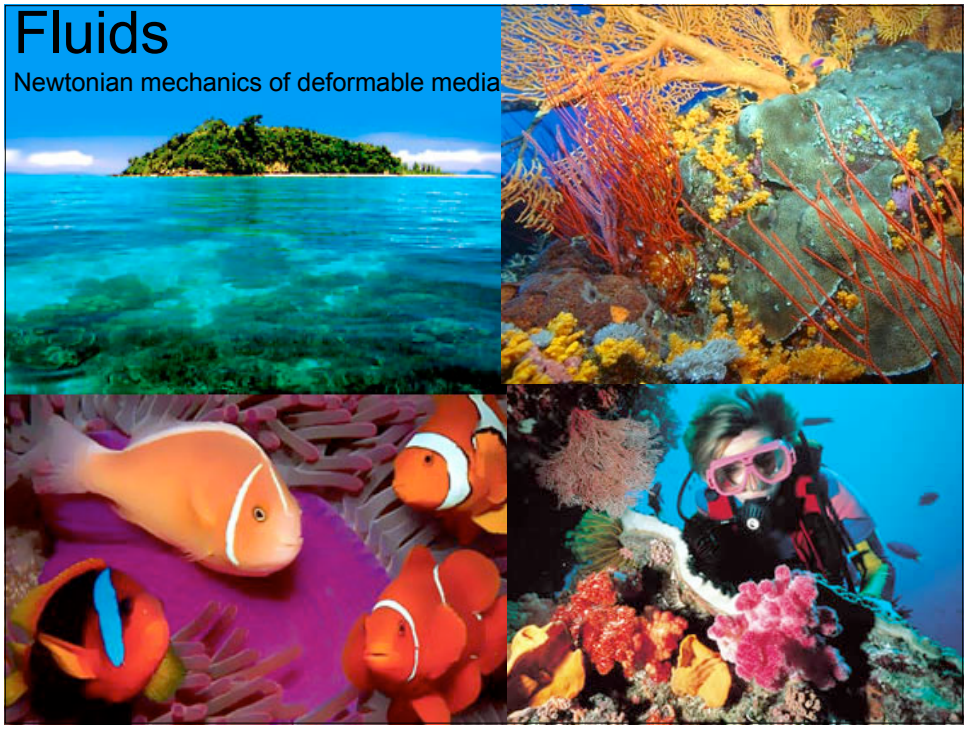
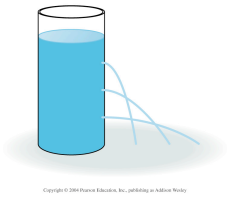
Fluids

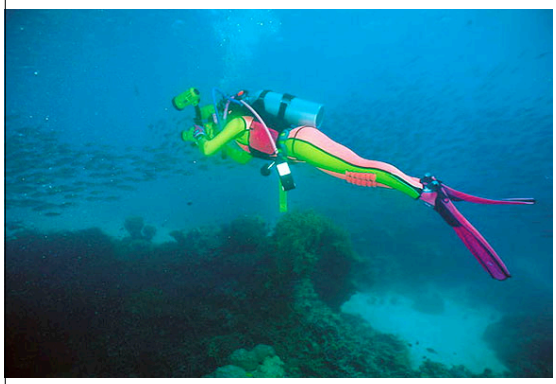
Newtonian mechanics of deformable media



Fluids

Newtonian mechanics of deformable media





a BCD (buoyancy control device) for SCUBA diving

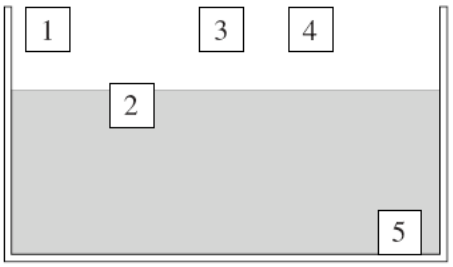
demos: Weight of air
Wooden block, steel and cork in aquarium
Neutral buoyancy balloon with He

Fluids: buoyancy

$V_1=V_2=V_3=V_4=V_5$

$m_1<m_2<m_3<m_4<m_5$

What is the final position of each block?



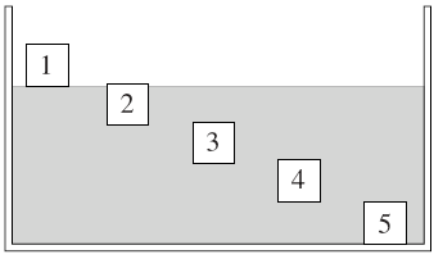
Fluids: buoyancy

$V_1=V_2=V_3=V_4=V_5$

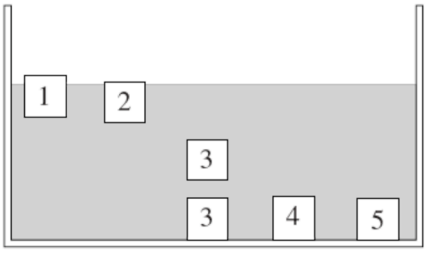
$m_1<m_2<m_3<m_4<m_5$

What is the final position of each block?

not this!



but this!

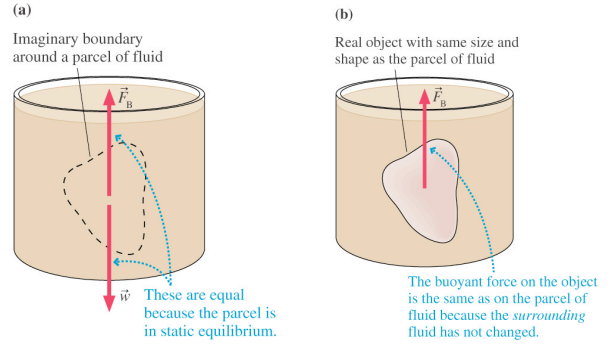


Fluids: buoyancy

Archimedes principle: demo

A fluid exerts an upward buoyant force $\vec{F}_B$
on an object immersed in or floating on the fluid.

The buoyant force equals the weight of the fluid displaced by the object.



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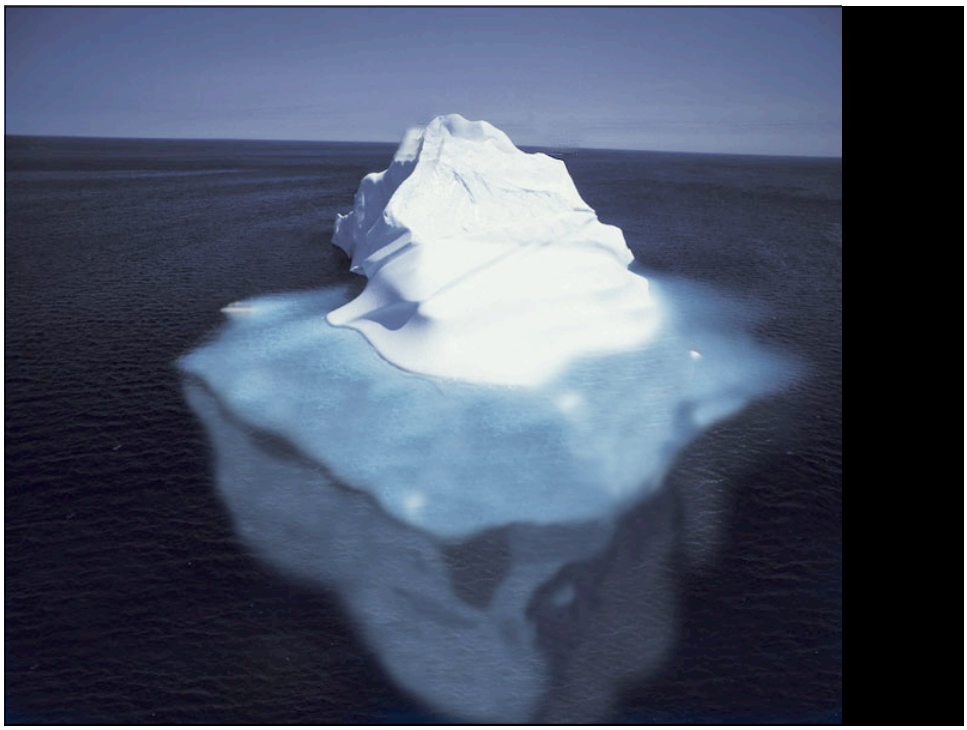
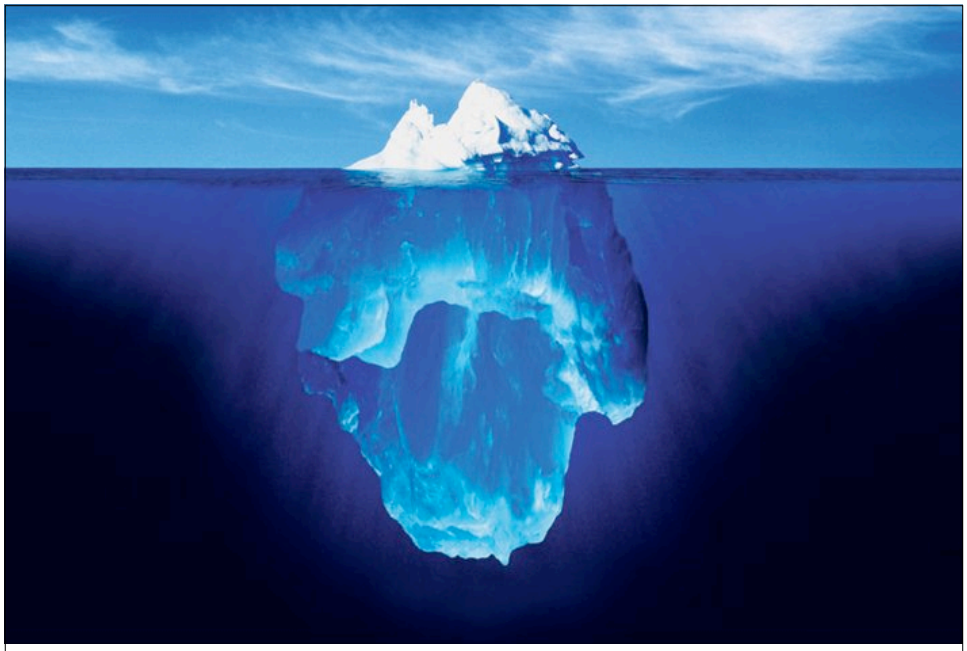
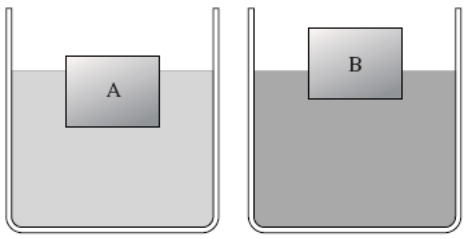




This is an actual photo of an iceberg, taken by a rig manager for Global Marine Drilling in St. Johns, Newfoundland. The water was calm and the sun was almost directly overhead so that the diver was able to get into the water and take this picture. They estimated the weight at 300,000,000 tons.

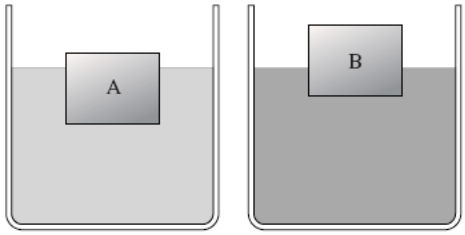
Fluids: buoyancy



Identical cubes A and B are placed in liquids of different densities.

Is the buoyant force on A greater, smaller or equal to the buoyant force on B?

Fluids: buoyancy

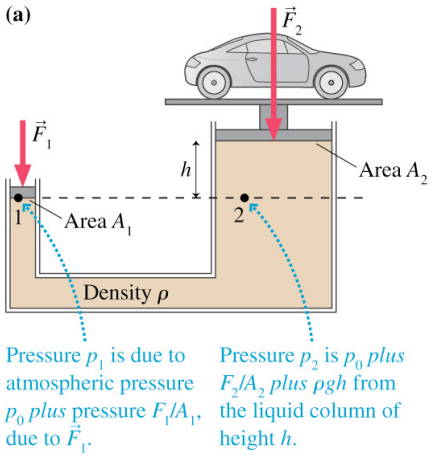


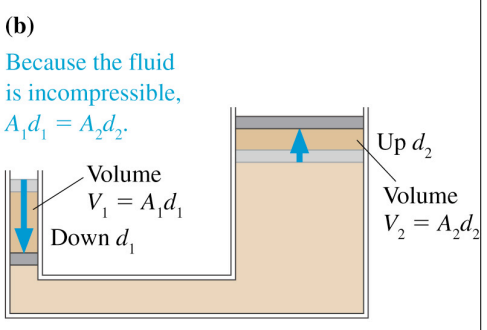
Identical cubes A and B are placed in liquids of different densities.

Is the buoyant force on A greater, smaller or equal to the buoyant force on B?
The two identical cubes are in equilibrium, and their weight does not depend on position (height), therefore the buoyant forces must be identical

fluids: the hydraulic lift

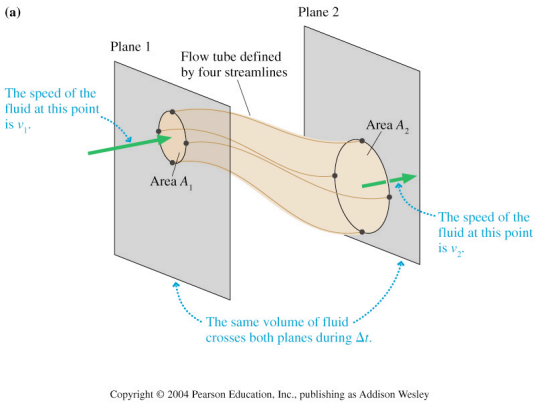
Pascal's principle: a change in the pressure at one point in an incompressible fluid appears undiminished at all points in the fluid





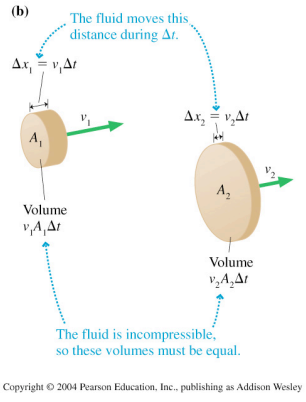
demo : hydraulic press

Fluids: equation of continuity



Equation of continuity: $v_1 A_1 = v_2 A_2$

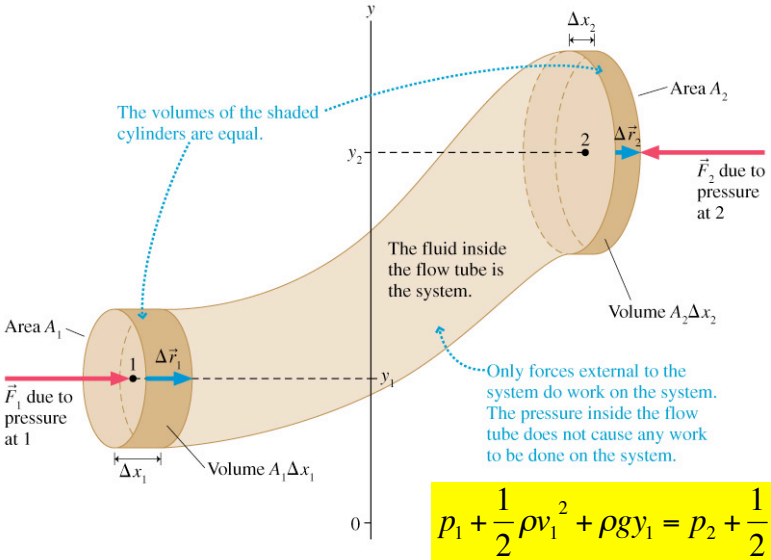
Fluids: equation of continuity



Equation of continuity: $v_1 A_1 = v_2 A_2$

tools,demo Bern.w/ping pong balls

fluids: Bernoulli's equation



$$p_1 + \frac{1}{2}\rho v_1^{\,2} + \rho g y_1 = p_2 + \frac{1}{2}\rho v_2^{\,2} + \rho g y_2$$

$$p + \frac{1}{2}\rho v^2 + \rho g y = const$$

Fluids: blood pressure