Name: _____ Date: _____

Solid Mechanics Worksheet Answers

Please show all of your work, including which equations you are using, and circle your final answer. Be sure to include the units in your answers.

1. **What is the stress in a rod that is exposed to a 2000-N load and has a radius of 0.25 m?**

$F = 2000$ N
$r = 0.25$ m
$\sigma = ?$

$$\sigma = \frac{F}{A} \qquad A = \pi r^2$$

$$A = \pi(0.25m)^2$$

$$A = 0.196m^2$$

$$\sigma = \frac{2000N}{0.196m^2}$$

$\sigma = 10186Pa$ *or* $10.2kPa$

2. **What is the strain of a rod that had an initial length of 2 m and has deformed 0.25 m?**

$L = 2$ m
$\Delta L = 0.25$ m
$\varepsilon = ?$

$$\varepsilon = \frac{\Delta L}{L}$$

$$\varepsilon = \frac{0.25m}{2m}$$

$\varepsilon = 0.125$

3. **If the rods in problems 1 and 2 are the same rod, then what is the modulus of elasticity?**

$\sigma = 10186$ Pa
$\varepsilon = 0.125$
$E = ?$

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

$$E = \frac{10186Pa}{0.125}$$

$E = 81488Pa$ *or* $81.5kPa$

4. **A strain gage located on the surface of a bone indicates that the average normal stress in the bone is 3,800,000 Pa when the bone is subjected to a 1200-N force. Assuming the cross section of the bone to be annular and knowing that its outer diameter is 0.025 m, determine the inner diameter of the bone's cross section. Assume the bone has elastic behavior.**

Note: An annular cross section is a ring, as shown here ➔

σ = 3,800,000 Pa
F = 1200 N
d_o = 0.025 m
d_i = ?

$$\sigma = \frac{F}{A} \qquad A = \pi r_o^2 - \pi r_i^2 \qquad r = \frac{d}{2}$$

$$3{,}800{,}000 Pa = \frac{1200 N}{A}$$

$$A = 3.157x10^{-4}\, m^2$$

$$A = \pi r_o^2 - \pi r_i^2$$

$$3.157x10^{-4}\, m^2 = \pi\left(\frac{0.025m}{2}\right)^2 - \pi r_i^2$$

$$3.157x10^{-4}\, m^2 = 4.909x10^{-4}\, m^2 - \pi r_i^2$$

$$\pi r_i^2 = 1.751x10^{-4}\, m^2$$

$$r_i^2 = 5.573x10^{-5}\, m^2$$

$$\sqrt{r_i^2} = \sqrt{5.573x10^{-5}\, m^2}$$

$$r_i = 0.0075m$$

$$d_i = 2r_i$$

$$d_i = 2(0.0075m)$$

di = 0.0149m *or* 14.9mm