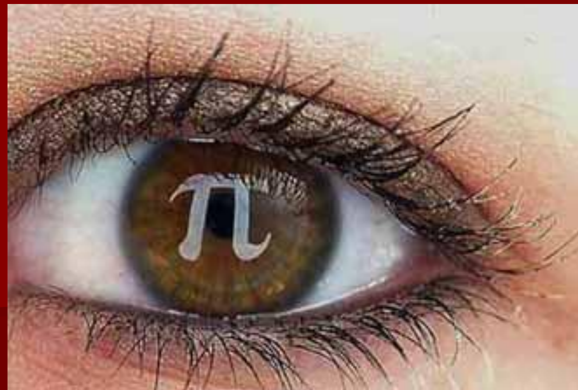
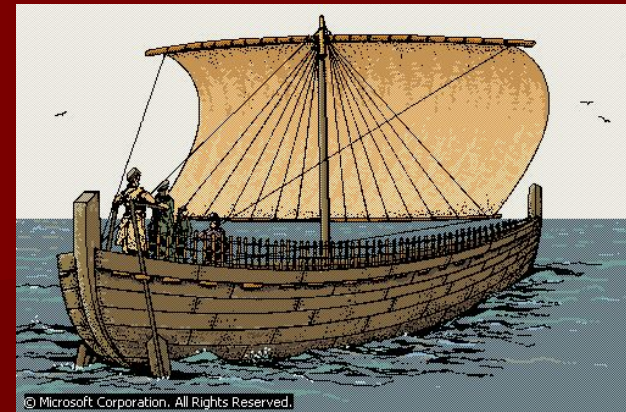
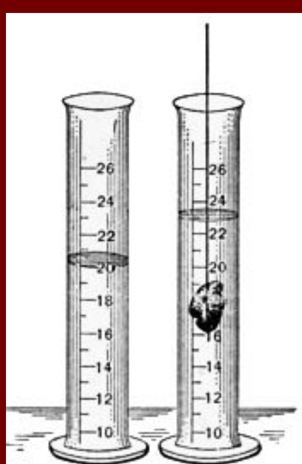
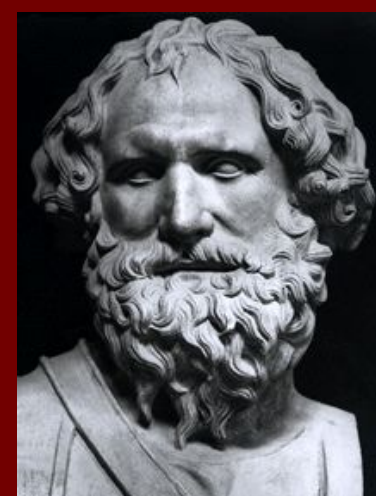


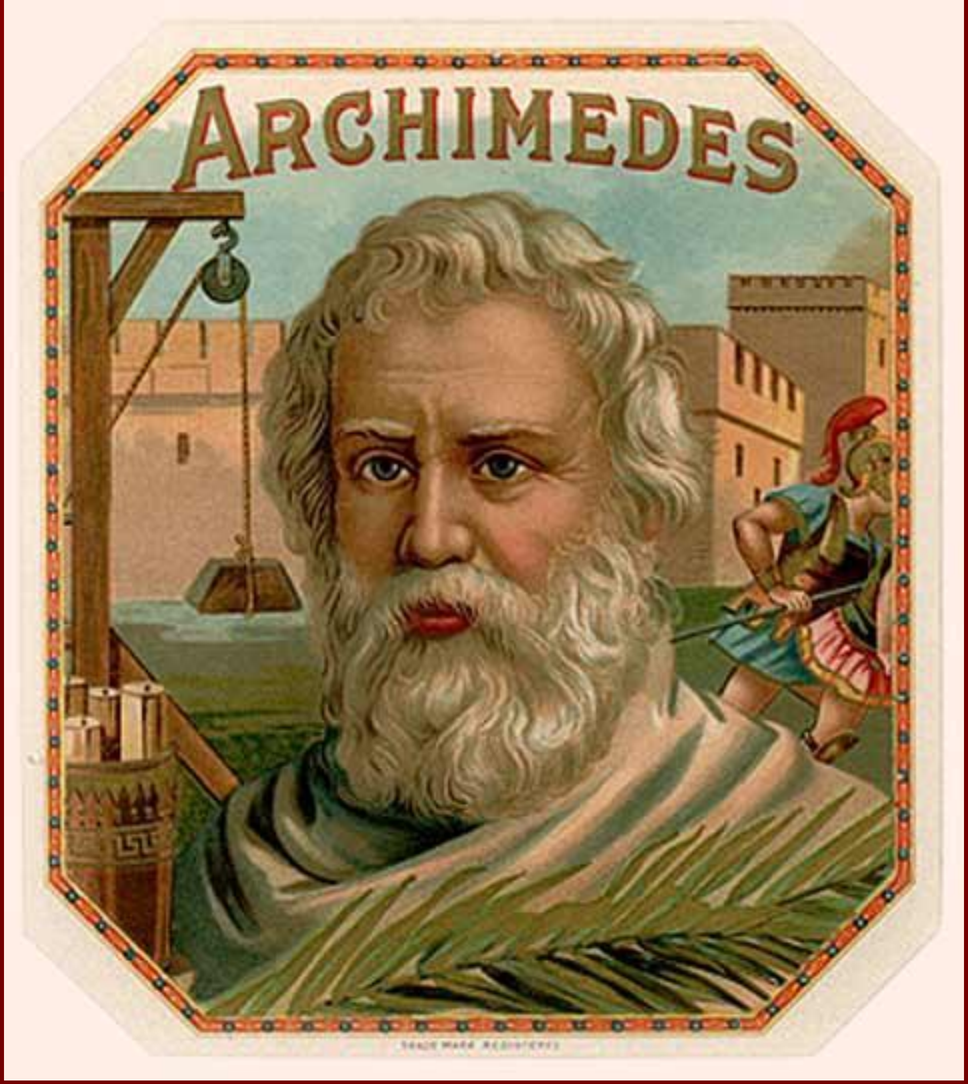


ARCHIMEDES' PRINCIPLE





Who is Archimedes?



A little history…

The King must know: is his crown true gold?

Eureka, Eureka.

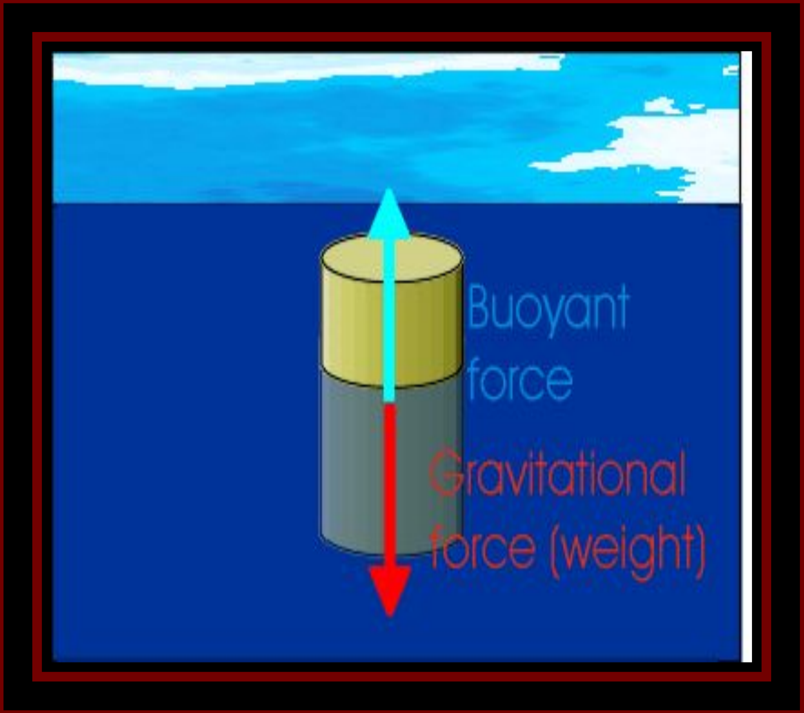
The law

- **Archimedes' Principle**, law of physics that states that when an object is totally or partially immersed in a fluid, it experiences an upthrust equal to the weight of the fluid displaced.

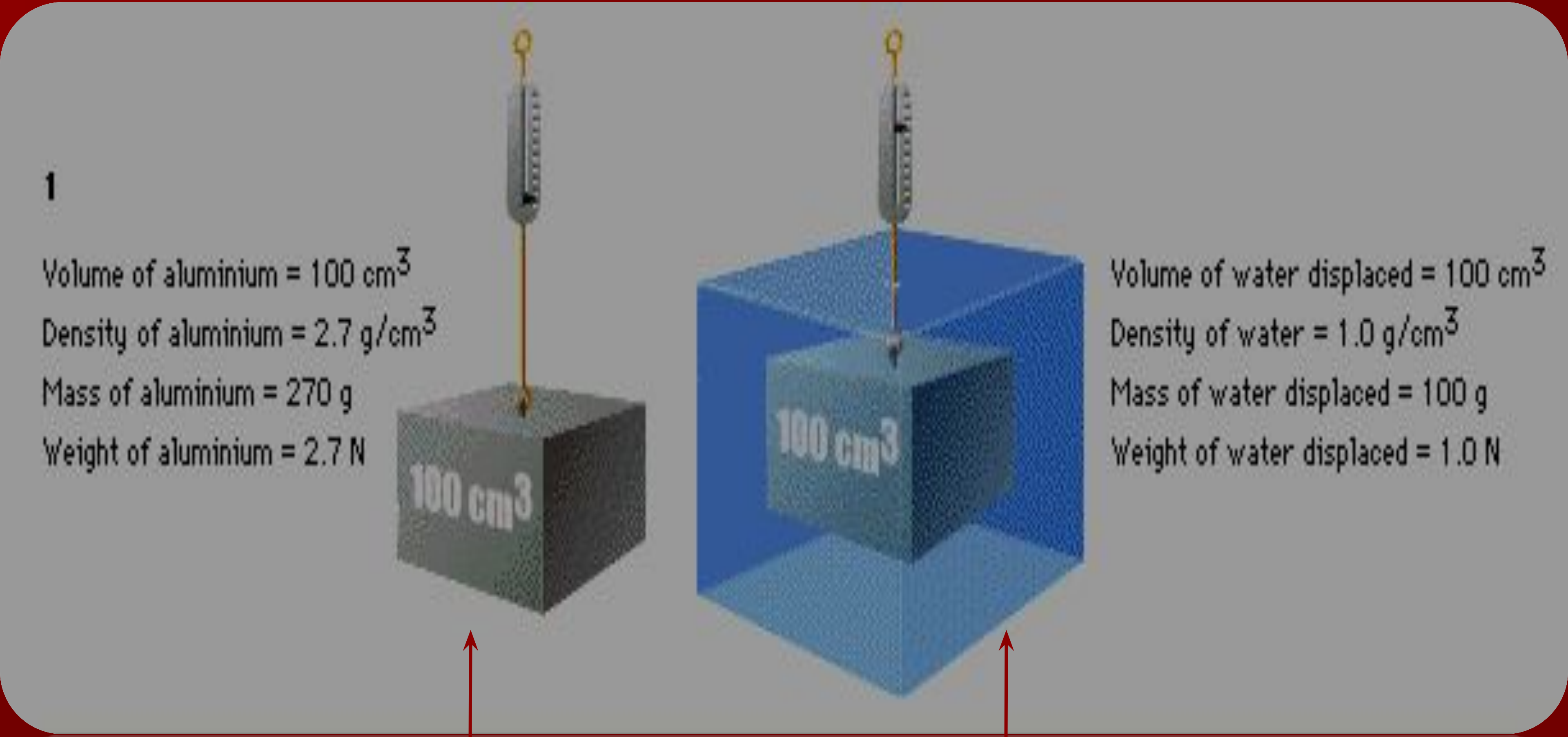
  The principle is most frequently applied to the behaviour of objects in water, and helps to explain floating and sinking, and why objects seem lighter in water. It also applies to balloons in the air.

UPTHRUST AND BUOYANT FORCE

The key word in the principle is "upthrust" (or buoyant force), which refers to the force acting upward to reduce the actual weight of the object when it is under water.

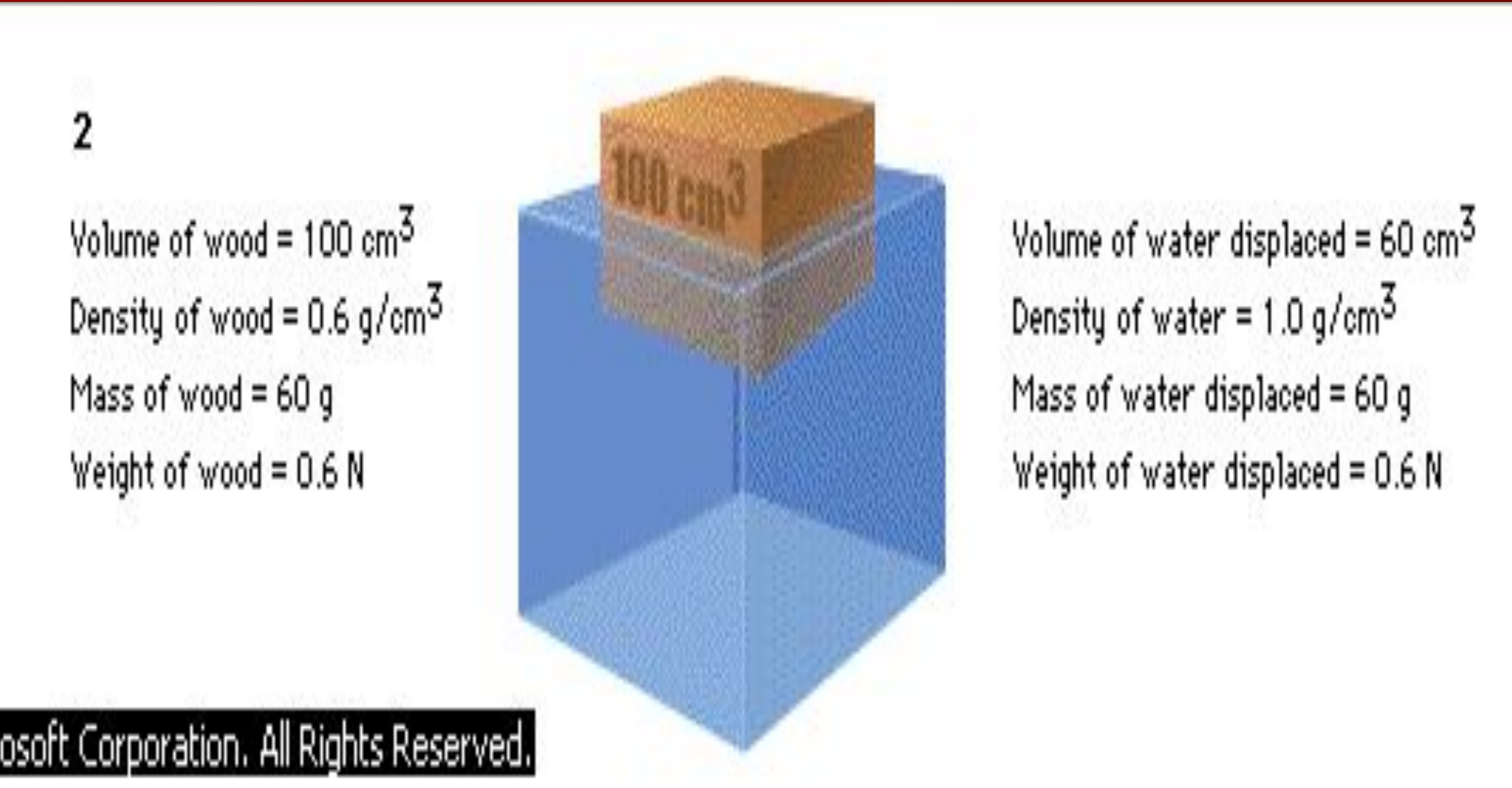


SINKING AND FLOATING OBJECTS



The reading of spring balance is 2.7 N

The reading of spring balance is 1.7 N



What is the reading of spring balance if the wood is attached to it ?

Density and Buoyancy

From Archimedes's Principle :

Buoyant Force = Weight of fluid displaced

= mg (note : F = ma)

= ρVg (note : $\rho = \frac{m}{V}$)

Thus $F_B = \rho V g$

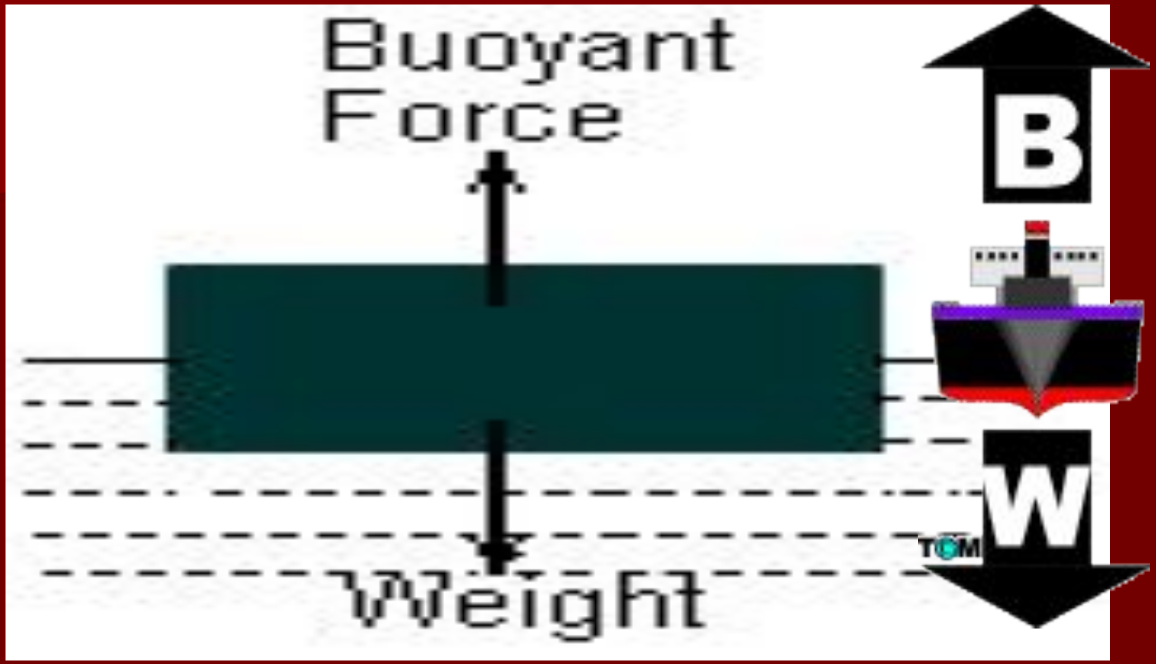
Where ……

F_B = Buoyant Force or Upthrust

ρ = Density of fluid

V = Volume of fluid displaced or the volume of the object that immersed in the fluid.

Buoyant Force and Floatation



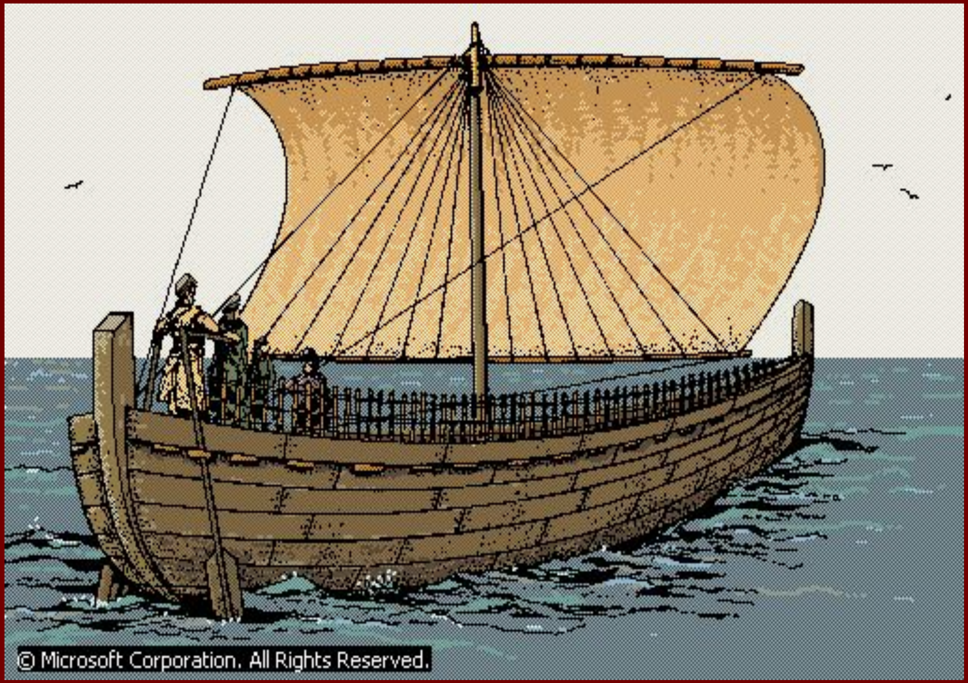
Buoyant force = weight $\Rightarrow$ the object floats and stationary

Buoyant force > weight $\Rightarrow$ the object moves up

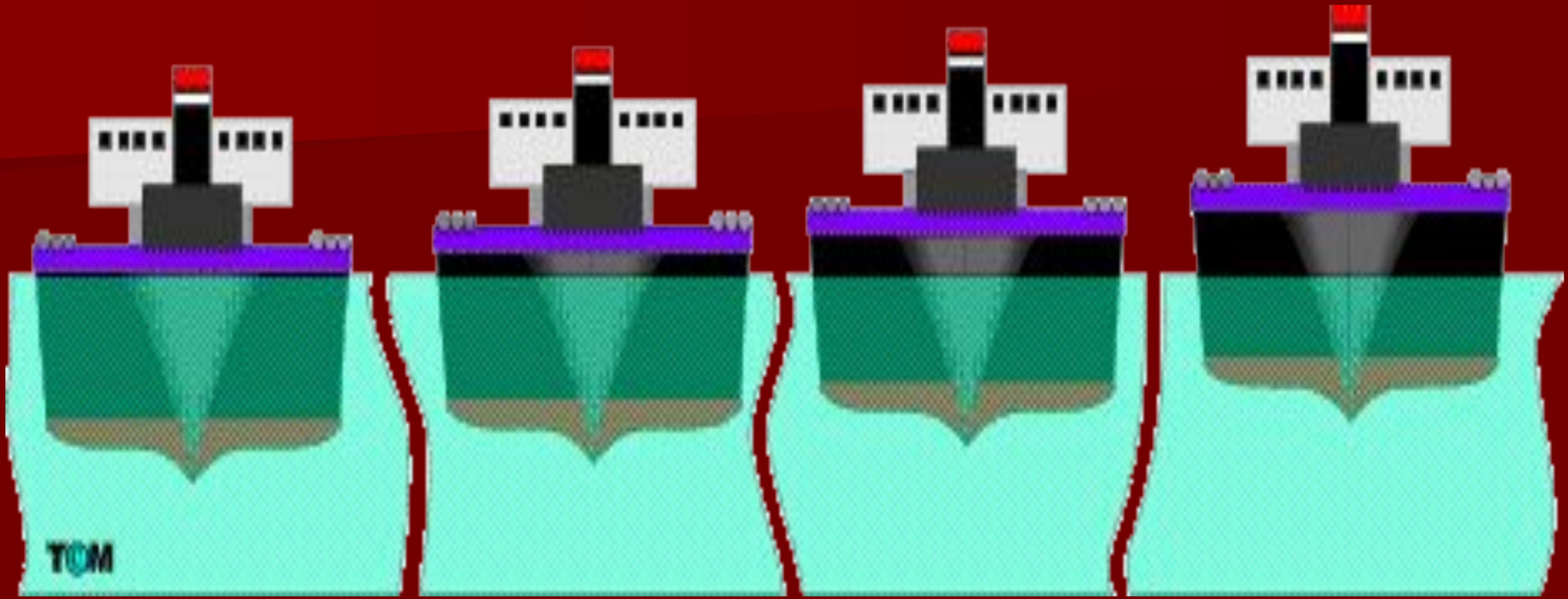
Buoyant force < weight $\Rightarrow$ the object moves down

The Law of Floatation

A floating object displaces its own weight of fluid in which it floats.



THINK!!!!!



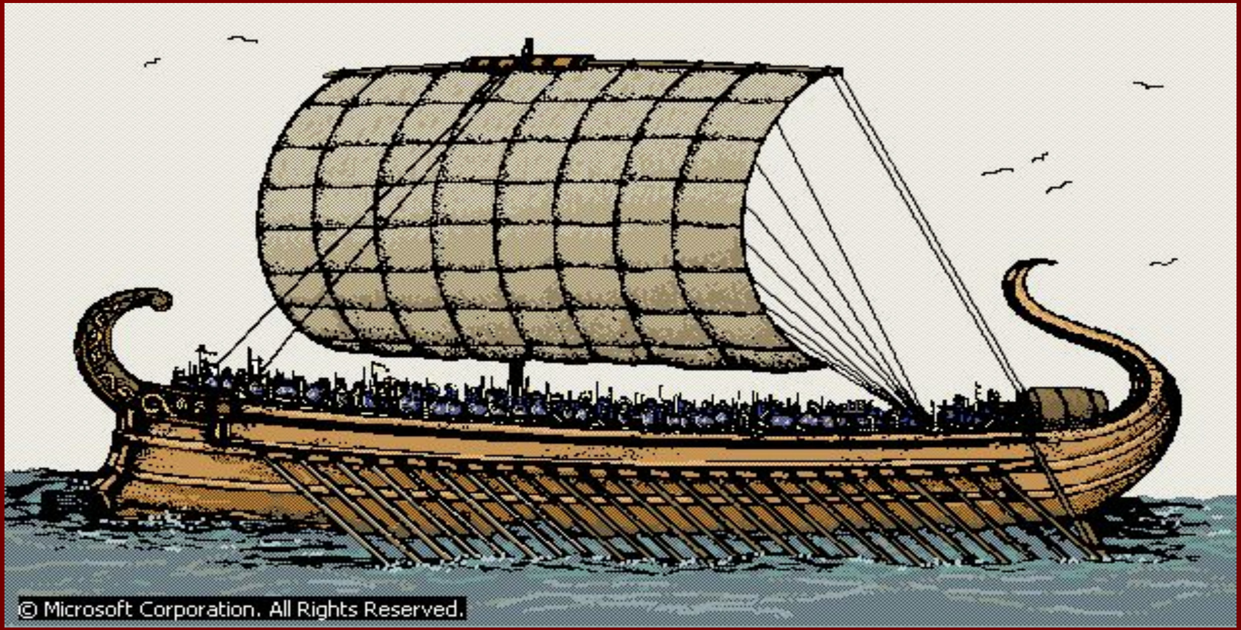
warm fresh water

cold fresh water

warm sea water

cold sea water

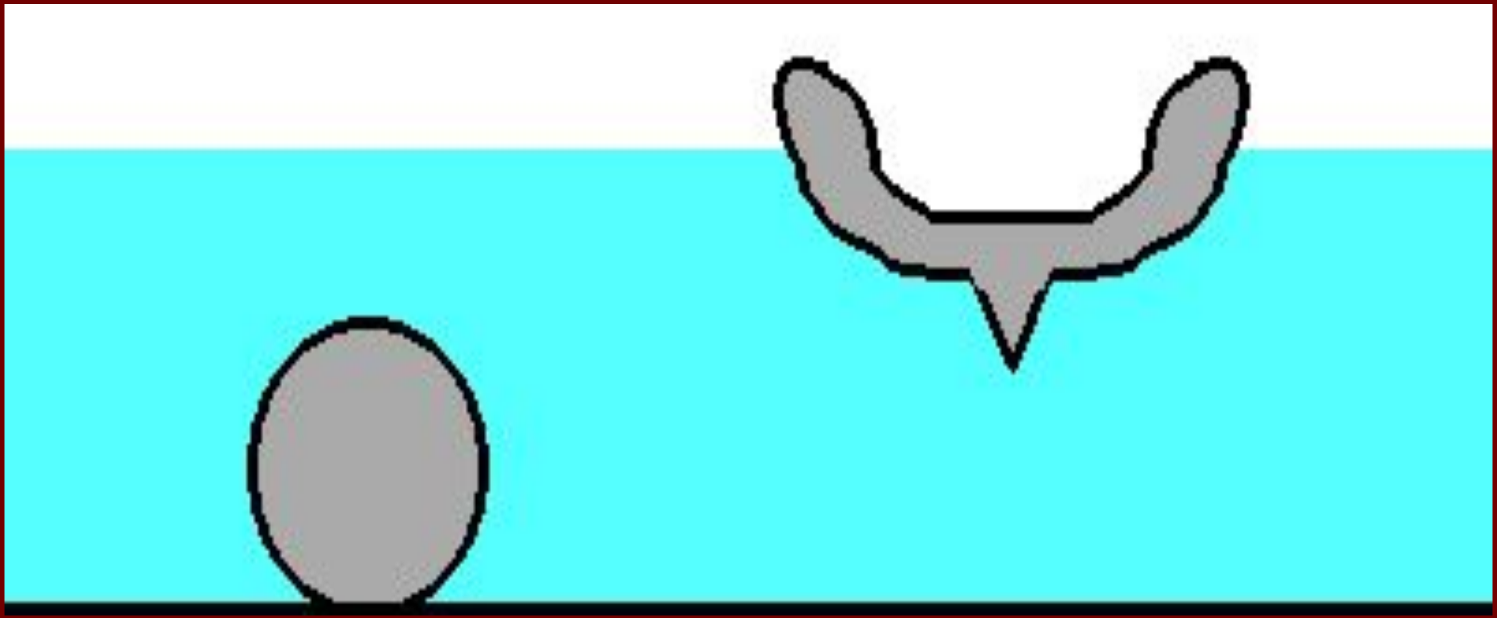
1. Why the depth of ship immersed in the water different?



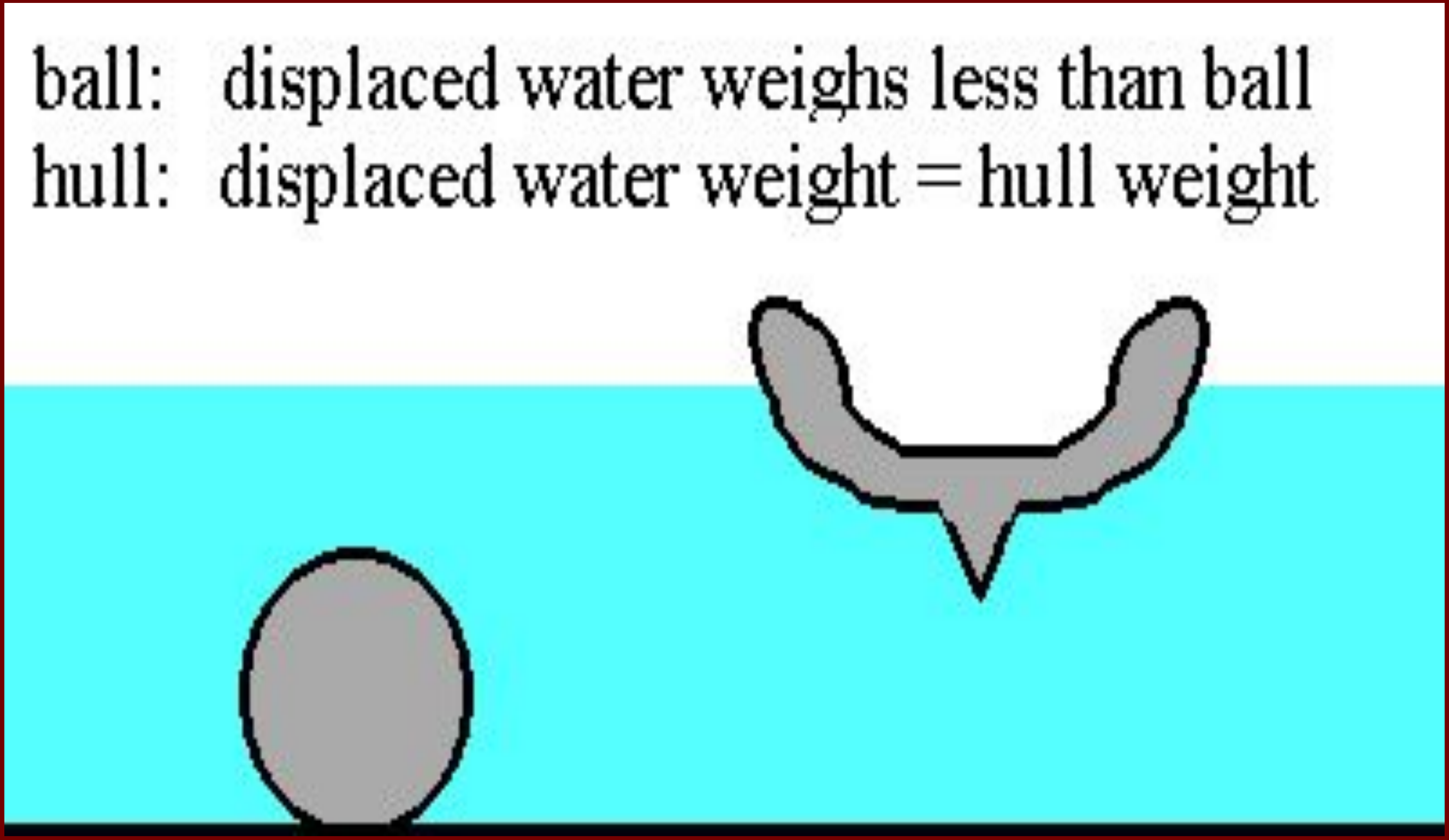
Fresh water less dense than sea water and warm water less dense than coldwater so warm fresh water need to be displaced more to keep the uptrust force equal with weight of the boat so it still can float.

2. If the plasticine is formed into a ball, it will sink. But when it is formed into a hull it will float. Why?

-



BECAUSE…..


ball: displaced water weighs less than ball
hull: displaced water weight = hull weight

APPLICATIONS

Hot air balloon

1. rises upwards

(Upthrust > Weight of hot air (helium gas) + weight of airship fabric + weight of gondola + weight of passengers.)(balloon expand)

2..descends

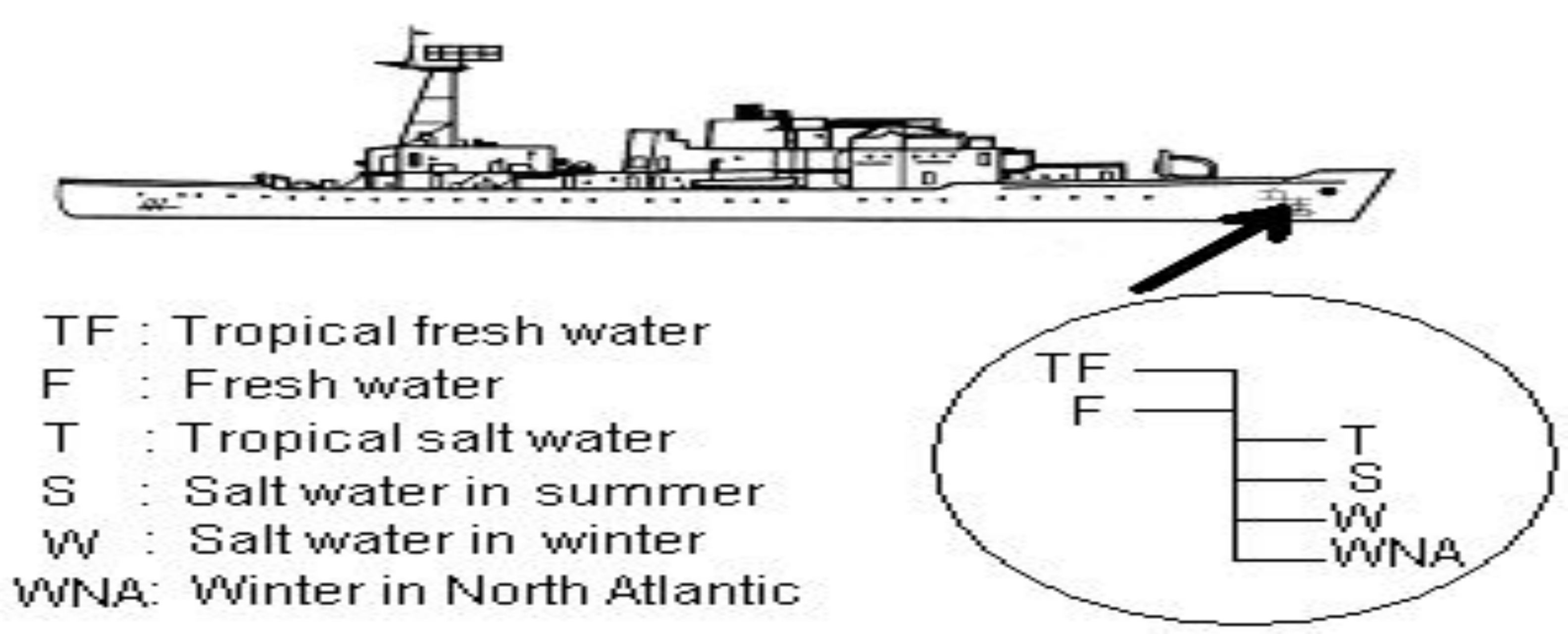
(Upthrust < Weight of hot air (helium gas) + weight of airship fabric + weight of gondola + weight of passengers.)(balloon shrinks)

3. stationary

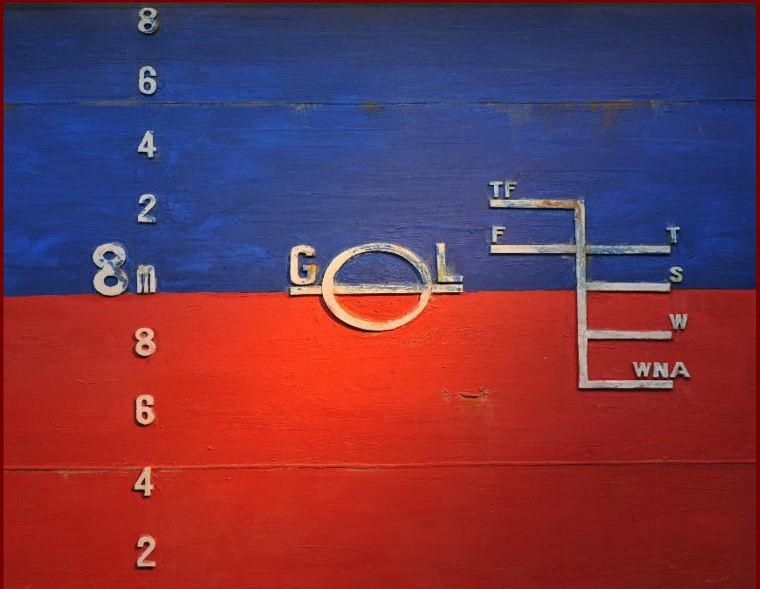
(*Upthrust* = Weight of hot air (helium gas) + weight of airship fabric + weight of gondola + weight of passengers.)(balloon size uncanged)

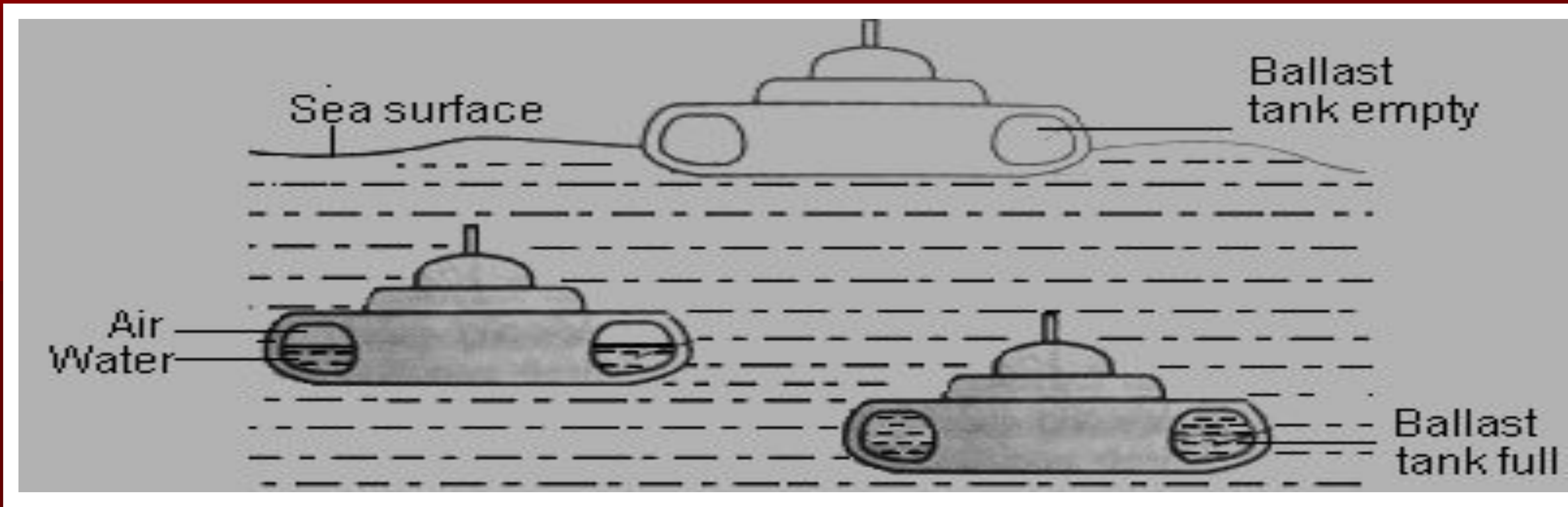
Water Bridge in Germany

PLIMSOLL LINE OF THE SHIP



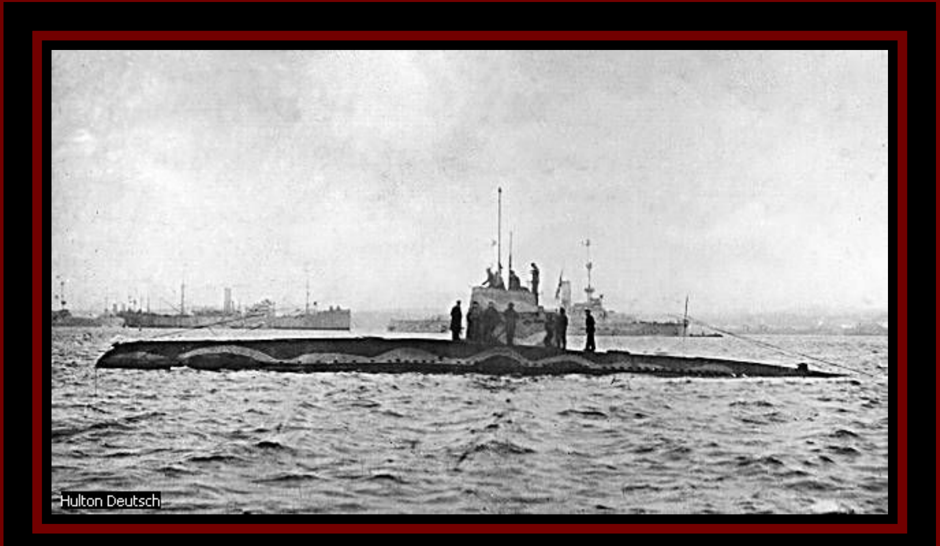
The density of sea water varies with location and season. To ensure that a ship is loaded within safe limits , the Plimsoll line marked on the body of the ship acts as a guide.



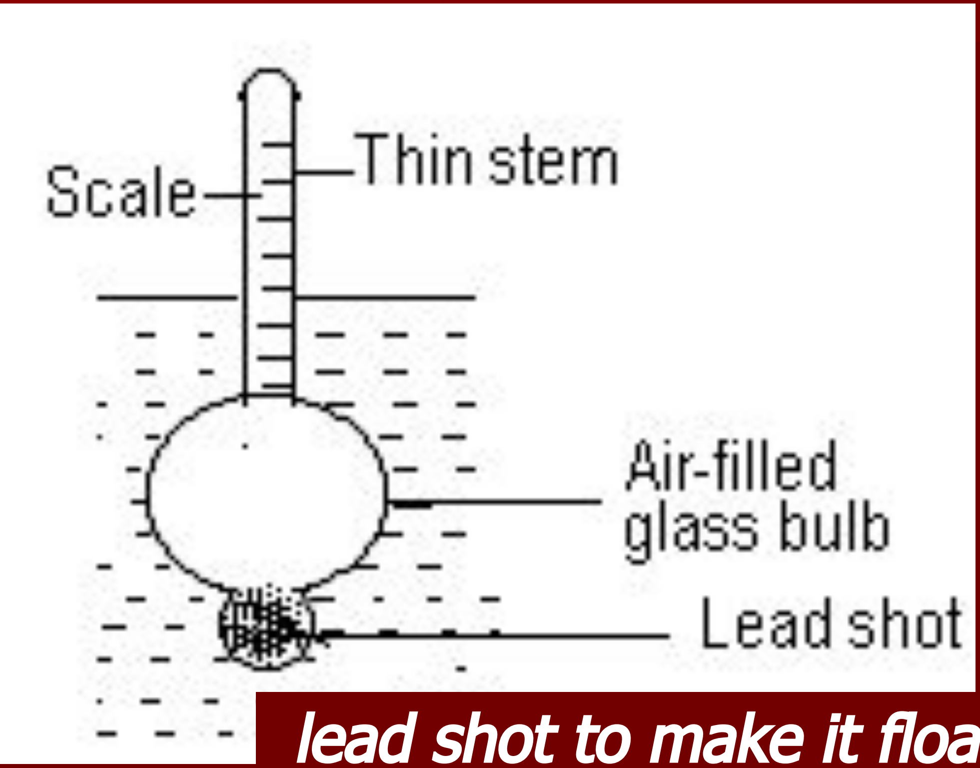


If ballast tanks empty ⇒Upthrust > weight ⇒ submarine rises to surface
If ballast tanks full ⇒ Upthrust < weight ⇒ submarine sinks to bottom

SUBMARINE



Hydrometer



An hydrometer is an instrument used to measure the density of a liquid.

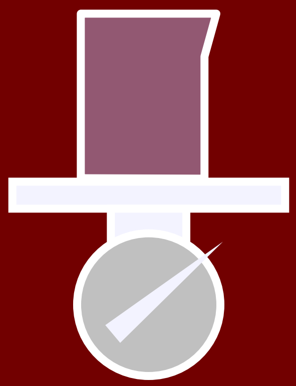
lead shot to make it float upright

In a liquid of lesser density , the hydrometer is more submerged. The hydrometer floats higher in a liquid of higher density.

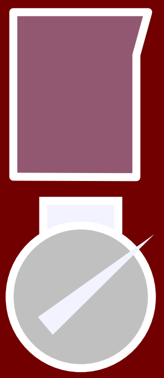
Wood in Water I

Two beakers are filled to the brim with water. A wooden block is placed in the beaker 2 so it floats. (Some of the water will overflow the beaker and run off). Both beakers are then weighed. Which scale reads a larger weight?

a



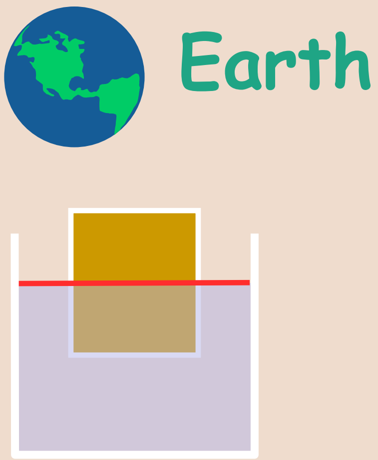
b

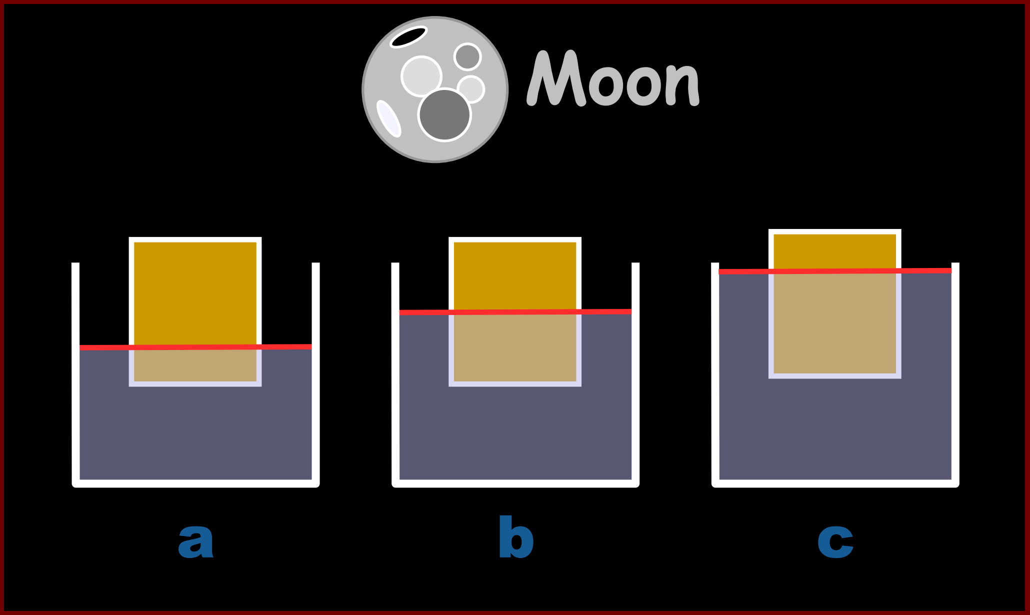


c same for both

Wood in Water II

A block of wood floats in a container of water as shown on the right. On the Moon, how would the same block of wood float in the container of water?





THE END

PHYSICS IS SIMPLY FUN