Equations and Conversion Factors

$$N = 2^{n-1}$$

$$A_{circle} = \frac{\pi}{4} d^2$$

$$\sigma = \frac{F}{A}$$

$$\sigma = \frac{2P}{\pi d t}$$

$$V_{sphere} = \frac{\pi d^3}{6}$$

$$\rho = \frac{m}{V} \text{ or } \gamma = \frac{W}{V}$$

$$F = A_o k \ln\left(\frac{A_o}{A_f}\right)$$

$$R = \frac{A_o}{A_f}$$

$$\varepsilon = \frac{L_f - L_o}{L_o} = \frac{\Delta L}{L_o}$$

$$E = \frac{\sigma}{\varepsilon}$$

$$\tau = \frac{T}{2\pi r^2 t}$$

$$\gamma = \frac{r\phi}{l}$$

$$G = \frac{\tau}{\gamma}$$

Cold working $\frac{T}{T_m} < 0.3$

Warm working $0.3 < \frac{T}{T_m} < 0.6$

Hot working $\frac{T}{T_m} > 0.6$

$$DP = \frac{MW_{polymer}}{MW_{monomer}}$$

$1\,\text{Pa} = \frac{\text{N}}{\text{m}^2}$

$1\,\text{in.} = 25.4\,\text{mm}$

$1\,\text{in.} = 1000\,\text{mils}$

$1\,\text{kip} = 1000\,\text{pounds}$

$1\,\text{ksi} = \frac{1\,\text{kip}}{\text{in.}^2}$

$1\,\text{psi} = \frac{1\,\text{lb.}}{\text{in.}^2}$

$°\text{R} = °\text{F} + 460$

$\text{K} = °\text{C} + 273$

$\pi\ \text{rad} = 180°$

Metric prefixes

n	=	nano-	=	10^{-9}
μ	=	micro-	=	10^{-6}
m	=	milli-	=	10^{-3}
c	=	centi-	=	10^{-2}
k	=	kilo-	=	10^{3}
M	=	mega-	=	10^{6}
G	=	giga-	=	10^{9}
T	=	tera-	=	10^{12}

Sheet Metal

$$\frac{v_f}{v_o} = \frac{h_o}{h_f}$$

$$\text{thickness reduction} = \frac{h_f - h_o}{h_o}$$

$$\text{scrap} = \frac{\sigma - \tilde{}}{\sigma}$$

Torsion Test

$$\theta = \frac{T L}{J G} \text{ where } J = \frac{\pi d^4}{32}$$

$$T = W x$$

$$MOR_T = \frac{T d}{2 J}$$

Some topics covered on previous midterm exams*

Calculate atoms per unit cell
Calculate casting shrinkage
Calculate casting solidification time
Calculate corrosion rate
Calculate ceramic disk test values
Calculate DOP
Calculate E/stress/strain relationships
Calculate grain size
Calculate grains per unit volume
Calculate hot extrusion force
Calculate scrap in sheet metal blanking
Calculate torsion-G relationship
Calculate wire or sheet metal speed in drawing/forming
Compare cast iron properties with graphite shapes
Compare grain size and strength
Compare hardness tests
Convert Brinell diameter to hardness
Define mechanical and physical properties
Describe Dunlop's contribution to rubber industry
Discuss blow molding
Discuss case hardening methods
Discuss casting methods
Discuss fillers in polymers
Discuss glass transition temperature
Discuss injection molding
Discuss leaded vs. lead-free brass
Discuss methods to prevent cavitation
Discuss methods to prevent galvanic corrosion
Discuss methods to prevent sensitization (stainless steel)
Discuss powder metallurgy
Discuss properties of ceramics
Discuss properties that change with heat treat
Discuss properties measurable with a tensile test
Discuss reasons for materials testing
Discuss Rockwell, Brinell, & other hardness tests
Discuss short range / long range order
Explain camber
Explain earing
Explain eutectic/eutectoid/liquidus/solidus
Explain how bimetallic strips work
Explain how to harden or soften steel
Explain how to make coarse/fine pearlite
Explain how to make grains bigger
Explain how to make martensite/prevent martensite
Explain how to prevent corrosion at stainless welds
Explain sources of error in various materials test methods
Explain why hardness can vary
Explain why steel is so widely used
Explain springback
Plot hardness vs. distance for a case-hardened steel
Read/draw/interpret impact curves
Read/draw/interpret isothermal transformation diagrams
Read/draw/interpret phase diagrams
Read/draw/interpret stress strain curves

* This is not a complete list. Questions will come from the assigned reading, lectures, labs, and homework.