Solution to Problem 104A

There are two forces acting on the L-shaped gate:

(1) A force, F_1, on the horizontal part (per unit depth):

$$F_1 = \rho g h L$$

The line of action of this is $L/2$ from the hinge, so the moment it creates is:

$$M_1 = \rho g h \frac{L^2}{2}$$

(2) A force, F_2, on the vertical part (per unit depth):

$$F_2 = \rho g \frac{h}{2} h$$

The line of action of this is $h/3$ from the hinge, so the moment it creates is:

$$M_2 = \rho g \frac{h^3}{6}$$

As h increases, M_2 increases faster than M_1. The gate opens when $M_2 = M_1$, so that the critical height, h, is:

$$h = \sqrt{3}L = 1.73 \ m$$