Chapter 9

(Linear) momentum of an object	**p** = m * **v** , where p is the object's momentum, m the mass and **v** the velocity.
Total momentum of a system of objects	$\mathbf{p}_{total} = \mathbf{p}_1 + \mathbf{p}_2 + \mathbf{p}_3 + ...$
Momentum form of Newton's 2nd law	$\Sigma\ \mathbf{F} = \lim_{t\to 0} \Delta\ \mathbf{p}/\Delta\ t$ (or $\Sigma\ \mathbf{F}_{ave} = \Delta\ \mathbf{p}/\Delta\ t$)

Definition of impulse	$\mathbf{I} = \mathbf{F}_{ave} * \Delta t$
Impulse-momentum theorem	$\mathbf{I} = \Delta \mathbf{p}$ (= $\mathbf{p}_{final} - \mathbf{p}_{initial}$)
Conservation of momentum (used to analyze collisions)	$\mathbf{p}_{total\ initial} = \mathbf{p}_{total\ final}$ (this holds when no net external force acts on a system of particles with total momentum $\mathbf{p}_{total}$)

Elastic collisions	collisions for which $KE_{initial} = KE_{final}$ in this particular case we derived that $v1_{initial} + v1_{final} = v2_{initial} + v2_{final}$
Perfectly inelastic collisions	collisions where the two colliding objects stick together so that $v_{1final} = v_{2final}$
mass m_1 is located at $x=x_1$ mass m_2 is located at $x=x_2$ where is the center of mass X_{cm} located?	$X_{cm} = (m_1*x_1 + m_2*x_2)/(m_1 + m_2)$ (A similar expression for Y_{cm} holds if the particles are spread out in the y-direction.)

Formulas for the velocity of the center of mass and for the acceleration of the c.m.	$\mathbf{V}_{cm} = (m_1{*}\mathbf{v}_1 + m_2{*}\mathbf{v}_2)/(m_1 + m_2)$ $\mathbf{A}_{cm} = (m_1{*}\mathbf{a}_1 + m_2{*}\mathbf{a}_2)/(m_1 + m_2)$
Newton's 2nd law for the motion of the c.m.	$M{*}\mathbf{A}_{cm} = \mathbf{F}_{net,ext}$ where $M = (m_1 + m_2)$, and where $\mathbf{F}_{net,ext}$ = the net external force.
If a system is isolated so that $\mathbf{F}_{net,ext}$ is zero then	the velocity of the c.m. is constant ($\mathbf{V}_{cm}$ = constant)

If a two dimensional extended object is thrown	Its c.m. traces out projectile motion while the object rotates about its c.m. with constant angular velocity.

Chapter 10

Angular displacement $\Delta\theta$	$\Delta\theta = \theta_{final} - \theta_{initial}$ θ is measured by the angle of rotation counter-clockwise relative to the x-direction.
Angular velocity ω	$\omega = \lim (\Delta\theta/\Delta t)$ t->0
units of angular velocity	radians per second, (r)/sec

Angular acceleration	$\alpha = \lim_{t\to 0} (\Delta\omega/\Delta t)$
Units of angular acceleration	radians per second^2; (r)/sec^2
Kinematical equations for the case where α = constant (use just t in place of Δ t)	$\alpha = (\Delta \omega)/t$ $\theta = \omega_{ave}*t$ $\omega_{ave} = 1/2\ (\omega_{nitial} + \omega_{inal})$ $\theta = \omega_{initial}*t + 1/2\ \alpha*t^2$ $\omega_{final}^2 - \omega_{initial}^2 = 2*\alpha*\theta$ (compare these eqs. with those in Ch 2)

relate angular velocity to period T	$T = 2\pi/\omega$ [or, $\omega=2*\pi/T$]
relate angular velocity to rpm	#rpm = $\omega*(60/2*\pi)$
relate angular velocity to tangential velocity	tangential velocity = radius*ω

express centripetal acceleration in terms of angular velocity and radius	a_{cp} = radius*ω^2
express tangential acceleration during circular motion in terms of the angular acceleration	a_t = radius * α
moment of inertia	$I = \Sigma\, m_i * r_i^2$ = $M*R^2$ (ring of mass M) =1/2 $M*R^2$ (solid disc of mass M) = 1/12 $M*L^2$ (rod of length L mass M)

Total kinetic energy of a rolling hoop or disc	$KE_{tot} = KE_{translational} + KE_{rotational}$ $= 0.5\ M^*v^2 + 0.5\ I^*\omega^2$ (note that for rolling, $v = \omega$ * radius of hoop of disc)