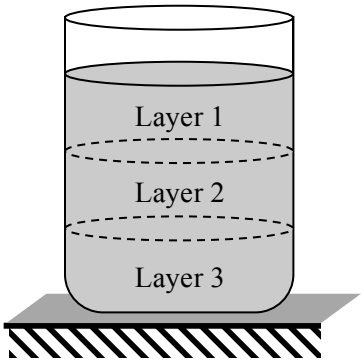
Pressure

I. WATER IN LAYERS

When water squirts out of a container, unbalanced forces are accelerating the blob of water nearest the hole. In this section we will consider the relationship between pressure (squirtiness) and forces.



To begin, imagine a water-filled beaker with straight sides. Two imaginary boundaries that divide the water into three layers of equal volume have been drawn in the diagram. No material barrier separates the layers. (The three discs at your table may be used as models of the layers.)

A. For each layer, draw a free-body diagram in the space provided. Draw both vertical and horizontal forces.

Layer 1	Layer 2	Layer 3

1. Rank the magnitudes of all the vertical forces you have drawn in the three diagrams from largest to smallest. Explain your reasoning.

2. Consider each of the contact forces in your diagrams. Use the disks to show where each of the contact forces in your diagrams is exerted. (Hint: Each force is exerted over a surface, not only at a point.)

B. The technical definition of pressure is *force per unit area.*

1. Suppose you wanted to know the pressure at the bottom of layer 2.

i. What vertical *force would you associate with that pressure?*

ii. Over what area is the force you chose distributed? Indicate the area physically on the discs at your table.

2. Suppose you wanted to know the pressure at the middle of layer 2.

i. *What* horizontal *force would you associate with that pressure?*

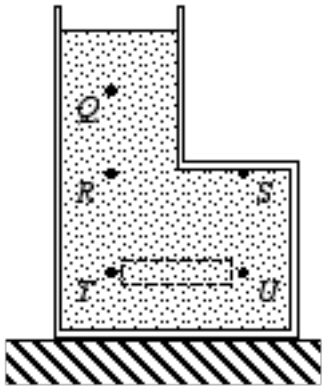
ii. *Over what area is the force you chose distributed? Indicate the area physically on the discs at your table.*

C. Imagine opening a hole in the side of the beaker. What force would determine how water squirts out?

☆ *Consult an instructor before you proceed.*

II. WATER IN A CONTAINER SHAPED SORT OF LIKE UTAH

The container shown in side view at right is filled with water.



A. What's your initial feeling about how the pressure at point T would compare to the pressure at point U? Explain your reasoning.

B. Draw a free-body diagram for the small volume of water that's outlined by the dotted box.

1. Explain to yourself how you can use the free-body diagram to compare the pressures at T and U.

2. How do the pressures compare? How do you know?

C. Rank the pressures at points Q, R, S, T, and U. Explain your reasoning.

D. Is this a case where you needed to draw a free-body diagram to fully understand the situation, or was a free-body diagram not necessary?