Surface Tension Worksheet

Derivations and definition based problems

Question 1 Define Surface tension and explain surface tension on the basis of molecular theory.
Question 2 Define Surface energy. Prove it is numerically equal to surface tension.
Question 3 Show that a pressure difference exists between two sides of curved liquid surface.
Question 4 Derive an expression for excess pressure
(a) Inside a liquid drop
(b) Inside a soap bubble.
Question 5 What do you understand by the term capillarity? Give some examples of capillarity from daily life.
Question 6 Derive an expression for the rise of liquid in capillary tube and show that the height of the liquid column supported is inversely proportional to the radius of the tube.

Numerical based problems

Question 1 Calculate the work done in blowing in a soap bubble from radius 2 cm to 3 cm. The surface tension of the soap solution is 30 dyne/cm. (Answer:- 3770.4 erg)
Question 2 The liquid drop of diameter D breaks up into 27 tiny drops. Find the resulting change in energy. Take surface tension of liquid as σ. (Answer:- $2\pi D^2\sigma$)
Question 3 If 500 erg of work is done in blowing a soap bubble of a radius r , what additional work is required to be done to blow it to a radius equal to $3r$? (Answer:- 4000 erg)
Question 4 Soapy water drips from capillary. When the drop breaks away , the diameter of its neck is 1 mm. The mass of the drop is 0.0129 g. Find the surface tension of the soapy water. (Answer:- $4.03\times10^{-2}\,N/m$)
Question 5 If the number of little droplets of water of surface tension σ , all of the radius r , combine to form a single drop of radius R and the energy released is converted into kinetic energy, find the velocity acquired by the bigger drop.
Question 6 What should be the pressure inside a small air bubble of 0.1 mm radius, situated just below the surface? Surface tension of water = $7.2\times10^{-2}\,N/m$ and atmospheric pressure = $1.013\times10^{5}\,N/m^2$
Question 7 Two soap bubbles have radii in ratio 2:3. Compare the excess pressure of liquid inside these bubbles. Also compare the works done in blowing these bubbles.
Question 8 Water rises in a capillary tube to a height of 2.0 cm. In another capillary tube whose radius is one-third of it, how much the water will rise? (Answer: - 6.0 cm)
Question 9 A small hollow sphere having a small hole in it is immersed into water to a depth of 20 cm before any water penetrates it. If the surface tension of water is 73 dynes cm^{-1}, find the radius of the hole. (Answer:- 0.0075 cm)
Question 10 The maximum force, in addition to the weight required to pull a wire 5 cm long from the surface of water at 20°C is 728 dynes. Calculate the surface tension of water. (Answer:- 72.8 dynes/cm)
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