DPP 03

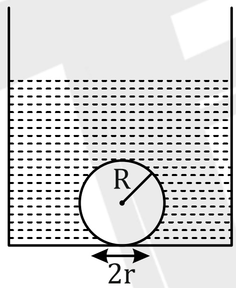
Q.1 A capillary tube made of glass of radius 0.15 mm is dipped vertically in a beaker filled with methylene iodide (surface tension $= 0.05 \text{ N m}^{-1}$, density $= 667 \text{ kg m}^{-3}$) which rises to height h in the tube. It is observed that the two tangents drawn from liquid-glass interfaces (from opposite sides of the capillary) make an angle of 60° with one another. Then h is close to $(g = 10 \text{ m s}^{-2})$

(A) 0.049 m (B) 0.137 m (C) 0.172 m (D) 0.087 m

Q.2 Pressure inside two soap bubbles are 1.01 and 1.02 atmosphere, respectively. The ratio of their volumes is

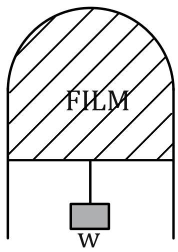
(A) 4: 1 (B) 0.8: 1 (C) 8: 1 (D) 2: 1

Q.3 On heating water, bubbles being formed at the bottom of the vessel detach and rise. Take the bubbles to be spheres of radius R and making a circular contact of radius r with the bottom of the vessel. If $r \ll R$, and the surface tension of water is T, value of r just before bubbles detach is (density of water is ρ_W)



(A) $R^2\sqrt{\frac{3\rho_W g}{T}}$ (B) $R^2\sqrt{\frac{2\rho_W g}{3T}}$ (C) $R^2\sqrt{\frac{\rho_W g}{6T}}$ (D) $R^2\sqrt{\frac{\rho_W g}{T}}$

Q.4 A thin liquid film formed between a U-shaped wire and a light slider supports a weight of 1.5×10^{-2} N (see figure). The length of the slider is 30 cm and its weight negligible. The surface tension of the liquid film is



(A) 0.1 N m^{-1} (B) 0.05 N m^{-1} (C) 0.025 N m^{-1} (D) 0.0125 N m^{-1}

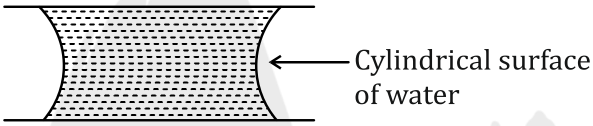
Q.5 Work done in increasing the size of a soap bubble from a radius of 3 cm to 5 cm is nearly (Surface tension of soap solution $= 0.03 \text{ N m}^{-1}$)

(A) 4πmJ (B) 0.2πmJ (C) 2πmJ (D) 0.4πmJ

Q.6 A small spherical droplet of density d is floating exactly half immersed in a liquid of density ρ and surface tension T. The radius of the droplet is (take note that the surface tension applies an upward force on the droplet.)

(A) $r=\sqrt{\frac{2T}{3(d+\rho)g}}$ (B) $r=\sqrt{\frac{3T}{(2d-\rho)g}}$ (C) $r=\sqrt{\frac{T}{(d-\rho)g}}$ (D) $r=\sqrt{\frac{T}{(d+\rho)g}}$

Q.7 If two glass plates have water between them and are separated by very small distance (see figure), it is very difficult to pull them apart. It is because the water in between forms cylindrical surface on the side that gives rise to lower pressure in the water in comparison to atmosphere. If the radius of the cylindrical surface is R and surface tension of water is T then the pressure in water between the plates is lower by



(A) $\frac{T}{4R}$ (B) $\frac{T}{2R}$ (C) $\frac{T}{R}$ (D) $\frac{2T}{R}$

Q.8 If ' M ' is the mass of the water that rises in a capillary tube of radius ' r ', then mass of water which will rise in a capillary tube of radius ' 2r ' is

(A) $\frac{M}{2}$ (B) 4M (C) M (D) 2M

Q.9 The ratio of surface tensions of mercury and water is given to be 7.5 while the ratio of their densities is 13.6. Their contact angles, with glass, are close to 135° and 0°, respectively. It is observed that mercury gets depressed by an amount h in a capillary tube of radius r_1, while water rises by the same amount h in a capillary tube of radius r_2. The ratio, (r_1/r_2), is then close to

(A) $\frac{2}{5}$ (B) $\frac{4}{5}$ (C) $\frac{3}{5}$ (D) $\frac{2}{3}$

Q.10 A small soap bubble of radius 4 cm is trapped inside another bubble of radius 6 cm without any contact. Let P_2 be the pressure inside the inner bubble and P_0, the pressure outside the outer bubble. Radius of another bubble with pressure difference $P_2 - P_0$ between its inside and outside would be

(A) 12 cm (B) 4.8 cm (C) 2.4 cm (D) 6 cm

ANSWER KEY

1.	(D)	**2.**	(C)	**3.**	(B)	**4.**	(C)	**5.**	(D)	**6.**	(B)	**7.**	(C)
8.	(D)	**9.**	(A)	**10.**	(C)								