

Equations and Conversion Factors

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

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

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

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

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

$$V_{cylinder} = \frac{\pi}{4} d^2 h$$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$^{\circ}\text{R} = ^{\circ}\text{F} + 460$$

$$\text{K} = ^{\circ}\text{C} + 273$$

$$\pi \text{ rad} = 180^{\circ}$$

Lab #2: Torsion Test

$$\theta = \frac{TL}{JG} \text{ where } J = \frac{\pi d^4}{32}$$

$$MOR_r = \frac{Td}{2J}$$

Metric prefixes

$$\text{n} = \text{nano-} = 10^{-9}$$

$$\mu = \text{micro-} = 10^{-6}$$

$$\text{m} = \text{milli-} = 10^{-3}$$

$$\text{c} = \text{centi-} = 10^{-2}$$

$$\text{k} = \text{kilo-} = 10^3$$

$$\text{M} = \text{mega-} = 10^6$$

$$\text{G} = \text{giga-} = 10^9$$

$$\text{T} = \text{tera-} = 10^{12}$$

Some topics covered on previous midterm exams*

Calculate atoms per unit cell
Calculate corrosion rate
Calculate ceramic disk test values
Calculate DP (degree of polymerization)
Calculate E/stress/strain relationships
Calculate grain size
Calculate grains per unit volume
Calculate torsion-G relationship
Compare cast iron properties with graphite shapes
Compare grain size and strength
Compare hardness tests
Convert Brinell diameter to hardness using a table
Define mechanical and physical properties
Describe Dunlop's contribution to rubber industry
Discuss case hardening methods
Discuss methods to prevent cavitation
Discuss methods to prevent galvanic corrosion
Discuss glass transition temperature

Discuss leaded vs. lead-free brass
Discuss properties of ceramics
Discuss properties that change with heat treat
Discuss reasons for materials testing
Discuss short range / long range order
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 why hardness can vary
Explain why steel is so widely used
Plot hardness vs. distance for a case-hardened steel
Read/draw/interpret phase diagrams
Read/draw/interpret isothermal transformation diagrams

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