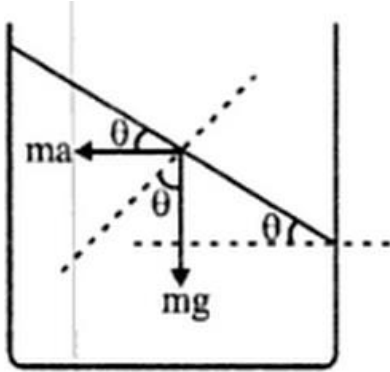


Answer on Question #52209- Physics-Optics

A vertical pencil of rays comes from bottom of a tank filled with a liquid. When the tank is accelerated with an acceleration of 7.5m/s^2 , the ray is seen to be totally reflected by liquid surface. What is minimum possible refractive index of liquid?

Solution



This is the position of the liquid surface with respect to frame of the tank.

Since any liquid surface cannot sustain any tangential force with respect to container

$$ma \cos \theta = mg \sin \theta.$$

$$\tan \theta = \frac{a}{g} = \frac{7.5}{10} \rightarrow \tan \theta = \frac{3}{4} \rightarrow \theta = 37^\circ \rightarrow \theta_c < 37^\circ \text{ (for T.I.R.)}$$

Taking sine on both sides, we get from the above equation

$$\sin \theta_c < \sin 37^\circ \rightarrow \frac{\mu_r}{\mu_d} < \sin 37^\circ \rightarrow \frac{1}{\mu_L} < \frac{3}{5} \rightarrow \mu_L > \frac{5}{3}.$$

Answer: slightly greater than $\frac{5}{3}$.