Chapter Title: Motion in Two and Three Dimensions

Sections: Position and Displacement, Average Velocity and Instantaneous Velocity, Average Acceleration and Instantaneous Acceleration, Uniform Circular Motion

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Motion in Multi-dimensions:

Motion is a change in position with time.

Motion in 3-dimensions:

$$\Delta x = x_f - x_i$$

$$\Delta y = y_f - y_i$$

$$\Delta z = z_f - z_i$$

Position and displacement:

$$\vec{r} = x\hat{\imath} + y\hat{\jmath} + z\hat{k}$$

$$\Delta\vec{r} = \Delta x\hat{\imath} + \Delta y\hat{\jmath} + \Delta z\hat{k}$$

Average velocity and instantaneous velocity:

$$\vec{v}_{avg} = v_x\hat{\imath} + v_y\hat{\jmath} + v_z\hat{k}$$

$$\vec{v} = \frac{d\vec{r}}{dt}$$

Average acceleration and instantaneous acceleration:

$$\vec{a}_{avg} = \frac{\Delta\vec{v}}{\Delta t}$$

$$\vec{a} = a_x\hat{\imath} + a_y\hat{\jmath} + a_z\hat{k}$$

Uniform circular motion:

A particle is in uniform circular motion if it travels around a circle or a circular arc at constant (uniform) speed. Although the speed does not vary, the particle is accelerating because the velocity changes in direction.

If a is the centripetal acceleration, and T is the period of revolution, then it can be written as,

$$a = \frac{v^2}{r}$$

$$T = \frac{2\pi r}{v}$$