

What is the range of specific gravities that can be measured with the hydrometer shown in the figure? ($D = 2$ cm, $L = 8$ cm, $d = 1$ cm, $l = 8$ cm, $m = 35$ g)

$$F_B = W \quad W = mg$$

When only the bulb is submerged (very thick liquid, high specific height)

$$F_B = \gamma_{high} \frac{\pi D^2}{4} L$$

$$\gamma_{high} \frac{\pi D^2}{4} L = mg \Rightarrow \gamma_{high} = \frac{4mg}{\pi D^2 L} = \frac{4 \times 0.035 \times 9.81}{3.14 \times 0.02^2 \times 0.08} = 13,668 \text{ N/m}^3$$

The stem is submerged (very thin liquid, low specific height)

$$\gamma_{low} = \frac{4mg}{\pi(D^2 L + d^2 l)} = \frac{4 \times 0.035 \times 9.81}{3.14 \times (0.02^2 + 0.01^2) \times 0.08} = 10,935 \text{ N/m}^3$$

$$S_{high} = \frac{\gamma_{high}}{\gamma_{Water}} = \frac{13,668}{9,810} = 1.39$$

$$S_{low} = \frac{\gamma_{low}}{\gamma_{Water}} = \frac{10,935}{9,810} = 1.12$$

$$1.12 \leq S \leq 1.39$$

