Given: Rectangular container of water undergoing constant acceleration as shown.

Determine: The slope of the free surface.

Solution:

Basic equation: \(-\frac{\partial p}{\partial x} + \rho g = \rho g\)

Writing the component equations:
- \(\frac{\partial p}{\partial x} + \rho g_x = \rho g_x\)  \(\text{For given coordinates}\)
- \(\frac{\partial p}{\partial y} + \rho g_y = \rho g_y\)
- \(\frac{\partial p}{\partial z} + \rho g_z = \rho g_z\)

\(\rho g_x = \rho g \sin \theta - \rho g_x\)
\(\rho g_y = -\rho g \cos \theta\)
\(\rho g_z = \rho g \sin \theta\)
\(\rho g = 0\)

From the component equations we conclude that \(\rho = \rho(x, y)\)

Then
\[ d\rho = \frac{\partial \rho}{\partial x} dx + \frac{\partial \rho}{\partial y} dy \]

Along the free surface \(\rho = \text{constant}\) and \(d\rho = 0\). Hence

\[
\frac{dy}{dx} \mid \text{surface} = -\frac{\frac{\partial \rho}{\partial x}}{\frac{\partial \rho}{\partial y}} = -\frac{\rho g \sin \theta - \rho g_x}{\rho g \cos \theta}
\]

\[ = \frac{g \sin \theta - g_x}{g \cos \theta} \]

\[ = \frac{32.2 (0.5) ft/s^2 - 10 ft/s^2}{32.2 (0.5) \cos \theta} \]

\[ \frac{dy}{dx} \mid \text{surface} = 0.22 \]