Pressure

*Understanding fluids requires an understanding of pressure. That’s our focus today.*

A classic question in physics is the following: A boat containing a heavy anchor floats in a reservoir. If the anchor is thrown overboard and is completely submerged, what happens to the water level in the reservoir?

What’s your prediction, and your reason?

The actual result is:

It might help if you complete the following sentences:

When the anchor is completely submerged the anchor displaces a volume of water that ____________.

When the anchor is inside the boat the anchor is responsible for displacing a volume of water that ____________.

We’ll do a couple of demonstrations involving atmospheric pressure. One involves crushing a can with atmospheric pressure. To help understand this draw two diagrams. Each diagram should show the forces being exerted on the outside of the can and the inside of the can.

| Diagram 1: Can open to the atmosphere. | Diagram 2: Air removed from inside the can. |
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Estimate the force that the atmosphere exerts on one side of the can.
Another good atmospheric pressure demonstration is the vacuum cannon, in which a ping pong ball is propelled down an evacuated tube by atmospheric pressure. Estimate the speed at which the ball comes out of the tube assuming the following:

- Atmospheric pressure is $1 \times 10^5$ Pa.
- Pressure inside the tube is 0.
- Mass of the ball is 4 g.
- Area of the ball is $1.2 \times 10^{-3}$ m$^2$.
- Zero friction or resistance for the ball.
- The tube length is 2 m.

1. Find the force exerted on the ball by the air.

2. Either find the ball’s acceleration and use a constant-acceleration equation, or use the work-energy relationship, to find the ball’s speed at the end of the tube.

Have a look at the picture of the three points in the J-shaped tube.

Rank these points based on the pressure at the points, from largest to smallest. Justify your ranking.

The actual ranking is: