Chapter 9

Angular Velocity and Acceleration	
Θ = angle (radians)	s = length
r = radius	90^o = π/2 rad
Θ = (s/r)	s = r · Θ
1 rad = (360^o / 2π) = 57.3^o	180^o = π rad
Angular Velocity	(1st Derivative)
ω = ($Θ_f$ - $Θ_i$) / (t_f-t_i)	ω = "velocity"
1 rev/s = 2π rad/s	1 rev/min = 1 rpm = 2π/60 rad/s
Angular Acceleration	(2nd Derivative)
α = ($ω_f$ - $ω_i$) / (t_f-t_i)	α = "acceleration"
Rotation w/ Constant Angular Acceleration	
$α_f$ = ($ω_f$ - $ω_i$) / (t - 0)	$α_f$ = constant
$ω_f$ = $ω_i$ + $α_f$ · t	
$Θ_f$ - $Θ_i$ = 1/2($ω_i$+$ω_f$) · t	
$Θ_f$ = $Θ_i$ + ($ω_i$ · t) + 1/2 ($α_f$ · t^2)	
$ω_f^2$ = $ω_i^2$ + 2·$α_f$($Θ_f$ - $Θ_i$)	
Relating Linear and Angular Kinematics	K = 1/2(m · v^2)
Linear Speed in Rigid-Body Rotation	s = r · Θ
Linear Speed	v = r · ω
Linear Acceleration in Rigid-Body Rotation	a_{tan} = r · α
Centripetal Component of Acceleration	a_{rad} = (v^2/r) = $ω^2$·r
Energy in Rotational Motion	K_E: 1/2·m·v^2 = 1/2·m·r^2·$ω^2$
K = 1/2·m·r^2·$ω^2$	I = m·r^2
Gravitational Potential Energy for an Extended Body	U = M·g·y_{cm}

Chapter 9 (cont)

Moment of Inertia	I_p=I_{cm}+Md^2

Chapter 9 Cont:

Rotational Kinetic Energy	K = Joules
K = 1/2·I·$ω^2$	R = Radius
M = mass pivoted about an axis	
Perpendicular to the Rod	I = (M·L^2) / 3
Slender Rod (Axis Center)	I = 1/12M·L^2
Slender Rod (Axis End)	I = 1/3M·L^2
Rectangular Plate (Axis Center)	I = 1/12M·(a^2+b^2)
Rectangular Plate (Axis End)	I = 1/3M·(a^2)
Hallow Cylinder	I = 1/2M(R_i^2+R_f^2)
Solid Cylinder	I = 1/2MR^2
Hollow Cylinder (Thin)	I = MR^2
Solid Sphere	I = 2/5MR^2
Hollow Sphere (Thin)	I = 2/3MR^2

Chapter 11: Equilibrium and Elasticity

1st Condition of Equilibrium (at rest)	ΣF = 0
2nd Condition of Equilibrium (nonrotating)	Στ = 0
Center of Gravity	r_{cm} = (m_1 · r_1) / m_1
Solving Rigid-Body Equilibrium Problems	$ΣF_x$ = 0
1st Condition	$ΣF_x$ = 0 $ΣF_y$ = 0
2nd Condition (Forces xy-plane)	$Στ_z$ = 0

Chapter 11: Equilibrium and Elasticity (cont)

Stress, Strain, and Elastic Moduli	Stress = Force Applied to deform a body Strain = how much deformation
Hooke's Law	(Stress / Strain) = Elastic Modulus
A = Area	F = Magnitude of Force
Tensile Stress	F / A
1 Pascal = Pa = 1 N/m^2	1 psi = 6895 Pa
l = length	1 Pa = 1.450 · 10^{-4}
Tensile Strain	(l_f - l_i) / (l_i)
Young Modulus	(Tensile Stress) / (Tensile Strain)
Pressure	p = F (Force Fluid is Applied) / A (Area which force is exerted)
Bulk Stress	(p_f - p_i)
Bulk Strain	(V_f - V_i) / (V_i)
Bulk Modulus	Bulk Stress / Bulk Strain

Chapter 10: Dynamics of Rotational Motion

Torque	
F = Magnitude of F	|| || = Magnitude Symbol
τ = F·l = r·F·sinΘ = F_{tan}r	L = lever arm of F
τ = ||r|| x ||F||	
Torque and Angular Acceleration for a Rigid Body	
Newtons 2nd Law of Tangential Component	F_{tan} = m_1·a_1
Rotational analog of Newton's second law for a rigid body	
$Στ_z$ = I·$α_z$	z = rigid body about z-axis

Chapter 10: Dynamics of Rotational Motion (cont)

Combined Translation and Rotation: Energy Relationships	
$K = 1/2M \cdot v^2 + 1/2 \cdot I \cdot \omega^2$	
Rolling without Slipping	$v = R \cdot \omega$
Combined Translation and Rotation: Dynamics	
Rotational Motion about the center of mass	$\Sigma\tau_z = I \cdot \alpha_z$
Work and Power in Rotational Motion	$F = M \cdot a$
When it rotates from Θ_i to Θ_f	$W = \int (\Theta_f$ to $\Theta_i)\ \tau_f\ d\Theta$
When the torque remains constant while angle changes	$W = \tau_f(\Theta_f$ to $\Theta_i)$
Total WorkDone on rotating rigid body	$W = 1/2(\omega_f^2) - 1/2(\omega_i^2)$
Power due to torque on rigid body	$P = \tau_z \cdot \omega_z$
Angular Momentum	L = r x p (r x m · v)
Angular Momentum of a Rigid Body	$L = m_i \cdot r_i^2 \cdot \omega$

Chapter 11: Equilibrium and Elasticity (cont.)

	F = Force acting tangent to the surface divided by the Area
Shear Stress	F / A
h = transverse dimension [bigger]	x = relative displacement (empty) [smaller]
Shear Strain	x / h