AP PHYSICS 1 BIG IDEAS

Kinematics

Average Velocity equals a change in position divided by time. (m/s)

Average Acceleration equals a change in velocity divided by time. (m/s^2)

Gravity will always change the velocity of an object by 10 m/s each second. It will accelerate at 10 m/s^2

Slope equals rise over run, so the slope of a distance vs. time graph gives velocity.

Slope equals rise over run, so the slope of a velocity vs. time graph gives acceleration.

Slope between two points gives average velocity or acceleration

Slope from one point, tangent to the curve, gives instantaneous velocity or acceleration.

Area is base times height, so the area under a velocity vs. time graph gives instantaneous position.

Area is base time height, so the area under acceleration vs. time graph gives instantaneous velocity.

Sign conventions: Up is positive, down is negative, right is positive, left is negative. This applies to position, velocity and acceleration.

Since gravity accelerates things down, the acceleration of gravity is -10 m/s^2.

Instantaneous velocity, v_x, equals initial velocity, v_{x0}, plus acceleration, a, times time, t.

Instantaneous position, x, equals initial position, x_0, plus initial velocity, v_0, times time plus one half acceleration, a, times time, t, squared.

Velocity is a vector quantity, it has both magnitude (speed) and direction.

Vector quantities must be added "head to tail". The resultant equals the diagonal from "tail to head".

Vector quantities can be broken up into two components that are at right angles to each other.

In two dimensional problems, horizontal motion is completely independent of vertical motion. The fact that an object is moving horizontally has absolutely no effect on how much time it will take to fall vertically.

In two dimensional problems, it is usually best to find the time the object will take to fall vertically, then use the time to find what distance the object will travel.

When an object is launched at some angle, find components of the velocity in the horizontal and vertical directions.

Knowing the instantaneous horizontal and vertical components of velocity, the actual instantaneous velocity can be found using Pythagorean's Theorem.

Dynamics

Inertia is a property of all matter. Mass resists changes in motion, acceleration. (Newton's 1st Law)

Acceleration is directly proportional to the net force, inversely proportional to mass. (Newton's 2nd Law)

Mass is a measure of how much matter there is, and it is directly proportional to inertia. Mass is measured in kilograms.

Two objects of different weights will accelerate at the same rate because the object with more force, weight, will also have more mass, inertia. Acceleration is ratio of force per mass.

Weight is the force of gravity. It is measured in Newton's.

Weight equals mass times acceleration of gravity.

Acceleration is in the same direction as the net force.

Acceleration is zero when the net force is zero. An object is in equilibrium when the net force is zero.

Acceleration is zero does not imply the velocity is zero. Acceleration is zero means the velocity is not changing.

Force is vector quantities. Forces can be added "head to tail". Force can be broken into components.

An object is in 2-dimensional equilibrium if the sum of the forces in horizontal and vertical directions both equal zero.

For every action, there is an opposite and equal reaction. (Newton's 3rd Law)

A spring pushes or pulls with a force that is directly proportional to the displacement. The direction of the force is always opposite the displacement. The ratio of force to displacement is called the spring constant, k. (Hooke's Law).

Static Friction is the force which must be overcome to initiate motion. Static friction adjusts to try to keep an object stationary.

Kinetic Friction is the force which must be overcome to maintain motion. The direction of friction is always opposite the direction of motion.

Friction, static or kinetic, is directly proportional to the Normal Force, F_n.

The coefficient of friction, μ, is the ratio of frictional force, f_f, per normal force, f_n. It depends on what materials are rubbing past each other.

The coefficient of static friction is always greater than the coefficient of kinetic friction.