Answer on Question#41096 – Physics - Mechanics | Kinematics | Dynamics

Work done in increasing the size of a soap bubble from a radius of 3 cm to 5cm is nearly (Surface tension of soap solution = 0.03 Nm–1) :
(1) 2 π mJ
(2) 0.4 π mJ
(3) 4π mJ
(4) 0.2 π mJ

Solution:

$\mathrm{T} = 0.03\,\frac{\mathrm{N}}{\mathrm{m}} - \text{surface tension of soap;}$
$\mathrm{r_1} = 0.03\ \mathrm{m} - \text{initial radius of the bubble;}$
$\mathrm{r_2} = 0.05\ \mathrm{m} - \text{final radius of the bubble;}$

$\text{Work done } = \text{ (surface tension)} \times \text{(increase in area):}$

$$\mathrm{W} = \mathrm{T}(\mathrm{S_2} - \mathrm{S_1}) \qquad (1)$$

Increase in area of the soap bubble:

$$\mathrm{S_2} - \mathrm{S_1} = 4\pi\mathrm{r_1^2} - 4\pi\mathrm{r_2^2} = 4\pi(\mathrm{r_1^2} - \mathrm{r_2^2}) \qquad (2)$$

$(2)\ \text{in}\ (1)\text{:}$

$$\mathrm{W} = \mathrm{T}\cdot 4\pi(\mathrm{r_1^2} - \mathrm{r_2^2}) = 0.03\,\frac{\mathrm{N}}{\mathrm{m}}\cdot 4\cdot\pi\cdot((0.05\mathrm{m})^2 - (0.03\mathrm{m})^2) = 0.2\pi\cdot 10^{-3}\mathrm{J}$$
$$= 0.2\ \mathrm{mJ}$$

Answer: (4) 0.2 π mJ.