## Cheatography

### MidTerm 3 by Jaco (brandenz1229) via cheatography.com/138824/cs/29996/

### Chapter 9

Angular Velocity and Acceleration		
$\Theta$ = angle (radians)	s = length	
r = radius	$90^{\circ} = \pi/2 \text{ rad}$	
$\Theta = (s/r)$	$s = r \cdot \Theta$	
1 rad = (360 <sup>o</sup> / 2π) = 57.3 <sup>o</sup>	180 <sup>0</sup> = π rad	
Angular Velocity	(1st Derivative)	
$\omega = (\Theta \texttt{f-} \Theta \texttt{i})  /  (\texttt{tf-}\texttt{ti})$	$\omega$ = "velocity"	
1 rev/s = 2π rad/s	1 rev/min = 1 rpm = 2π/60 rad/s	
Angular Acceleration	(2nd Deriva- tive)	
$\alpha = (\omega \text{f-} \omega \text{i}) / (\text{tf-ti})$	α = "accelerat- ion"	
Rotation w/ Constant Angula	ar Acceleration	
$\alpha f = (\omega f - \omega i) / (t - 0)$	$\alpha_{\text{f}}$ = constant	
$\omega f = \omega i + \alpha f \cdot t$		
$\Theta$ f- $\Theta$ i = 1/2( $\omega$ i+ $\omega$ f) · t		
$\Theta_{\text{f}} = \Theta_{\text{i}} + (\omega_{\text{i}} \cdot t) + 1/2 (\alpha_{\text{f}} \cdot t^2)$		
$\omega f^2 = \omega i^2 + 2 \cdot \alpha f(\Theta f - \Theta i)$		
Relating Linear and Angular Kinematics	$K = 1/2(m \cdot v^2)$	
Linear Speed in Rigid- Body Rotation	$s = r \cdot \Theta$	
Linear Speed	$v = r \cdot \omega$	
Linear Acceleration in Rigid-Body Rotation	atan = r · α	
Centripetal Component of Acceleration	$a_{rad} = (v^2/r) = \omega^2 \cdot r$	
Energy in Rotational Motion	$K_{E}: 1/2 \cdot m \cdot v^2 = 1/2 \cdot m \cdot r^2 \cdot \omega^2$	
$K = 1/2 \cdot m \cdot r^2 \cdot \omega^2$	$I = m \cdot r^2$	
Gravitational Potential Energy for an Extended Body	U = M·g·ycm	

Chapter 9 (cont)		
Moment of Inertia	Ip=Icm+Md <sup>2</sup>	
Chapter 9 Cont:		
Rotational Kinetic Energy	K = Joules	
$K = 1/2 \cdot I \cdot \omega^2$	R = Radius	
M = mass pivoted about an axis		
Perpendicular to the Rod	$I = (M \cdot L^2) / 3$	
Slender Rod (Axis Center)	$I = 1/12 M \cdot L^2$	
Slender Rod (Axis End)	$I = 1/3M \cdot L^2$	
Rectangular Plate (Axis Center)	I = 1/12M⋅(a <sup>2</sup> +b <sup>2</sup> )	
Rectangular Plate (Axis End)	$I = 1/3M \cdot (a^2)$	
Hallow Cylinder	I = 1/2M(Ri <sup>2</sup> +R f <sup>2</sup> )	
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		
<b>1st Condition of Equilibrium</b> $\Sigma F = 0$ (at rest)		
2nd Condition of Equilibriu (nonrotating)	im Στ = 0	
Center of Gravity	rcm = (m1·r 1)/m1	

Chapter 11: Equilibrium and E	lasticity
1st Condition of Equilibrium (at rest)	ΣF = 0
2nd Condition of Equilibrium (nonrotating)	Στ = 0
Center of Gravity	rcm = (m1·r 1)/m1
Solving Rigid-Body Equili- brium Problems	$\Sigma F_{\rm X} = 0$
1st Condition	$\Sigma F_{X} = 0$ $\Sigma F_{Y} = 0$
2nd Condition (Forces xy- plane)	$\Sigma_{T_{Z}} = 0$

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Stress, Strain, and Elastic Moduli	Stress = Force Applied to deform a body Strain = how much deform- ation
Hooke's Law	(Stress / Strain) = Elastic Modulus
A = Area	F = Magnitude of Force
Tensile Stress	F/A
1 Pascal = Pa = 1 N/m <sup>2</sup>	1 psi = 6895 Pa
I = length	1 Pa = 1.450 · 10 <sup>4</sup>
Tensile Strain	(lf-li)/(li)
Young Modulus	(Tensile Stress) / (Tensile Strain)
Pressure	p = F (Force Fluid is Applied) / A (Area which force is exerted)
Bulk Stress	(pf-pi)
Bulk Strain	(Vf-Vi)/(Vi)
Bulk Modulus	Bulk Stress / Bulk Strain

Chapter 11: Equilibrium and Elasticity (cont)

#### Chapter 10: Dynamics of Rotational Motion

Forque             = Magnitude Magnitude Symbol         T = F.I = r.F.sinΘ = Ftanr of F       L = lever arm of F         T = [r]  ×   F         L = lever arm of F         Howtons 2nd Law of Sody       Ftan = m1.ean of Stangential Component         Rotational analog of New+Second Law for a rigid body       Ftan = m1.ean Stangential Component		
T = F·l = r·F·sin $\Theta$ = FtanrL = lever arm of FT =   r   x   F  L = lever arm of FTorque and Angular Acceleration for a Rigid BodyFtan = m1·a1 rangential ComponentNewtons 2nd Law of rangential ComponentFtan = m1·a1 second law for a rigid body	Torque	
of F T =   r   x   F   Torque and Angular Acceleration for a Rigid Body Newtons 2nd Law of Ftan = ml·al angential Component Ftan = ml·al Rotational analog of Newton's second law for a rigid body	F = Magnitude of F	Magnitude
Torque and Angular Acceleration for a Rigid Body         Newtons 2nd Law of       Ftan = m1.a1         Tangential Component         Rotational analog of Newton's second law for a rigid body	$\tau = F \cdot I = r \cdot F \cdot sin\Theta = F tan r$	
Body Newtons 2nd Law of Ftan = m1.a1 Tangential Component Rotational analog of Newton's second law for a rigid body	$\tau =   \mathbf{r}   \times   F  $	
Tangential Component Rotational analog of Newton's second law for a rigid body		ration for a Rigid
for a rigid body		Ftan <b>= m1∙a</b> 1
$\Sigma_{TZ} = I \cdot \alpha_Z$ $z = rigid body$		
	$\Sigma_{TZ} = I \cdot \alpha_Z$	$_{\rm Z}$ = rigid body
about z-axis		about z-axis

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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 Rot Dynamics	ation:	
Rotational Motion about the center of mass	$\Sigma_{TZ} = I \cdot \alpha_Z$	
Work and Power in Rotational Motion	F = M ⋅ a	
When it rotates from $\Theta \texttt{i}$ to $\Theta \texttt{f}$	W = ∫ (Θf to Θi)τf dΘ	
When the torque remains constant while angle changes	W = τf(Θf to Θi)	
Total WorkDone on rotating rigid body	W = 1/2(ωf <sup>2</sup> ) - 1/2(ωi <sup>2</sup> )	
Power due to torque on rigid body	$P = T_z \cdot \omega_z$	
Angular Momentum	$L = r x p (r x m \cdot v)$	
Angular Momentum of a Rigid Body	L = mi·ri <sup>2</sup> ·ω	
Chapter 11: Equilibrium and Elasticity (cont.)		
F = Force acting tangent to		

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



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