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Problem 17.51 (RHK)

How much surface energy is stored in the surface of a soap bubble 2.1 cm in radius if its surface tension is $4.5 \times 10^{-2} \text{ N m}^{-1}$?

Solution:

An equivalent definition of surface tension is surface energy per unit area.

A soap bubble has two surfaces one outer and the other inner each of area $4\pi r^2$, where r is the radius of the bubble.

Therefore, the surface energy stored in a soap bubble of radius 2.1 cm is

$$\begin{aligned}\text{Surface energy} &= 8\pi r^2 \gamma \\ &= 8\pi (2.1 \times 10^{-2})^2 \times 4.5 \times 10^{-2} \text{ J} = 499 \mu\text{J}.\end{aligned}$$