Appendix J Advanced Topics

CONVERSION BETWEEN RADIANS AND DEGREES

$$\theta(\text{rad}) = \frac{\pi}{180^\circ}\theta(\text{deg})$$

ANGULAR DISPLACEMENT

This equation gives $\Delta\theta$ in radians.

$$\Delta\theta = \frac{\Delta s}{r}$$

AVERAGE ANGULAR VELOCITY

$$\omega_{avg} = \frac{\Delta\theta}{\Delta t}$$

AVERAGE ANGULAR ACCELERATION

$$\alpha_{avg} = \frac{\Delta\omega}{\Delta t}$$

ROTATIONAL KINEMATICS

These equations apply only when the angular acceleration is constant. The symbol ω represents instantaneous rather than average angular velocity.

$$\omega_f = \omega_i + \alpha\Delta t$$
$$\Delta\theta = \omega_i\Delta t + \tfrac{1}{2}\alpha(\Delta t)^2$$
$$\omega_f^2 = \omega_i^2 + 2\alpha(\Delta\theta)$$
$$\Delta\theta = \tfrac{1}{2}(\omega_i + \omega_f)\Delta t$$

TANGENTIAL SPEED

For this equation to be valid, ω must be in rad/s.

$$v_t = r\omega$$

TANGENTIAL ACCELERATION

For this equation to be valid, α must be in rad/s^2.

$$a_t = r\alpha$$

NEWTON'S SECOND LAW FOR ROTATING OBJECTS

$$\tau = I\alpha$$

ANGULAR MOMENTUM

$$L = I\omega$$

ROTATIONAL KINETIC ENERGY

$$KE_{rot} = \tfrac{1}{2}I\omega^2$$

IDEAL GAS LAW

Boltzmann's constant (k_B) equals 1.38×10^{-23} J/K.

$$PV = Nk_BT$$

BERNOULLI'S EQUATION

$$P + \tfrac{1}{2}\rho v^2 + \rho gh = \text{constant}$$