Active learning exercise

The following exercise is known as a **jig-saw technique**. Everyone team in the class will be assigned one of three problems. Everyone will solve their assigned problem *before* the next class. (Your assigned problem is on the back of this sheet.) **You will turn in your attempt at the problem with your next homework assignment.** You may work the problem on the back of this sheet, and you need not follow the standard homework format**.**

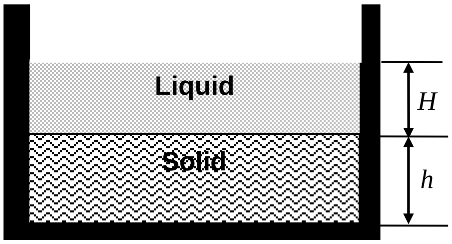
In our next class we will work in teams in which each member has already worked one of the three problems. One of your jobs as a team member is to serve as a guide for helping the others solve the problem you are already an "expert" on.

<u>Procedure for solving problems during class:</u>

1) Everyone will spend one (1) minute reading the problem silently.
2) Three (3) minutes will be allotted for *discussing* the problem solving strategy. Things to discuss should include
    a. The system to choose: What are the boundaries? Is it open or closed? Why this system and not another?
    b. The time frame required.
    c. Additional information required: Do you need to make any assumptions? What are they? Are there additional relationships (equations) that you can use?
3) Ten (10) minutes will be allotted for documenting the solution. Documented solutions *must* adhere to the following:
    a. When using a conservation or accounting principle, you must clearly indicate a system by drawing a system boundary on a diagram.
    b. All conservation principles must start with the most general form first and then show a logical progression to the solution.
    c. You cannot crunch number until the last step. Work all solutions in symbolic form.

Example C

As shown in the figure, an open tank with rigid walls and a base area A_{base} = 0.5 m^2 contains a composite layer of liquid resting on solid. By cooling the base of the tank, solidification occurs at the liquid-solid interface. The liquid layer has density ρ_L = 800 kg/m^3 and the solid layer has density ρ_S = 1000 kg/m^3. Initially, the liquid layer and solid layer have identical thicknesses, i.e. $H = h$ = 150 mm (see the figure).



A tank containing a composite

You have been asked to examine how the thicknesses of the individual layers and the composite layer are related during this process. In operation, the thickness h of the solid layer increases at a constant rate dh/dt = 5 mm/min.

(a) Write a symbolic expression for the total mass inside the system.

(b) Apply Conservation of Mass to this closed system (the material in the tank) and answer the following questions:
  - How is dH/dt, the rate of change of the liquid-layer thickness H, related to dh/dt?
  - Does the top surface of the composite layer (liquid plus solid) layer rise or fall during this process? How fast?

(c) How would your answers to Part (b) change if the density values were reversed, i.e. $\rho_S < \rho_L$? If the density values were equal i.e. $\rho_S = \rho_L$?