Section 1.5

Uniform Acceleration :

Up to this point we have averaged our calculations, using the assumption that the object in question was always moving at a constant speed. While this can be useful , and comes with the benefit of simplified math, it is time we start increasing the level of application.

Uniform Acceleration : Changing from one velocity to a next at a constant rate.

$$\vec{a} = \frac{\Delta\vec{v}}{\Delta t} \qquad \vec{a} = \frac{\vec{v}_f - \vec{v}_i}{\Delta t}$$

recall in math that Δ is used to represent a change, and we will use the subscripts "f" and "i" to represent the final and initial velocities respectively.

**Note - Acceleration is a vector quantity, and therefore we must pay close attention to the direction of the velocities given in the question **

Ex. #1

A motorcycle is traveling at 10 m/s [E] and accelerates to 20 m/s [E] in a time of 5 seconds. Determine the acceleration of the motorcycle.

givens

$\vec{v}_f = 20\ \frac{m}{s}\ [E]$

$\vec{v}_i = 10\ \frac{m}{s}\ [E]$

t = 5 s

$\vec{a} = \frac{20\,\frac{\mathrm{m}}{\mathrm{s}}[\mathrm{E}] - 10\,\frac{\mathrm{m}}{\mathrm{s}}[\mathrm{E}]}{5\ \mathrm{s}}$ → we can only continue to solve the problem if the directions are the same, otherwise we must fix the directions to be the same.

$\vec{a} = \frac{10\,\frac{\mathrm{m}}{\mathrm{s}}[\mathrm{E}]}{5\ \mathrm{s}}$

$\vec{a} = 2\ \frac{m}{s^2}\ [E]$ → a positive answer means that the velocity was increasing over time

Ex. #2

A motorcycle is traveling at 10 m/s [E], turns and accelerates to 10 m/s [W] in a time of 5 seconds. Determine the acceleration of the motorcycle.

givens

$\vec{v}_f = 10\ \frac{m}{s}\ [W]$

$\vec{v}_i = 10\ \frac{m}{s}\ [E]$

t = 5 s

$\vec{a} = \frac{10\,\frac{\mathrm{m}}{\mathrm{s}}[\mathrm{W}] - 10\,\frac{\mathrm{m}}{\mathrm{s}}[\mathrm{E}]}{5\ \mathrm{s}}$ → we can only continue to solve the problem if the directions are the same, these are not, so we must fix the directions to be the same.

$\vec{a} = \frac{10\,\frac{\mathrm{m}}{\mathrm{s}}[\mathrm{W}] - \left(-10\,\frac{\mathrm{m}}{\mathrm{s}}[\mathrm{W}]\right)}{5\ \mathrm{s}}$

$\vec{a} = \frac{20\,\frac{\mathrm{m}}{\mathrm{s}}[\mathrm{W}]}{5\ \mathrm{s}}$

$\vec{a} = 4\,\frac{m}{s^2}\ [W]$

We can rearrange our acceleration equation so that we can solve for the other variables if given the acceleration in the problem.

$$\vec{a} = \frac{\vec{v}_f - \vec{v}_i}{\Delta t}$$

$$t = \frac{\vec{v}_f - \vec{v}_i}{\vec{a}}$$

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

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

Some other very useful equations

$$\vec{v}_f^2 = \vec{v}_i^2 + 2\vec{a}\vec{d}$$

$$\vec{v}_i^2 = \vec{v}_f^2 - 2\vec{a}\vec{d}$$

$$\vec{d} = \frac{\vec{v}_f^2 - \vec{v}_i^2}{2\vec{a}}$$

$$\vec{a} = \frac{\vec{v}_f^2 - \vec{v}_i^2}{2\vec{d}}$$

$\vec{d} = \vec{v}_i t + \frac{1}{2}\vec{a}t^2$ rearranging this one leads to solving the quadratic equation for time.

Assigned Problems - page 36 - 3 to 6

- page 46 - 1 to 5, 7

Review for Chapter 1 Test - page 49 - 1 to 3, 4bc, 5ab, 7 to 9, 12, 14 to 16, 20