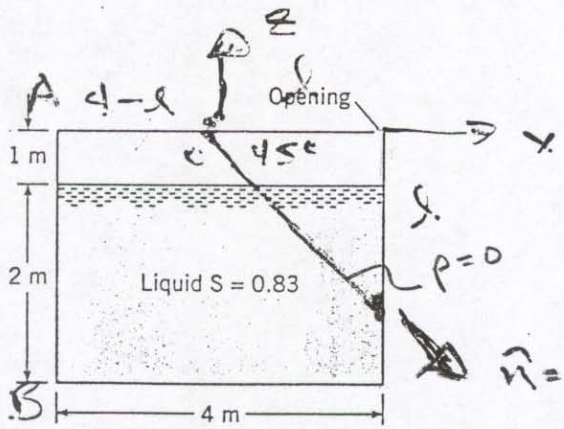
5.24 The tank shown is 4 m long, 3 m high, and 3 m wide, and it is closed except for a small opening at the right end. It contains oil (S = 0.83) to a depth of 2 m in a static situation. If the tank is uniformly accelerated to the right at a rate of 9.81 m/s^2, what will be the maximum pressure intensity in the tank during acceleration?



PROBLEM 5.24

$\hat{n}$ = unit vector in direction $p = \text{const.}$

$$\underline{a} = a_x\hat{i} + a_z\hat{k} = a_x\hat{i} = g\hat{i}$$

$$\nabla p = -\rho(g\hat{k} + \underline{a}) = -\rho(g\hat{k} + a_x\hat{i})$$

$$\frac{\partial p}{\partial x} = -\rho a_x = -\rho g \qquad \frac{\partial p}{\partial z} = -\rho g \qquad \theta = \tan^{-1}\frac{a_x}{g + a_z} = 1 \Rightarrow \theta = 45^\circ$$

amount of air some before / after a_x

$$\frac{1}{2}l^2 \times 3 = 4 \times 1 \times 3 \Rightarrow l = \sqrt{8} = 2.8$$

$$X_0 = 0$$

$$\frac{p_0 - p_A}{x_0 - x_A} = -\rho g \qquad p_A - p_0 = -\rho g(x_A - x_0) \qquad x_A = -(4 - l)$$

$$p_A = \rho g(4 - l)$$

$$z_A = 0$$

$$\frac{p_A - p_B}{z_A - z_B} = -\rho g \qquad p_B - p_A = -\rho g(z_B - z_A) \qquad z_B = -3$$

$$p_B = p_A + 3\rho g$$

$$= \rho g(4 - l + 3)$$