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Mech. Engg. Departt.
Fluid Mechanics, 0904361

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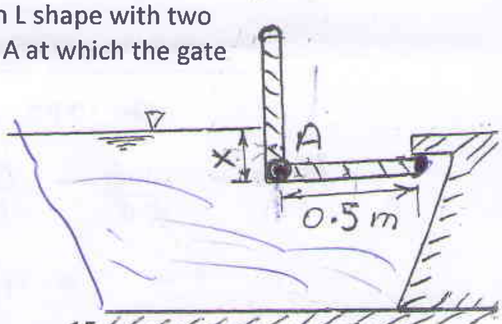
1) A tank contains water, with a side gate hinged at A. The gate is an L shape with two rectangular sides. As shown. What is the water level above point A at which the gate opens.



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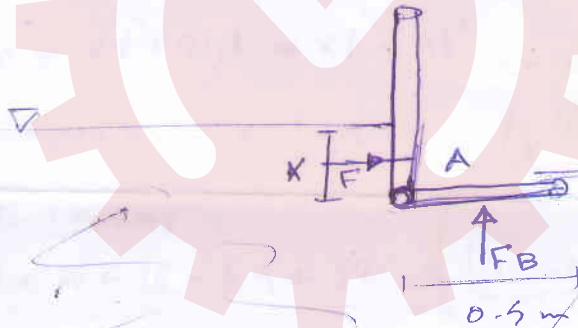

$F = \gamma h_c A = (9.81)*(10^3)*(\frac{X}{2})*(0.5)^2$

$\boxed{F = 1226.25X^2}$ N

$y_{cp} - \bar{y} = \frac{I}{\bar{y}A} = \frac{0.5*(0.5)^3/12}{(\frac{X}{2})(0.5)^2}$??

$\boxed{y_{cp} - \bar{y} = 0.041667X}$

$\frac{1}{6}X$

$F_B = W$

$\Sigma M_A = 0$

$F * \frac{X}{2} = F_B(0.25)$

$\frac{1226.25}{2}X^2 = 0.25\ mg$ → mass of the gate

$X^2 = \frac{1}{250}m$

$\boxed{X = \cancel{0.0632}\ m_{gate}}$

if $X > \cancel{0.0632}\ m_{gate}$

⇒ the gate will open.

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2) Flow field having the following equations:

$$u = xt + 2y$$
$$v = xt^2 - yt$$
$$w = 0.0$$

Acceleration was monitored at point x=1, y=2, z=3, and at time t=4 seconds.

1) calculate a_x, a_y and a_z .
2) is the continuity equation satisfied.
3) is the flow rotational.

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① $a_x = \frac{\partial u}{\partial t} + u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial y} + w\frac{\partial w}{\partial z}$

$= (x) + (xt + 2y)(t) + (xt^2 - yt)(-t) + (\text{zero})$

$a_x = x + xt^2 + 2yt - xt^3 + yt^2$

a_x at $x=1, y=2, z=3, t=4$

$a_x = 1 + 16 + 16 - 64 + 32 = \boxed{1 \ m/s^2}$

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$a_y = u\frac{\partial v}{\partial x} + v\frac{\partial v}{\partial y} + w\frac{\partial v}{\partial z} + \frac{\partial v}{\partial t}$

$= (xt + 2y)(t^2) + (xt^2 - yt)(-t) + (0)(0) + (2xt - y)$

$a_y = 128 + (16 - 8)(-4) + 0 + 6$

$= \boxed{102 \ m/s^2}$

$a_z = u\frac{\partial w}{\partial x} + v\frac{\partial w}{\partial y} + w\frac{\partial w}{\partial z} + \frac{\partial w}{\partial t}$

$= (xt + 2y)(0) + (xt^2 - yt)(0) + (0)(0) + 0$

$= \boxed{\text{zero}}$

② continuity eqn. ⇒

$\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} + \frac{\partial w}{\partial z} = 0$

$t + -t + 0 = 0$

yes it's satisfied

③ $\frac{\partial u}{\partial y} = \frac{\partial v}{\partial x}$ ⇒ not rotational

⇒ $2 \overset{??}{=} t^2$

but $t = 4$ ⇒ $2 \neq 16$

so the flow is rotational

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