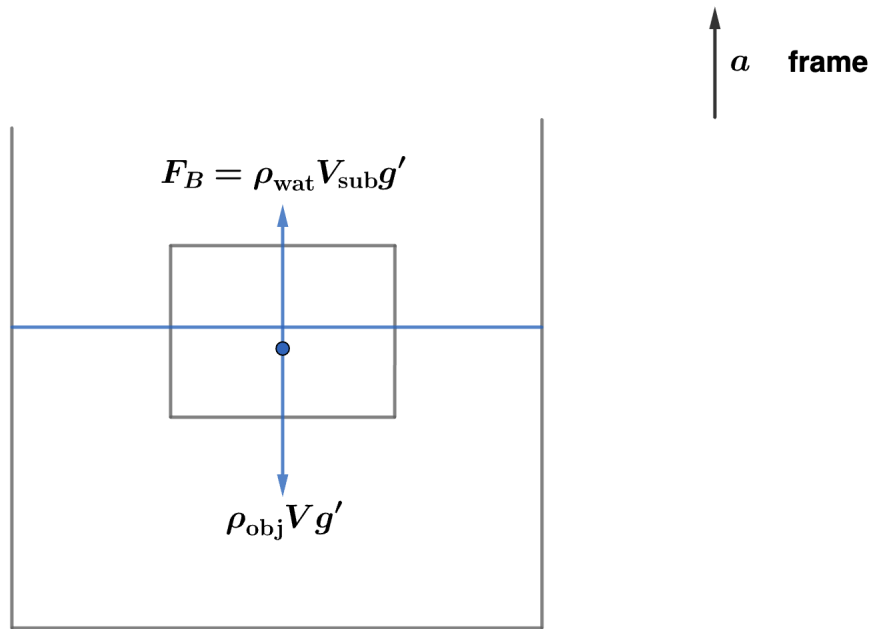# 2016 F=ma Exam: Problem 12

Kevin S. Huang

We initially balance the weight of the block with the buoyant force,

$$\rho_{\text{obj}} V g = \rho_{\text{wat}} V_{\text{sub}} g$$

so the fraction submerged is given by

$$f_{\text{sub}} = \frac{V_{\text{sub}}}{V} = \frac{\rho_{\text{obj}}}{\rho_{\text{wat}}}$$

$$a \quad \textbf{frame}$$

$$\boldsymbol{F_B} = \boldsymbol{\rho_{\text{wat}} V_{\text{sub}} g'}$$

$$\boldsymbol{\rho_{\text{obj}} V g'}$$

In the accelerating frame moving upward with a, the effective gravity is $g' = g + a$ since we include the fictitious inertial force $-m\vec{a}$. Thus, our force balance equation becomes

$$\rho_{\text{obj}} V g' = \rho_{\text{wat}} V_{\text{sub}} g'$$

which yields the same fraction submerged $f_{\text{sub}} = \rho_{\text{obj}}/\rho_{\text{wat}}$. Thus, the block does not move in the liquid so the answer is $\boxed{\text{C}}$.