Q A uniform capillary tube of inner radius r is dipped vertically into a beaker filled with water. The water rises to a height h in the capillary tube above the water surface in the beaker. The surface tension of water is σ. The angle of contact between water and the wall of the capillary tube is θ. Ignore the mass of water in the meniscus. Which of the following statements is (are) true?

A For a given material of the capillary tube, h decreases with increase in r

B If this experiment is performed in a lift going up with a constant acceleration, then h decreases.

(A) For a given material of the capillary tube, h decreases with increase in r

SOLUTION

$$\frac{2\sigma}{R} = \rho g h \qquad [R \rightarrow \text{Radius of meniscus}]$$

$$h = \frac{2\sigma}{R\rho g} \qquad R = \frac{r}{\cos\theta} \qquad [r \rightarrow$$

radius of capillary; $\theta \rightarrow$ contact angle]

$$h = \frac{2\sigma\cos\theta}{r\rho g}$$

(A) For given material, $\theta \rightarrow$ constant

$$h \propto \frac{1}{r}$$

B If this experiment is performed in a lift going up with a constant acceleration, then h decreases.

SOLUTION

$$\frac{2\sigma}{R} = \rho g h \quad [R \rightarrow \text{Radius of meniscus}]$$

$$h = \frac{2\sigma}{R\rho g} \quad R = \frac{r}{\cos\theta} \quad [r \rightarrow \text{radius of capillary}; \theta \rightarrow \text{contact angle}]$$

$$h = \frac{2\sigma\cos\theta}{r\rho g}$$

(A) For given material, $\theta \rightarrow$ constant

$$h \propto \frac{1}{r}$$

(B) If lift is going up with constant acceleration,

$$g_{eff} = (g + a)$$