**Young’s Modulus Practice Problems Answer Key**

1. **A patient’s leg was put into traction, stretching the femur from a length of 0.46 m to 0.461 m. The femur has a diameter of 3.05 cm. With the knowledge that bone has a Young’s modulus of ~ 1.6 🞨 1010 in tension, what force was used to stretch the femur?**

***F= Y (∆L/L0)A***

***Y*= 1.6 x 1010 Pa = 16000000000 Pa (given)**

***L0* = 0.46m (given)**

***ΔL* = 0.001 m (obtained from .461 m - .46 m – the given amount of “stretch”)**

***A* = πr2 = 3.14 (1.525)2 = 7.30 cm2 = 0.00073 m2 (obtained from given diameter of 3.05 cm)**

**Now, using the equation above:**

***F* = 16000000000 x (.001/0.46) x 0.00073**

***F* = 25,391.30 N**

1. **Using the following information on stress and strain, plot a graph in Excel to determine the Young’s modulus for an unknown material. The radius of the material is 4 cm.**

**Cross-sectional area = *A*= πr2 = 50.24 cm2**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Initial Length**  **(cm)** | **Final Length**  **(cm)** | **Change in Length – ΔL (cm)** | **Strain**  **(ΔL/L0)** | **Mass**  **(g)** | **Force**  **(N)** | **Stress**  **(N/cm2)** |
| **25** | **25.2** | **0.2** | **0.008** | **100** | **980** | **19.50637** |
| **25** | **25.7** | **0.7** | **0.028** | **200** | **1960** | **39.01274** |
| **25** | **26.3** | **1.3** | **0.052** | **300** | **2940** | **58.51911** |
| **25** | **26.9** | **1.9** | **0.076** | **400** | **3920** | **78.02548** |

**Young’s modulus = 8.54 x 106 Pa**