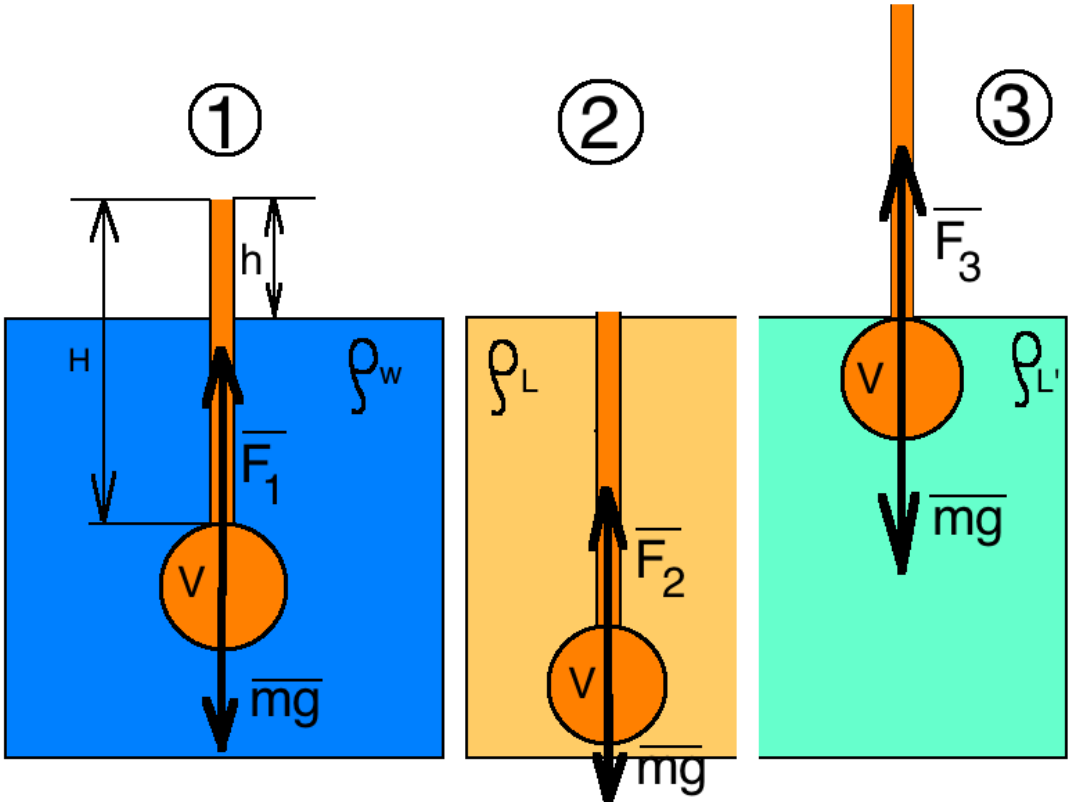
the length of stem of a hydrometer is 10 cm and volume is 10cm3. While floating in pure water it sinks
to 5 cm mark. The mass of hydrometer is 200 gm.What will be density of liquid in which the hydrometer:
1. sinks to top of stem
2. sinks to bottom of stem

Solution:



Let the volume of bulb is V. When hydrometr sinks to the mark h=5 cm of stem.

Using the law of Floatation (figure 1):

$F_1 = mg \qquad (1)$

$F_1 = \rho_w g(V + V_5) \qquad (2)$

$(2) in (1): \rho_w g(V + V_5) = mg$

$$V = \frac{m - \rho_w V_5}{\rho_w} = \frac{200g - 1\frac{g}{cm^3} \cdot 5cm^3}{1\frac{g}{cm^3}} = 195cm^3$$

1. Sinks to the top of the stem:

Law of Floatation (figure 2):

$F_2 = mg \qquad (1)$

$F_2 = \rho_L g(V + V_{10}) \qquad (2)$

$(2) in (1): \rho_L g(V + V_{10}) = mg$

$$\rho_L = \frac{m}{V + V_{10}} = \frac{200g}{195cm^3 + 10cm^3} = 0.976 \frac{g}{cm^3}$$

2. Sinks to the bottom of the stem:

Law of Floatation (figure 3):

$F_3 = mg \qquad (1)$

$F_3 = \rho_{L'} g(V + V_{10}) \qquad (2)$

$(2) in (1): \rho_{L'} g(V + V_{10}) = mg$

$$\rho_{L'} = \frac{m}{V} = \frac{200g}{195cm^3} = 1.026 \frac{g}{cm^3}$$

Answer: 1. $\rho_L = 0.976 \frac{g}{cm^3}$

2. $\rho_{L'} = 1.026 \frac{g}{cm^3}$