


Chapter 6: Forces in Fluids



Did you read chapter 6 before coming to class?
 A. Yes
 B. No

Forces and motion




Block inside monument




- Is the Block in accelerated or non-accelerated motion?

Forces and motion




Block inside monument




The motion of the block can be understood in terms of

- Several forces which are balanced
- There are no forces on the block
- Several forces which are do not balance

Forces and motion




Block inside monument



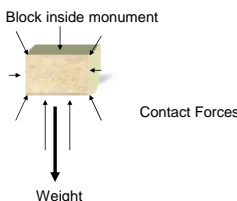
The contact force on the top of the block is

- Greater than the contact force on the bottom
- The same as the contact force on the bottom
- Less than the contact force on the bottom


Contact Forces



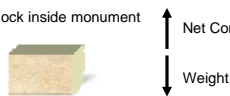
Block inside monument



Forces within objects at rest



Block inside monument



acceleration = 0
net force = 0

- A pieces of an object at rest must have internal contact forces equal to its weight.
- How would this change if we considered a block of equal size and weight located higher in the monument?

Fluids

- A fluid is a gas or liquid and has the essential features:
 - It assumes the shape of the container
 - Exerts no net sideways contact forces **when at rest**



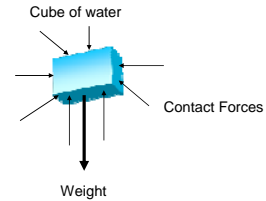
Temple Square



Capetown South Africa

Pressure

- Fluids come in contact with object at many points, so it is usually easier to talk about pressure than the individual forces.



Lets talk about pressure

- Pressure = Force / Area



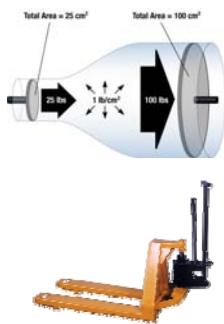
Pressure Demo

Bounded vs. Unbounded

- For a bounded fluid: Pressure applied to any part of a bounded fluid transmits equally to every other part with no loss.



Hydraulics

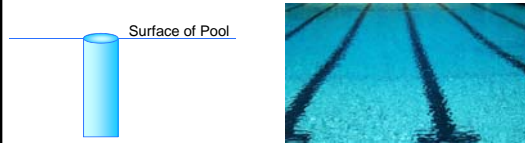


Rules for unbounded fluid behavior

- The pressure of an unbounded fluid increases with depth, and is the same at all points with the same depth, regardless of surface area
- Each bit of fluid pushes outward, perpendicular to any surface or boundary
- The pressure at a particular point is the same in all directions

The pressure of a fluid increases with depth. How much it increases depends on the fluid density.

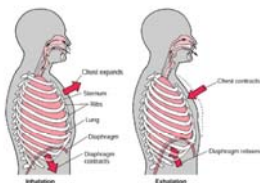
- We live at the bottom of a fluid
 - At sea level, air pressure is about 15 psi
- Deep end of the swimming pool
 - Water pressure increases about 1 atmosphere every 11 meters.



Pressure Demo



How do you breathe?



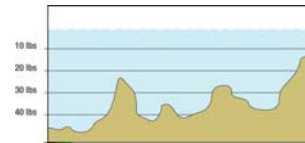
The pressure is the same at all points with the same depth, regardless of surface area



Lake Powell



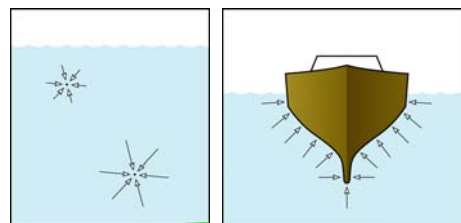
Glen Canyon Dam



Water pressure

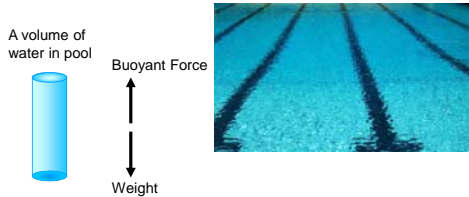


Pressure at a given depth is independent of direction, and pressure acts perpendicular to the surface of submerged objects



Archimedes Principle

- significant gravitational force?
- charges involved?
- is anything touching the object (contact forces)?
 - a. normal force
 - b. friction

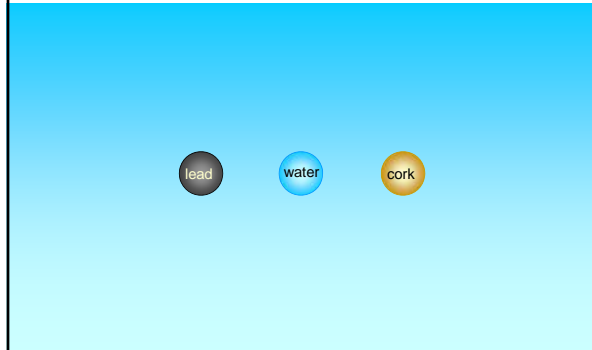


Archimedes Principle

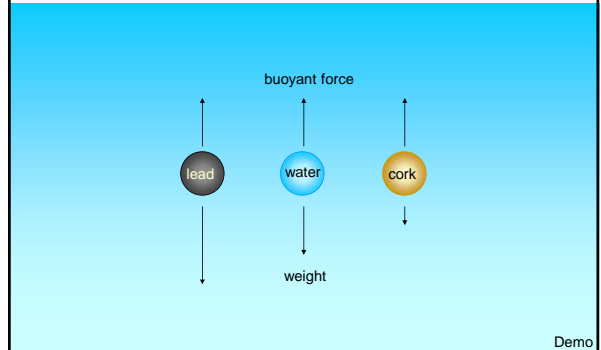
- An object immersed in an unbounded fluid experiences an upward buoyant force caused by contact interactions with the surrounding fluid. The strength of this force equals the weight of the **displaced fluid** *not the weight of the immersed object*.



Quiz: How will the different balls move

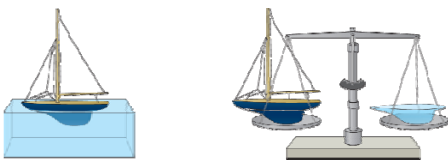


Quiz: How will the different balls move



Demo

Floating Objects



- According to Archimedes Principle, an object will sink until its weight equals the weight of displaced fluid.

How much water does it take to float an aircraft carrier?

- a) A few cups
- b) A volume of water equal to the volume of the ship
- c) A mass of water equal to the mass of the ship



A romantic evening gone sour...

- When you fall out of the boat you remain floating. The water level in the pond will
- Go up slightly
 - Go down slightly
 - Remain unchanged



Iceberg Example

- What happens if it snows on top?
- What happens if the top melts?

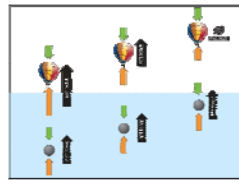


Ways to say something floats

- It is less dense than the surrounding fluid.
- It weighs less than an equal volume of fluid.
- The buoyant force is equal to its weight when it is only partially submerged.
- It displaces a weight of fluid equal to its weight when it is only partially submerged.

Freedom Festival

- "Hot air rises." Why?



Convection

- cold (high density) fluids sink
- warm (low density) fluids rise
- this creates circulating currents



Density and the king's crown

$$\text{Density} = \text{Mass} / \text{volume}$$

