W05 - Homework

Stepwise problems - Thu. 11:59pm

Hydrostatic pressure

01

Fluid force on a triangular plate

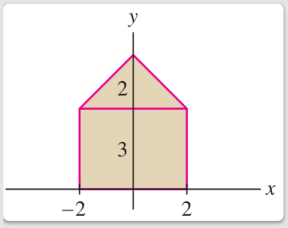
Find the total force on the submerged vertical plate that is an isosceles triangle with base 1m and height 2m, and assume it is submerged with the upper vertex 3m below the surface. Liquid is oil with density $\rho = 900\,\mathrm{kg/m^3}$.

Moments and CoM

02

Center of mass of a house

A "house" is the region bounded by the (non-regular) pentagon with vertex points at $(0, 5)$, $(2, 3)$, $(2, 0)$, $(-2, 0)$, $(-2, 3)$. Find the CoM of the house using additivity of moments.



03

CoM of region between curves

Find the CoM of the region between the graph of $y = e^x$ and the graph of $y = 1$ over $x \in [0, 1]$.

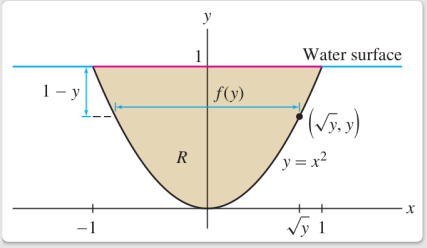
Regular problems - Sat. 11:59pm

Hydrostatic pressure

04

Fluid force on a parabolic plate

A parabolic plate is submerged vertically in water as in the figure:



The shape of the plate is bounded below by $y = x^2$ and above by the line $y = 1$. (Note that y *increases going up* in this coordinate system.)

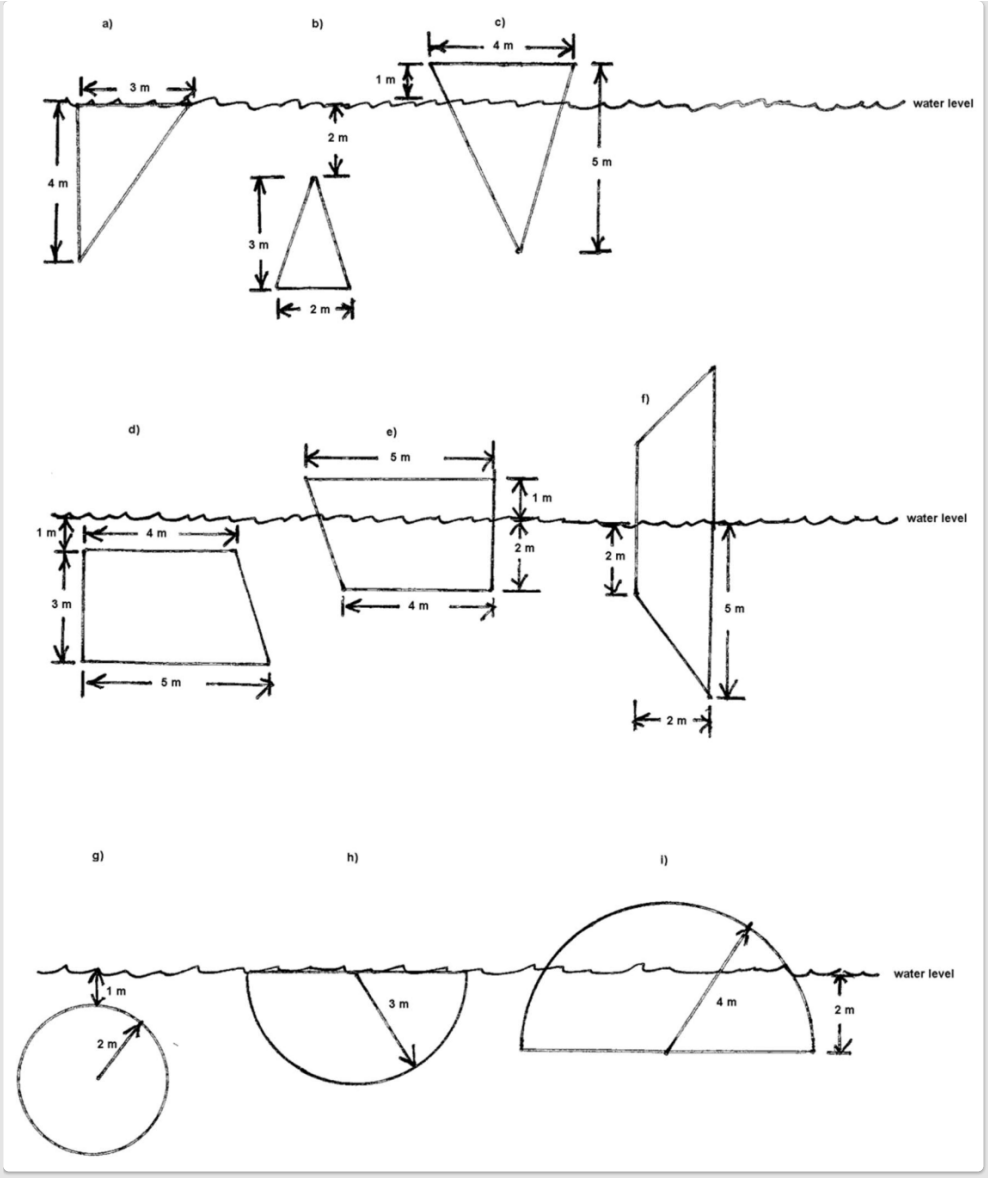
Compute the total fluid force on this plate.

(Hint: your integrand should contain $(1 - y)$ as a factor.)

05

Fluid force on various plates

For diagrams (a)-(i) below, set up an integral to compute the hydrostatic force on the plate.

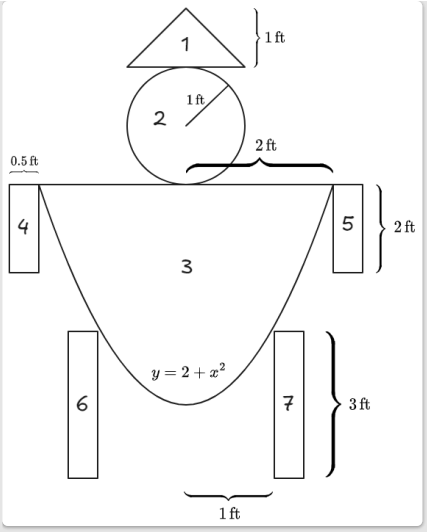


Moments and CoM

06

FlatCoMman

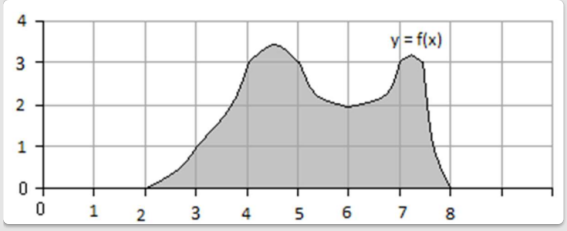
Find the center of mass of FlatCoMMan. Assume a constant mass density ρ. Use additivity of moments.



07

CoM from Simpson's

Use Simpson's rule (with 6 subintervals) to estimate the centroid of this region:



You will need to estimate M_x and M_y and M with three separate integrals. You can use a calculator for your arithmetic.