Midterm Exam 2

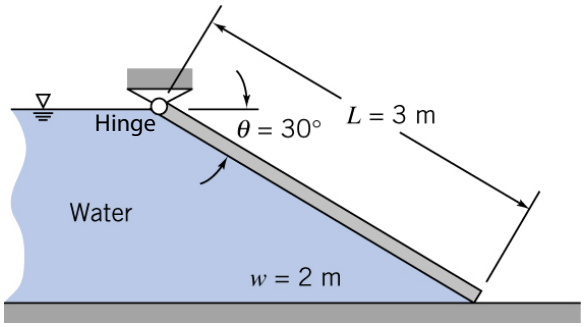
(9:30-10:45 am on November 9, 2010)

Problem 1 (10 pts). A rectangular gate of uniform thickness and width $w = 2\ m$ holds back a depth of water as shown.

(a:7) Determine the minimum weight needed to keep the gate closed.

(b:3) Determine the vertical component of the reaction force at the hinge.

Be sure to include a complete Free Body Diagram and list of relevant assumptions in your solution.

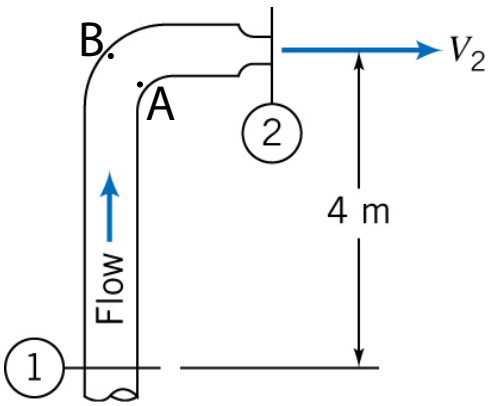


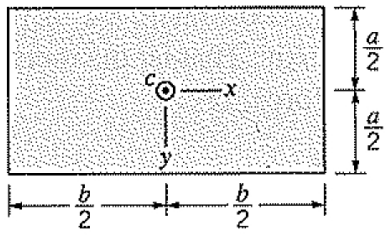
Problem 2 (12 pts). Water flows steadily up the vertical 0.1 m diameter pipe and out the nozzle, which is 0.05 m in diameter, discharging to atmospheric pressure. The stream velocity at the nozzle exit must be 20 m/s. Please do the following:

(a:5) Calculate the minimum gage pressure required at section 1. Be sure to clearly state any relevant assumptions.

(b:4) Where is the pressure largest, at A or B? You do not need to calculate the pressure, but you do need to adequately justify your answer.

(c:3) Does the water accelerate through the nozzle? Provide a brief explanation. (The outlet of the nozzle is located at section 2).





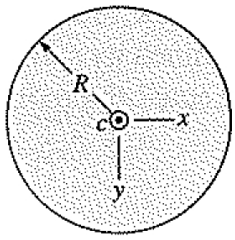
$A = ba$

$I_{xc} = \frac{1}{12}ba^3$

$I_{yc} = \frac{1}{12}ab^3$

$I_{xyc} = 0$

(*a*) Rectangle

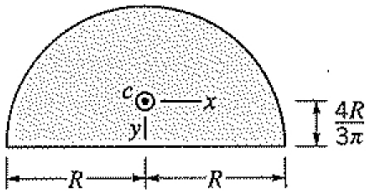


$A = \pi R^2$

$I_{xc} = I_{yc} = \frac{\pi R^4}{4}$

$I_{xyc} = 0$

(*b*) Circle



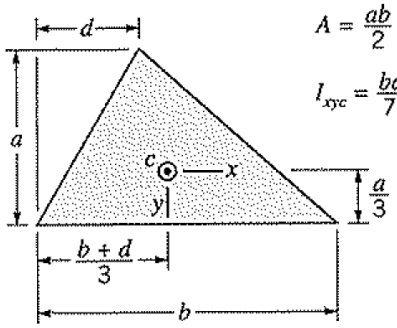
$A = \frac{\pi R^2}{2}$

$I_{xc} = 0.1098R^4$

$I_{yc} = 0.3927R^4$

$I_{xyc} = 0$

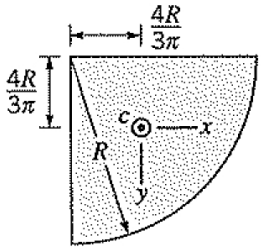
(*c*) Semicircle



$A = \frac{ab}{2}$ $I_{xc} = \frac{ba^3}{36}$

$I_{xyc} = \frac{ba^2}{72}(b - 2d)$

(*d*) Triangle



$A = \frac{\pi R^2}{4}$

$I_{xc} = I_{yc} = 0.05488R^4$

$I_{xyc} = -0.01647R^4$

(*e*) Quarter circle

FIGURE 2.18 Geometric properties of some common shapes.