Kinematics Unit Outline

I. Vectors

II. Six Definitions:
Distance, Position, Displacement,
Speed, Velocity, Acceleration

III. Two Equations:
Velocity, Displacement

IV. Freefall

Two Formulas

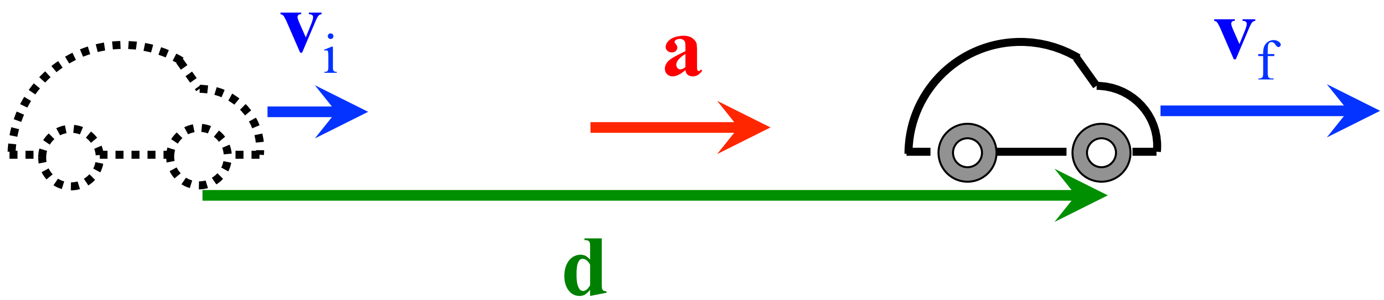
a “standard” kinematics model...

	The student will be able to:	HW:
1	Define and distinguish the concepts scalar and vector. Make the connection between the visual representation of a vector and its numerical representation of magnitude and direction angle. ✓	
2	Define, distinguish, and apply the concepts: distance, displacement, position. ✓	1, 2
3	Define, distinguish, and apply the concepts: average speed, instantaneous speed, constant speed, average velocity, instantaneous velocity, constant velocity. ✓	3 – 7
4	Define, distinguish, and apply the concepts: average acceleration and instantaneous acceleration, and constant acceleration. ✓	8 – 16
5	State the displacement and velocity relations for cases of constant acceleration and use these to solve problems given appropriate initial conditions and values.	17 – 28
6	State and use the conditions of freefall, including the value of *g*, to solve associated problems.	29 – 41

A Kinematics Model

- The six kinematics concepts (position, displacement, distance, speed, velocity, and acceleration) are interrelated.
- Two fairly simple formulas that relate some of these variables can be used to solve a huge variety of problems.
- The two formulas can be thought of as a simple and yet comprehensive *model* of moving objects.

Consider an object with initial velocity, $\mathbf{v}_i$, and acceleration, $\mathbf{a}$.



After a given amount of time, *t*, the object will have a final velocity, $\mathbf{v}_f$, and undergo displacement, $\mathbf{d}$. It can be shown that:

$$\vec{v}_f = \vec{v}_i + \vec{a}t \qquad \vec{d} = \vec{v}_i t + \tfrac{1}{2}\vec{a}t^2$$

A "Standard" Model of Motion

velocity: $\vec{v}_f = \vec{v}_i + \vec{a}t$

displacement: $\vec{d} = \vec{v}_i t + \frac{1}{2}\vec{a}t^2$

Important!

- Acceleration must be **constant** for these equations to be true.
- Vector directions must be accounted for using +/- signs.

Constant Acceleration Formulas

$$\vec{v}_f = \vec{v}_i + \vec{a}t$$

$$v_f^2 = v_i^2 + 2ad$$

$$\vec{d} = \vec{v}_i t + \tfrac{1}{2}\vec{a}t^2$$

$$\vec{d} = \tfrac{1}{2}\left(\vec{v}_i + \vec{v}_f\right)t$$

It is possible to derive many other equations from the two most fundamental formulas. These additional equations are not essential but can be useful for certain types of problems – subject to the same condition of constant acceleration!