Linear	Angular	Linear	Angular
$F = ma$	$M = I\alpha = \vec{r} \times \vec{F}$	$LKE = \frac{1}{2}mv^2$	$RKE = \frac{1}{2}I\omega^2$
$v = u + at$	$\omega = \omega_0 + \alpha t$	$W = \int F\, ds = \Delta LKE$	$W = \int M\, d\theta = \Delta RKE$
$v^2 - u^2 = 2as$	$\omega^2 - \omega_0^2 = 2\alpha\theta$	$P = Fv$	$P = M\omega$
$s = \frac{1}{2}at^2 + ut$	$\theta = \frac{1}{2}\alpha t^2 + \omega_0 t$	$p = mv$	$L = I\omega$
$s = \frac{1}{2}(u+v)t$	$\theta = \frac{1}{2}(\omega_0 + \omega)t$	$J = \Delta p = \int F\, dt$	$\Delta L = \int M\, dt$

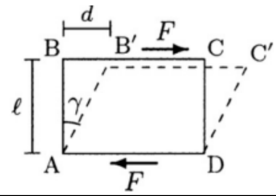
Standard force and motion stuff

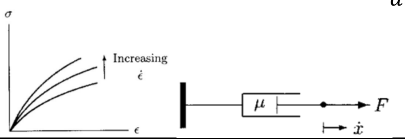
$GPE = mgh$	$f_{max} = \mu N$	$a_n = \frac{v^2}{r} = r\omega^2$	$a_t = r\alpha$
$I = \sum mr^2 = m\rho^2$	$I = I_C + mh^2$	$v = r\omega$	☺

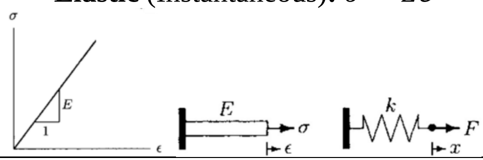
Deformation stuff

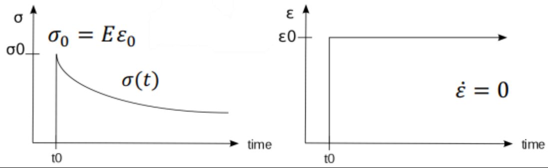
<table>
<tr><td>

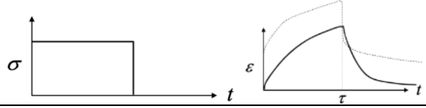
	Normal	Shear
Stress	$\sigma = \frac{F}{A}$	$\tau = \frac{F}{A}$
Strain	$\varepsilon = \frac{\Delta l}{l}$	$\gamma \approx \tan\gamma = \frac{d}{l}$
Modulus	$E = \frac{\sigma}{\varepsilon}$	$G = \frac{\tau}{\gamma}$

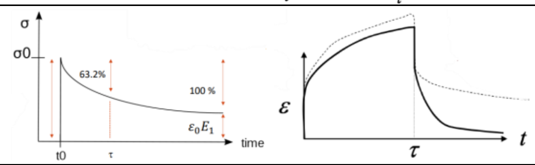
</td><td>


</td></tr>
<tr><td>$\tau_{xy} = \tau_{yx};\ \tau_{yz} = \tau_{zy};\ \tau_{zx} = \tau_{xz}$</td><td>Stiffness: $k = \frac{F}{\Delta L}$</td></tr>
<tr><td>Strength: Stress before failure</td><td>Yield point: 0.002 strain</td></tr>
<tr><td>Ductility: Deformation before rupture</td><td>Toughness: Energy absorbed before rupture</td></tr>
<tr><td>Viscous (Time-dependent): $\sigma = \eta\frac{d\varepsilon}{dt}$


</td><td>Elastic (Instantaneous): $\sigma = E\varepsilon$


</td></tr>
<tr><td>Maxwell Body: Spring + Dashpot in series
$\sigma(t) = \sigma_0 e^{-\frac{t}{\tau}}$</td><td>


</td></tr>
<tr><td>Voigt Body: Spring + Dashpot in parallel
$\varepsilon(t) = \frac{\sigma_0}{E}\left(1 - e^{-\frac{Et}{\sigma}}\right)$</td><td>


</td></tr>
<tr><td>Standard linear solid: Spring + Voigt in series
$\sigma(t) = \varepsilon_0\left(E_1 + E_2 e^{-\frac{t}{\tau}}\right)$
$\varepsilon(t) = \sigma_0\left[\frac{1}{E_1}e^{-\frac{E_2 t}{\eta}} + \frac{E_1+E_2}{E_1E_2}\left(1 - e^{-\frac{E_2\tau}{\eta}}\right)\right]$</td><td>


</td></tr>
<tr><td>$\varepsilon = \frac{\sigma_0 t}{\eta}$ | $\tau = \frac{\eta}{E}$</td><td>Poisson's Ratio (Force along x): $v = -\frac{\varepsilon_y}{\varepsilon_x} = -\frac{\varepsilon_z}{\varepsilon_x}$</td></tr>
<tr><td>Hooke's Law: $\varepsilon_x = \frac{1}{E}\left[\sigma_x - v\left(\sigma_y + \sigma_z\right)\right]; \ldots$</td><td>$E = G(2 + 2v) = K(3 - 6v)$</td></tr>
</table>

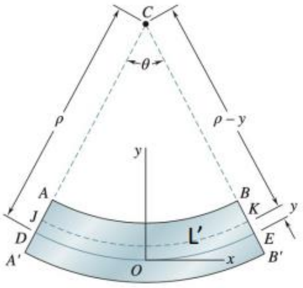
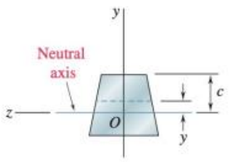
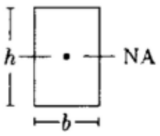
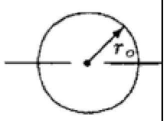
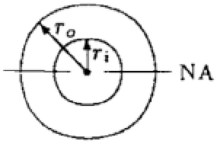
Mohr's circle stuff

$\bar{\sigma} = \frac{1}{2}(\sigma_x + \sigma_y)$	$R = \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2}$	$\sigma_{min/max} = \bar{\sigma} \pm R$	$\tan 2\theta_p = \frac{2\tau_{xy}}{\sigma_x - \sigma_y}$
$(\sigma_{x'} - \bar{\sigma})^2 + \tau_{x'y'}^2 = R^2$		$\tau_{x'y'} = -\frac{\sigma_x - \sigma_y}{2}\sin 2\theta + \tau_{xy}\sin 2\theta$	

$$\sigma_{x'} = \frac{\sigma_x + \sigma_y}{2} + \frac{\sigma_x - \sigma_y}{2}\cos 2\theta + \tau_{xy}\sin 2\theta = \sigma_x\frac{1 + \cos 2\theta}{2} + \sigma_y\frac{1 - \cos 2\theta}{2} + \tau_{xy}\sin 2\theta$$

$$\sigma_{y'} = \frac{\sigma_x + \sigma_y}{2} - \frac{\sigma_x - \sigma_y}{2}\cos 2\theta - \tau_{xy}\sin 2\theta = \sigma_x\frac{1 - \cos 2\theta}{2} + \sigma_y\frac{1 + \cos 2\theta}{2} - \tau_{xy}\sin 2\theta$$

Bending stuff

  			**Longitudinal displacement:** $\delta = -y\theta$ **Longitudinal strain:** $\varepsilon_x = \frac{\delta}{L} = -\frac{y}{\rho}$ **Maximum strain:** $\varepsilon_{max} = \frac{c}{\rho}$ **Flexure stress:** $\sigma_x = \frac{-My}{I}$ **Curvature:** $\frac{1}{\rho} = \frac{\varepsilon_{max}}{c} = \frac{M}{EI}$ **Flexure rigidity:** EI		
Area (A); Area moment of inertia (J); First moment of area (Q)					
 	$A = bh$ $J = \frac{1}{12}bh^3$ $Q = \frac{1}{8}bh^2$ $\sigma_{max} = \frac{Mh}{2J}$ $\tau_{max} = \frac{3V}{2A}$	 	$A = \pi r_o^2$ $J = \frac{1}{4}\pi r_o^4$ $Q = \frac{2}{3}r_o^3$ $\sigma_{max} = \frac{Mr_o}{J}$ $\tau_{max} = \frac{4V}{3A}$	 	$A = \pi(r_o^2 - r_i^2)$ $J = \frac{1}{4}\pi(r_o^4 - r_i^4)$ $Q = \frac{2}{3}(r_o^3 - r_i^3)$ $\sigma_{max} = \frac{Mr_o}{J}$ $\tau_{max} = \frac{4V}{3A}\left(\frac{r_o^2+r_or_i+r_i^2}{r_o^2+r_i^2}\right)$

Torsion stuff

Angle of twist: $\theta = \frac{ML}{GJ}$	**Torsional rigidity:** GJ		
$\gamma_{max} = \frac{c\theta}{L}$	$\gamma = \frac{\rho}{c}\gamma_{max}$	$\tau_{max} = \frac{Mc}{J}$	$\tau = \frac{\rho}{c}\tau_{max} = \frac{M\rho}{J}$

Miscellaneous information

Low strain:	Elastin dominates	**High strain:**	Collagen dominates
Warm-up:	Decreases viscosity of synovial fluid; Increases flexibility **(Thixotropy)**		
Wolff's law:	Tissues would remodel themselves to meet the functional demands		
Stress shielding:	Tissues would resorb if they are shielded from normal physiological stress