

Chapter 8-1

- Fluids and Buoyancy
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What is a Fluid?

- One property that they have in common is the ability to flow and to alter their shape.
- Liquids and gases are both fluids.
- Liquids have a definite volume and gases do not.

Density

- Density = mass / volume
- Mass density is represented by the Greek letter ρ (rho) but we'll use a capital D for density.
- SI units are kg/m^3 .

Diet Coke Versus Coke Demo



Buoyant Force

- A fluid exerts an upward force on objects that are partially or completely submerged in it. This is called buoyant force.
- Archimedes' Principle determines the amount of buoyancy:
- Any object completely or partially submerged in a fluid experiences an upward buoyant force equal in magnitude to the weight of the fluid displaced.

Changing Buoyancy

- A fish can adjust its average density by inflating or deflating an organ called the swim bladder.
- A fish fills its swim bladder with gas by gulping air at the surface.
- It empties its bladder by secreting gas from the gas gland in the swim bladder.

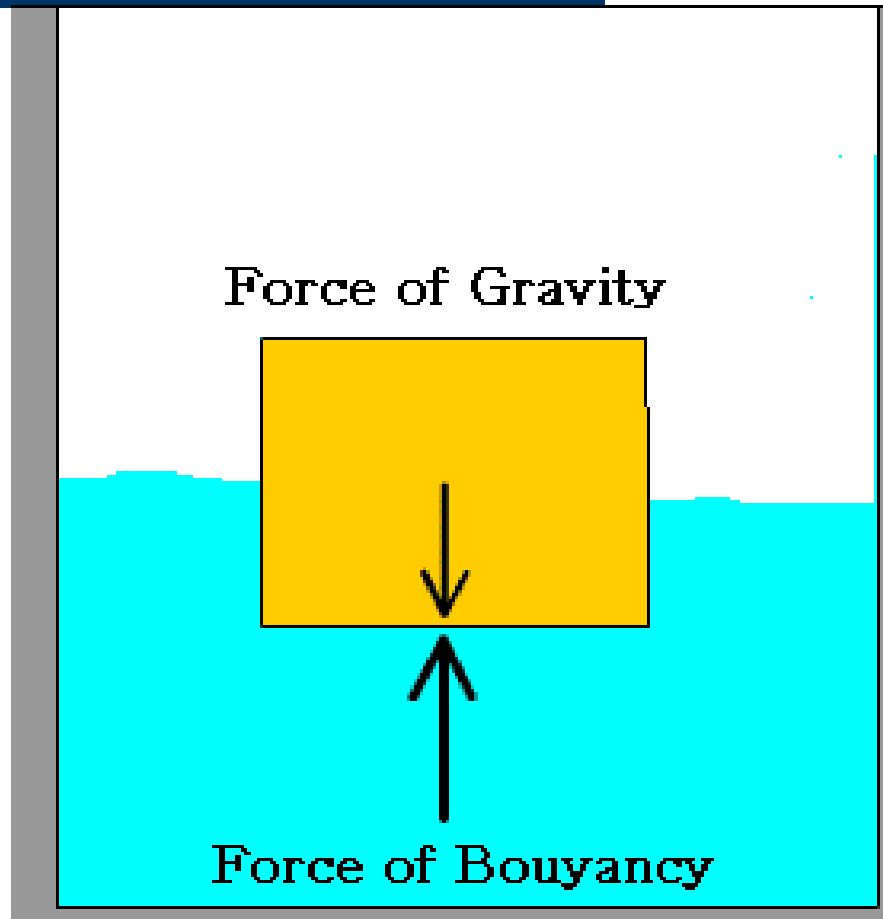
Changing Buoyancy

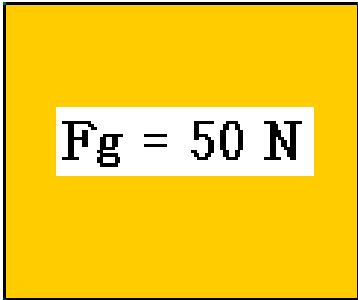
- A submarine also can change its buoyancy similar to a fish.
- Instead of a swim bladder, a sub has a ballast tank that can pump in compressed air and pump out water to rise to the surface.
- To dive, the ballast tank takes in water and pushes out the compressed air.

Equations

- If floating:

- $F_B = F_g$

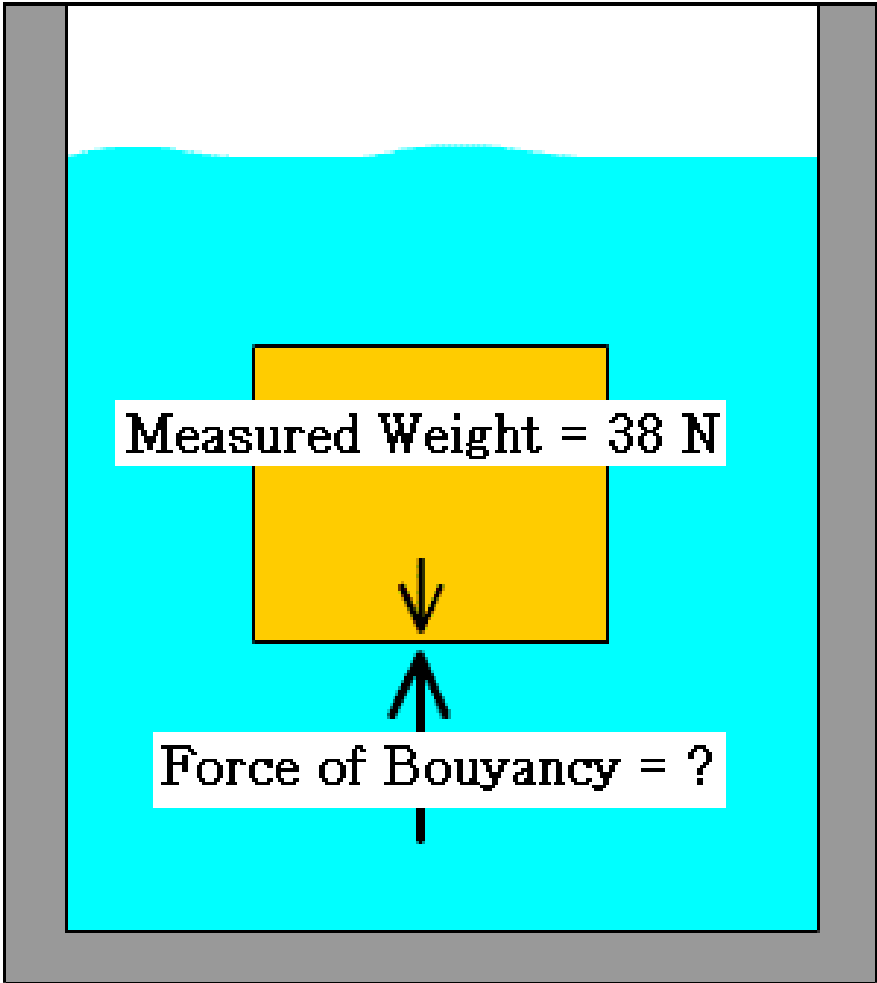




$F_g = 50 \text{ N}$

- If submerged:

- $F_B = F_g -$
apparent
weight
(measured)



Measured Weight = 38 N

Force of Bouyancy = ?

Force and Density of objects are directly related

- $F_g / F_B = D_o / D_f$
- D_o = Density of Object
- D_f = Density of Fluid
- D_f (of Water) = 1000 kg/m^3
- Density of Water is a known like gravity = -9.8

Sample Problem 9A

- To find if a gold crown is real gold, we measure it and get a weight of 7.8N . Then we stick it in a tank of water and measure it to be 6.86N . Is it gold?
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- Knowns?
- Unknown?
- Equation?

More Equations

- Weight is F_g
- $F_g = D_f V g$
- $F_B = D_f V g$ (If object is floating)
- $V = l \times w \times h$ (rectangle)
- $V = \frac{4}{3} \pi r^3$ (sphere)

Last Equation

- $M_t = (D_f V) - m_o$ (Used to find how much weight a floating object can hold)
- If I have a floating mattress or other object, the question is how much mass can the mattress or object hold before sinking?
- m_o = the mass of the floating object

Assignment

- Unit 8.1 Worksheet