constant and decreasing speed cases.**
9. **Identify vectors in a two-dimensional coordinate axes within a reference frame for vector, projectile and relative motion and identify the direction of vectors within this frame.**
10. **Distinguish a projectile's instantaneous velocity from its horizontal and vertical velocity components and apply linear kinematic equations to determine its range and time of flight.**
11. **Distinguish a projectile's *inertial trajectory* from its *gravitational trajectory* and identify the complimentary angles which will produce identical ranges.**
12. **Use the principles of vectors and linear kinematics to describe projectile motion in terms of simultaneous independent horizontal and vertical motions.**
13. **Compare the vertical motion of an object dropped from rest and the vertical motion of a horizontally launched projectile in term of velocity, *g* and flight time.**
14. **Correctly identify and describe the horizontal and vertical velocities, accelerations and displacements for a projectile moving in the absence of air resistance.**
15. **Apply Galileo's law of odd numbers and law of squares to describe and calculate the vertical distance change of a projectile as it moves along its trajectory.**
16. **Apply the quadratic equation to determine a projectile's flight time and the parametric equations for range and height to determine the vertical and horizontal distances covered.**
17. **Describe the motion of a projectile with and without the influence of air resistance.**
18. **Distinguish between uniform and non-uniform circular motion in terms of tangential and radial acceleration component vectors and from these components determine the magnitude and direction of an object's instantaneous acceleration as it moves along a circular path.**
19. **Correctly write relative velocity equations for 1D and 2d cases and apply vector principles and frame of reference to describe and calculate relative velocity in both 1D and 2D cases.**

NOTE: Review diagrams, graphs, worksheets, applets/films, and handout materials.