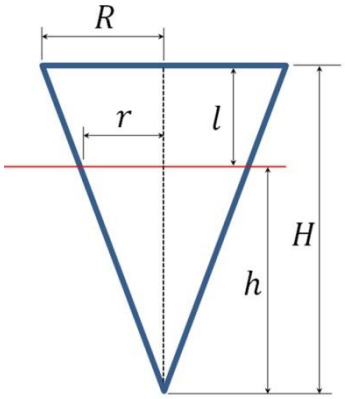
Answer on Question #83781, Physics / Mechanics | Relativity

Question. A conical solid of diameter $D = 1.5\ m$ and height $H = 2\ m$ was immersed into the river in an inverted position. The density of the water in the river was $\rho_{water} = 1000\ kg/m^3$. If the base of cone was exposed $l = 500\ mm$ in height over the water surface, find the density of the cone.

Solution

So,

$$mg = \rho_{water} \cdot g \cdot V,$$



where V is the volume of the immersed cone

$$V = \frac{1}{3} \cdot \pi \cdot r^2 \cdot h$$

$$\frac{H}{h} = \frac{R}{r} \quad \rightarrow \quad \frac{H}{H-l} = \frac{R}{r} \quad \rightarrow \quad r = \frac{R \cdot (H-l)}{H} = \frac{\frac{D}{2} \cdot (H-l)}{H} = \frac{D \cdot (H-l)}{2H} = \frac{1.5 \cdot (2-0.5)}{2 \cdot 2} = 0.5625\ m$$

We have

$$V = \frac{1}{3} \cdot \pi \cdot r^2 \cdot h = \frac{1}{3} \cdot 3.14 \cdot 0.5625^2 \cdot 1.5 = 0.497\ m^3$$

$$mg = \rho_{water} \cdot g \cdot V \quad \rightarrow \quad \rho \cdot V_{total} \cdot g = \rho_{water} \cdot g \cdot V \quad \rightarrow \quad \rho \cdot V_{total} = \rho_{water} \cdot V \quad \rightarrow \quad \rho = \frac{\rho_{water} \cdot V}{V_{total}},$$

where V_{total} is the full volume of the cone

$$V_{total} = \frac{1}{3} \cdot \pi \cdot R^2 \cdot H = \frac{1}{3} \cdot \pi \cdot \left(\frac{D}{2}\right)^2 \cdot H = \frac{1}{3} \cdot 3.14 \cdot \left(\frac{1.5}{2}\right)^2 \cdot 2 = 1.178\ m^3.$$

$$\rho = \frac{\rho_{water} \cdot V}{V_{total}} = \frac{1000 \cdot 0.497}{1.178} \approx 422\ \frac{kg}{m^3}.$$

Answer. $\rho = 422\ \frac{kg}{m^3}$.