

## Calculations (required for the final exam!)

To stretch a relaxed biceps muscle 3 cm requires a force of 25 N. To do the same stretch of a contracted muscle at its maximal tension requires a force of 500 N. Find the Young's modulus for both relaxed and tense muscle tissue. Assume the biceps is a uniform cylinder of length 20 cm and diameter 6 cm. (59 kPa, 1.18 MPa)

Collagen fiber is stressed with 12 N force. The cross-sectional area of the fiber is 3 mm<sup>2</sup>, its Young's modulus is 500 MPa. Give the percentage of relative extension. (0.8 %)

The length of an elastic thread used in orthodontics is 6 cm, its cross-sectional area is 1 mm<sup>2</sup>, its Young's modulus is 5 MPa. We extend the thread with 40 %. How large is the retracting force and what is the amount of elastic energy stored in the thread?(2 N, 24 mJ)

Bone has an average Young's modulus of 18 GPa. Under compression, it can withstand a stress of about  $2.7 \times 10^8$  Pa before breaking. Assume that a femur (thigh-bone) is 46 cm long, and calculate the amount of compression this bone can withstand before breaking. (6.9 mm)