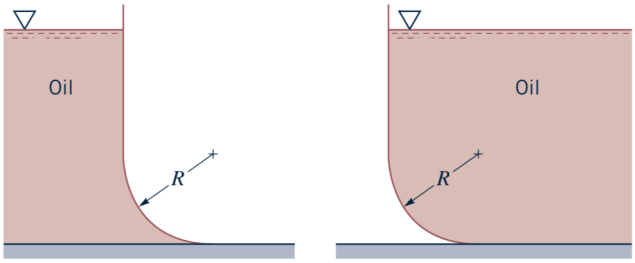
ME 3710 – Spring 2024
Homework 4
Due February 8 at 11:59pm – upload to files to Gradescope
21 points

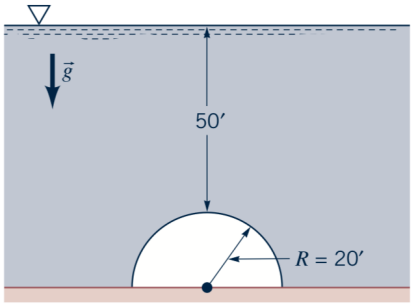
Problem 2.114

Consider the curved surface shown in the figure below (a) and (b). The two curved surfaces are identical. How are the vertical forces on the two surfaces alike? How are they different?



Problem 2.115

The figure below shows a cross section of a submerged tunnel used by automobiles to travel under a river. Find the magnitude and location of the resultant hydrostatic force on the circular roof of the tunnel. The tunnel is 4 mi long.



Problem 2.134

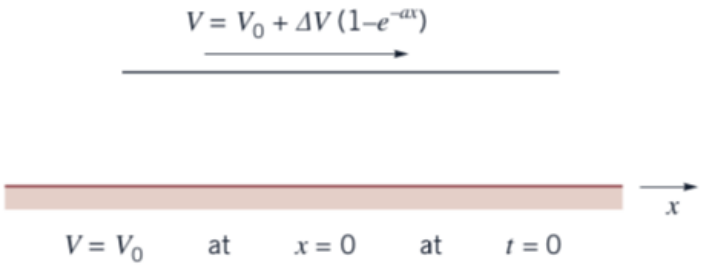
A floating 40-in.- thick piece of ice sinks 1 in. with a 500-lb polar bear in the center of the ice. What is the area of the ice in the plane of the water level? For seawater, $S = 1.03$.

Problem 4.2

The surface velocity of a river is measured at several locations x and can be reasonably represented by

$$V = V_0 + \Delta V(1 - e^{-ax}),$$

where V_0, ΔV, and a are constants. Find the Lagrangian description of the velocity of a fluid particle flowing along the surface if $x = 0$ at time $t = 0$.



Problem 4.4

A two-dimensional velocity field is given by $u = 1 + y$ and $v = 1$. Determine the equation of the streamline that passes through the origin. On a graph, plot this streamline.

Please use Matlab or Python to make your plot.

Problem 4.8

The components of a velocity field are given by $u = x + y$, $v = xy^3 + 16$, and $w = 0$. Determine the location of any stagnation points ($V = 0$) in the flow field.

Problem 4.9

A two-dimensional, unsteady velocity field is given by

$u = 5x(1 + t)$ and $v = 5y(-1 + t)$,

where u is the x-velocity component and v the y-velocity component. Find $x(t)$ and $y(t)$ if $x = x_0$ and $y = y_0$ at $t = 0$. Do the velocity components represent an Eulerian description or a Lagrangian description?

Also, plot the x(t) versus y(t) for $x_0 = 0$, $y_0 = 0$ from t = 0:0.1:1 sec. Assume the units of u and v are in m/s. Label and title your plot.