$$a = \frac{\Delta v}{\Delta t} \quad \frac{meters}{second^2} = \frac{m}{s^2}$$

Acceleration measures how quickly velocity changes in magnitude and/or direction. It is a vector (direction matters).

You feel accelerations.

Acceleration is the slope of a velocity vs. time graph.

$x = x_o + v_o t + \frac{1}{2}at^2$ ← constant acceleration

meters = m

Displacement is the straight line separation from the start point to the end points. (vector)
Distance is the total mileage traveled. When a runner completes one loop around a track oval displacement = 0, but distance = 400m.

Displacement is the area under velocity vs. time graph.. $\Delta v = a\Delta t$

$$\rho_i = \rho_f \qquad \frac{meters^2}{second} = m\frac{m}{s}$$

$$m_{1i}v_{1i} + m_{2i}v_{2i} = m_{1f}v_{1f} + m_{2f}v_{2f}$$

Momentum is a vector, so opposite directions cancel.

Momentum is always conserved, even in **inelastic** collisions (with heat, sticking together, deformation, etc.), ie. car crashes, ice skaters pushing off, guns firing, play-dough collisions.

$$KE_f + PE_f = E_{Kinetic} = KE_i + PE_i$$

$$\frac{1}{2}mv^2 + mgh = \frac{1}{2}mv_o^2 + mgh_o$$

$$v^2 = v_o^2 + 2a(\Delta x)$$

Energy is a scalar, opposite directions add up.

In **Elastic** Collisions (**no** heat, sound, deformation, etc.) total kinetic energy is conserved, ie. atomic collisions, perfect spring, perfect bouncy-ball, perfect pool balls, etc.

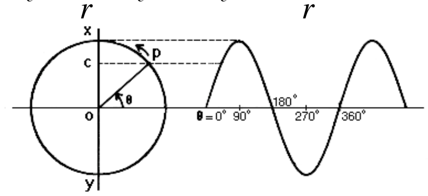
$$v = v_o + at \qquad v = \frac{\Delta x}{\Delta t} \quad \frac{meters}{second} = \frac{m}{s}$$

Velocity is the vector change in displacement (either magnitude or direction).
Speed is the scalar change in distance (never negative).

You don't feel constant velocity.

Velocity is the slope of a displacement graph $v = \Delta x / \Delta t$ and the area under an acceleration graph $\Delta v = a\Delta t$.

$a_c = \frac{v^2}{r} \quad F_c = ma_c = m\frac{v^2}{r}$ has harmonic motion



Centripetal force bends a straight path into a circle. It is always a pull towards the center (ie. tension in a string, friction on race track, magnetism, gravity or electric orbits, etc..

Gravity pulls towards the center of mass.

$$F_{g-far} = -\frac{Gm_1m_2}{r^2} \qquad U_{g-far} = -\frac{Gm_1m_2}{r}$$

If you are close enough to the sphere that it appears to be flat.

$$F_{g-near} = mg \qquad U_{g-near} = mgh$$

Gravitational orbits are elliptical, but for AP calculations are assumed to be circles.

$$W = Energy = F\Delta x\cos\theta = F_{||}\Delta x$$

$$kg\frac{m}{s^2} \bullet m = N \bullet m = Newton \bullet meters$$

Work is energy a force puts into or takes out of an object. Only forces in the direction of motion add/subtract energy. When Net Work is positive, internal energy increases (usually kinetic energy). When tension lifts an elevator at a constant velocity, the work done by the cable is balanced with the work done by gravity W_{Net}=0.

Gravity	Work vs. Net Work
Velocity vs. Speed	Centripetal Force and Acceleration
Conservation of Momentum	Conservation of Kinetic Energy
Acceleration	Displacement vs. Distance