Rotational Kinematics – Chapter 8

Rotational Motion – when a body rotates about a fixed axis (axis of rotation)

Angular Displacement (θ) – the angle swept out by a body rotating about an axis

$$S = \theta r$$

$$\boxed{\theta = \frac{S}{r}}$$

- fig. 8.1, 8.2, and 8.3 on p. 216

Angular Velocity (ω) – angular displacement per unit time

$$\boxed{\omega = \frac{\Delta\theta}{\Delta t}}$$

- example 3 on p. 219 – A gymnast on a high bar swings clockwise through two revolutions in 1.90 s. Find the angular velocity of the gymnast.

To change angular velocity to translational velocity, multiply by radius:

$$\boxed{v = r\omega}$$

Angular Acceleration (α) – rate of change of angular velocity

$$\alpha = \frac{\Delta\omega}{\Delta t}$$

- example 4 on p. 220 – Jet fan blades are rotating at -110 rad/s. As the plane takes off the angular velocity of the blades reaches -330 rad/s in a time of 14 s. Find the angular acceleration.

To change angular acceleration to translational acceleration, multiply by radius:

$$a = r\alpha$$

Rotational Kinematics

As with translational motion, rotational motion has a set of equations to analyze accelerating motion. For rotational accelerating motion we can use the rotational kinematic equations:

- **Table 8.2 on p. 222**

- example 5 on p. 222

Vector Nature of Angular Variables – Grasp the angle of rotation with your **right** hand, so that your fingers circle the axis in the same sense as the rotation. Your extended thumb points along the axis in the direction of the angular velocity vector.

- fig. 8.17 on p. 230

If angular velocity is increasing, the angular acceleration and torque vectors are in the same direction as the angular velocity. If angular velocity is decreasing, the angular acceleration and torque vectors are in the opposite direction as the angular velocity.