

Answer on Question #69065 – Physics | Mechanics

1) A metal rod 1m long and 0.5cm^2 cross sectional area found to stretch 0.2cm. Calculate the force on the rod if the young modulus of the metal is $2 \times 10^{11}\text{Nm}^{-2}$.

2) A muscle requires a force of 50N for an elongation of 4cm. Regarding the muscle as a uniform elastic cylinder, calculate the energy stored in it.

Solution:

1)

First of all, we know the following formula as a fact:

$$F = E * (l-l_0)/l_0 * A$$

Where F is total force from elongation of the rod with the length of l_0 till l, cross section area of A and young modulus of E.

Therefore we may put in all the magnitudes from the problem's setting.

But before let's convert all the magnitudes into the SI in order not to make any mistakes in calculations.

$$l_0 = 1\text{m}$$

$$l = 1 - 0.002 = 0.998\text{m}$$

$$A = 0.000005 \text{ m}^2$$

$$E = 2 \times 10^{11}\text{Nm}^{-2}$$

From all these by inscribing we find Force:

$$F = 2000\text{N}$$

2)

Here due to Hooke's law set force is equal to:

$$F = kx = 50\text{N}$$

From there we find coefficient k:

$$k = F/x$$

And the potential energy is equal to:

$$E = 0.5 * k * x^2$$

Substituting k by the formula above:

$$E = 0.5 * (F/x) * x * x = 0.5 * F * x = 0.5 * F * X = 50 * 0.5 * 0.04 = 1\text{J}.$$

Answer:

1) 2 kN

2) 1 J

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