Surface Tension

5. a. Define surface tension. On what factors does it depend? 2
   b. Establish a relation between surface tension and surface energy of a liquid. 2
   c. Work of $3\ x\ 10^{-4}$ J is required to be done in increasing the size of a soap film from $10cm\ \times\ 6cm$ to $10cm\ \times\ 11cm$. Calculate the surface tension of the soap film. 3

6. a. What do you mean by surface energy? 1
   b. Calculate the work done against surface tension forces in blowing a soap bubble of diameter 1 cm The surface tension of soap solution is 2.5 x 10^{-2} Nm^{-1}. [***Ans: 1.57×10^{-5}J***] 2
   c. Calculate the change in surface energy of a soap bubble when its radius decreases from 5 cm to 1 cm surface tension of soap solution is 2.0 $\times10^{-2}$ Nm^{-2} Let angle of contact be zero. [***1.2×10^{-3}J***] 2
   d. A rectangular plate of dimensions 6cm by 4cm and thickness of 2mm is placed with its largest face flat on the surface of the water.
      i. Calculate the downward force on the plate due to surface tension assuming zero angle of contact. ($T = 7\times10^{-2}$ Nm^{-1}). [***1.4×10^{-2}N***] 2
      ii. What is the downward force if the plate is placed vertically so that its longest side just touches the water? [***8.68×10^{-3}N***] 2

7. a. What are the factors affecting surface tension? 1
   b. Why the hair of painting brush spreads into the water but cling together when it is taken out. 2
   c. Why are the droplets of mercury when brought in contact pull together to form a bigger drop? How is its temperature be affected? 2
   d. What amount of energy will be liberated if 1000 droplets of water, each of diameter 10^{-8}m, coalesce to from a bigger drop? Surface tension of water is 0.072 Nm^{-1}. 2
   e. Calculate the work done in blowing up soap bubble from an initial surface area of $0.5\times 10^{-4}m^2$ to final surface area of $1.1\times10^{-4}m^2$. The surface tension of soap solution is 0.03Nm^{-1}. 2

8. Due to surface tension, the surface of liquid behaves like an elastic stretched membrane and the liquid tends to occupy minimum surface area.
   a. A tiny liquid drop is spherical but a larger drop is oval, why? 2
   b. Although the interior and exterior pressure in a soap bubble is different, the bubble does not break. Why? 2
   c. What causes the liquid fall or rise in a capillary tube?
   d. What causes the surface of a liquid as if it is under tension? 1
   e. Show that $T = \frac{h\rho gr}{2cos\theta}$, where symbols have their usual meaning. 3
   f. Explain rise of liquid in a tube of inefficient length 2
   g. The water rises to a height of 8cm above the outside level when a long clean capillary tube is dipped into a beaker of clean water and then withdrawn. What happen when a capillary tube of the same diameter but length 4cm is dipped into water? [***Ans: 60^0***] 2

9. a. Explain the concept of the angle of contact, with necessary figure, when the surface of a liquid is convex if viewed from the above. 2
   b. Define capillary action. Write down the ascent formula. By which phenomenon, the water rises from roots to leaves of plants? 3
   c. Mercury in a capillary tube is depresses by 1.32 x 10^{-2}m. Calculate the diameter of the tube if angle of contact of the mercury with glass is 140^o and density of mercury is 13600kg/m^3. Surface tension of the mercury is 0.54Nm^{-1}. 2
   d. One end of a capillary tube of radius r is immersed vertically in water and the mass of water rises in the capillary tube is 5 g. If one end of another capillary tube of radius 2r is immersed vertically in water, what will be the mass of water that will rise in it? [Ans. 10 g] 2