Optional Extra Credit: Dec 6
5-minute presentations

Group Project: 1-4 people (can do alone if you want but graded by the same rubric, incentive to work on your groupwork skills)

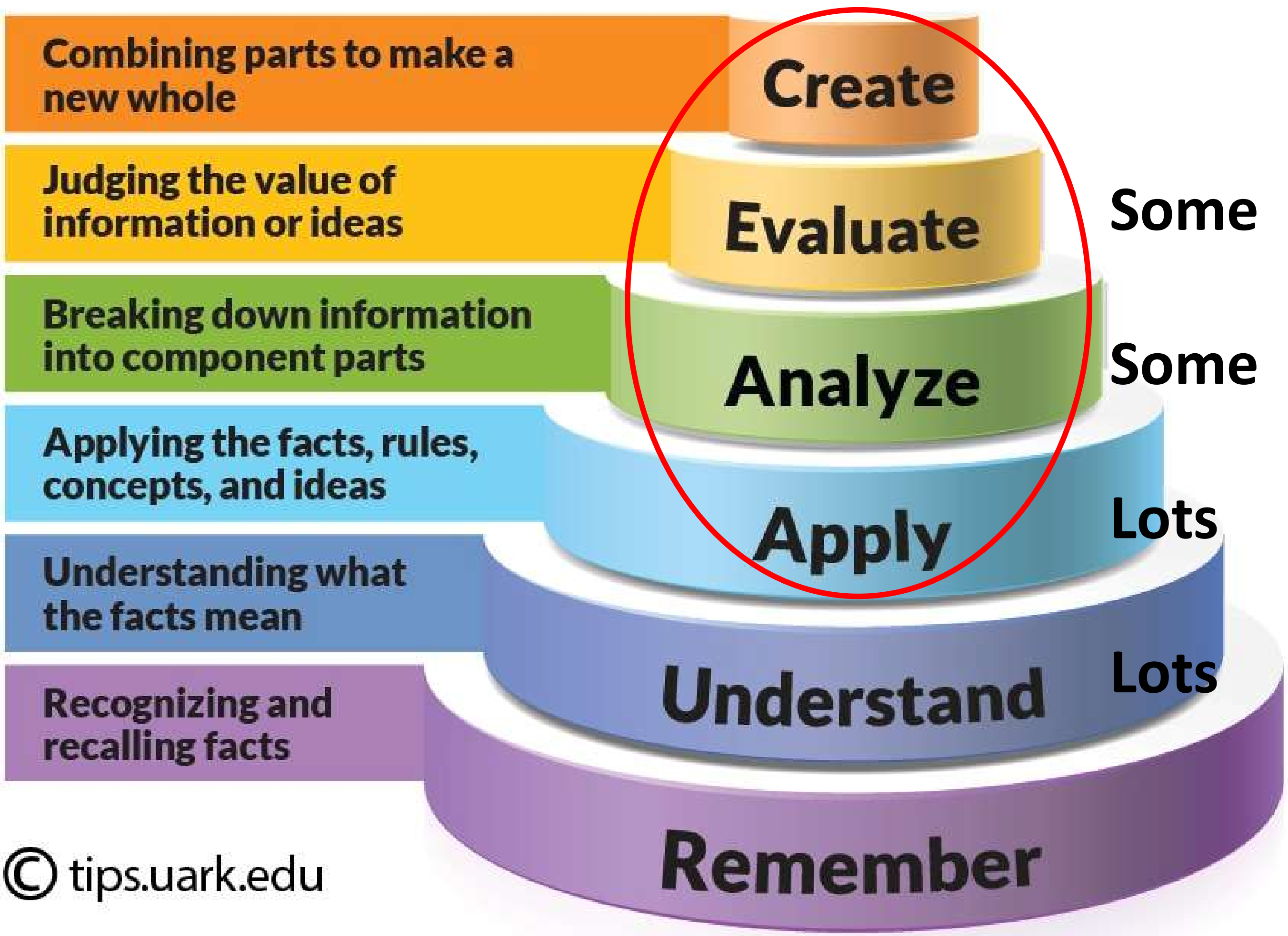
Graded based upon in-class presentation (see syllabus for detailed rubric)

You are to pick some movie/tv/tiktok/etc scene where you question whether the scene could physically happen. You should do calculations based on what we learned in class to analyze if it was depicted correctly.

Compare to information you find online.

Raising Our Learning

This assignment gives you practice in applying physics to more real-world like examples.



Some

Some

Lots

Lots

	Competent	Proficient
Preparedness	Had to access files from Google Drive or other. **Don't email to me.**	Came with flash drive of PPT or had other notes
Grammar and Typos	Some grammatical errors or typos, but they did not significantly affect understandability.	Few if any grammatical errors and/or typos. In the real world, everything you turn in should look professional.
Description of the Scene	Most of the scene is clearly explained, but there are some minor details skipped that could affect how the calculations should be approached.	Based upon your description, it is very clear what is going on in the scene.
Appropriateness	N/A (I am outlawing the bus/bridge scene in the movie Speed, October Sky and the circular bullet scene in Wanted.)	You followed the directions above about picking a scene related to class material and not obviously possible or impossible (e.g. easy sports or people flying)
Formulas Provided	Most of the needed formulas have been provided, but some are missed and/or unnecessary.	All of the formulas and only the appropriate formulas needed to calculate the scene have been provided.
Approach	There are only minor approach problems.	There are no problems with the approach.
Identify variable(s) to solve for	You have identified a variable(s), but this only tells you if the scene is precisely accurate (such as distances or times), and not if the scene could even occur	At least one variable is identified as what you will solve for to determine if the scene can occur in real life. (Generally that variable is not time, though you may need to solve for it to get something else.)
How you will find out if variable(s) reasonable	While you mention the comparison of your result to something you'll find online or in literature, no plan for searching for this information or range of possible results is given.	You discuss how you will determine if your selected variable(s) are actually achievable. This determination is either based on things that can be found in papers, or based on more calculations.
Estimations	Variables in need of estimation are mentioned. Some minor variables might be left out.	Any variables that need to be estimated are mentioned as well as how estimations will be made.
Understandable	A few minor things were unclear.	Your explanation of the calculations were easy to follow.

For a MAX of 10 extra points on the final Poor/incorrect attempts will get much fewer points

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Show of hands, how many people think they might do this?

How many people would like to do it as a group project?

How many people like the idea of a group, but don’t know who to work with?


Main Ideas Today:
Pressure with depth
Buoyancy

When a dense object (or any object) pushes against you, it applies pressure (or stress).

Pressure = Force / Area

Unit of pressure is **pascal** (Pa) $1\ \text{Pa} = 1\ \text{N/m}^2$

Pressure depends on the area over which the force is spread

(Also known as stress in solid materials, as in section 9.10.)

Pressure & Depth

- Fluids have pressure that varies with depth
  - Assume the density is the same throughout the fluid

Reminder: P = Force / Area

Pressure & Depth

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- If a fluid is at rest in a container, all portions of the fluid must be in static equilibrium $\sum \vec{F} = 0$

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  - Otherwise, the fluid would move (not equilibrium)

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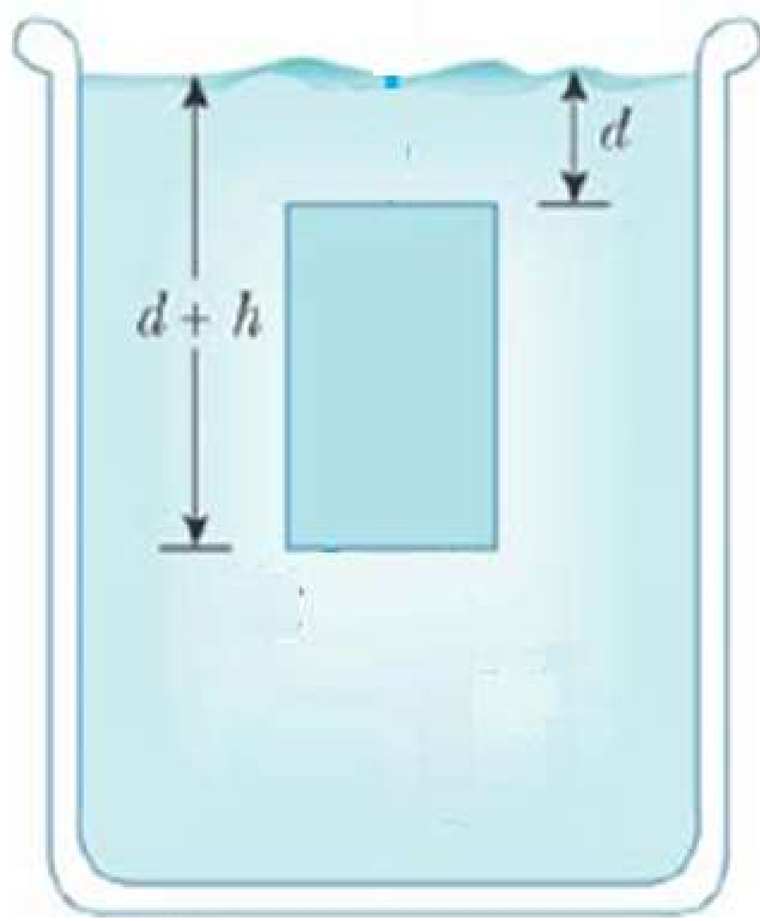
- Examine the darker region, a sample of liquid within a cylinder
  - It has a cross-sectional area A
  - Extends from depth d to $d + h$ below the surface



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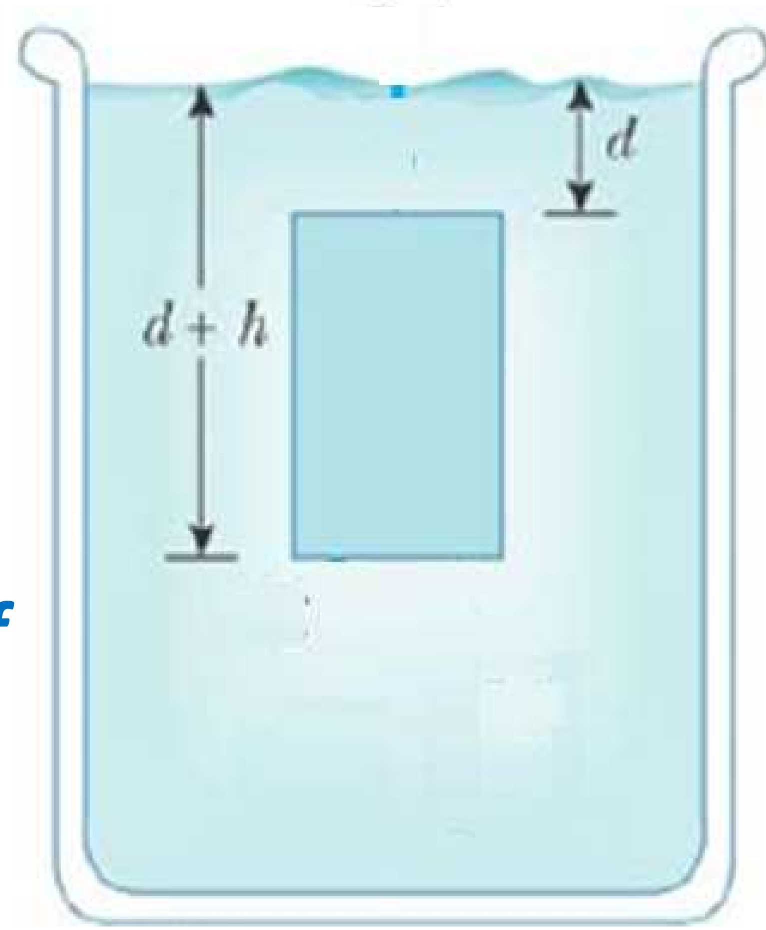
- Examine the darker region, a sample of liquid within a cylinder
  - It has a cross-sectional area *A*
  - Extends from depth *d* to *d* + *h* below the surface

Area *A* coming out at you *(hidden)*

What forces act on this box of liquid?



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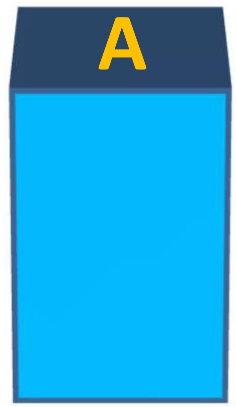
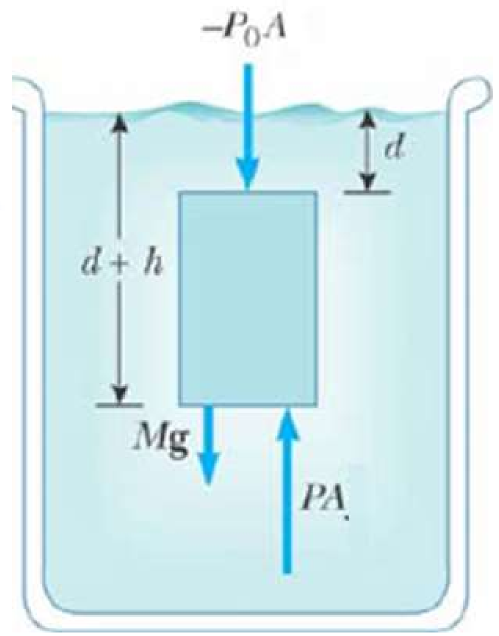
Pressure & Depth

$$P = F/A \text{ or } F=PA$$





- The three forces are: *(vertical direction)*
  - Gravity acting downward, Mg

Pressure & Depth

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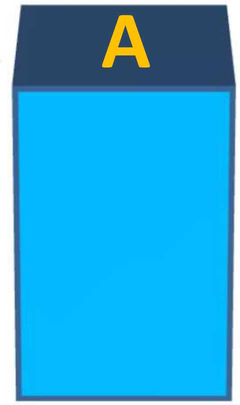
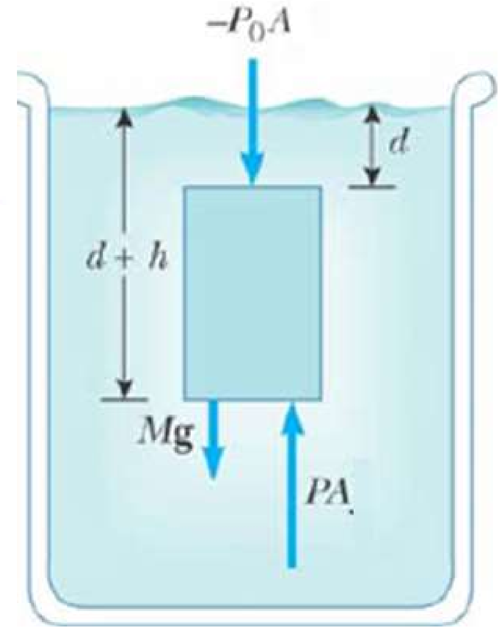




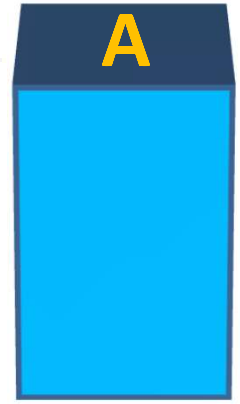
- The three forces are: *(vertical direction)*
  - Downward force on the top, P_0A
  - Upward on the bottom, PA
  - Gravity acting downward, M**g**

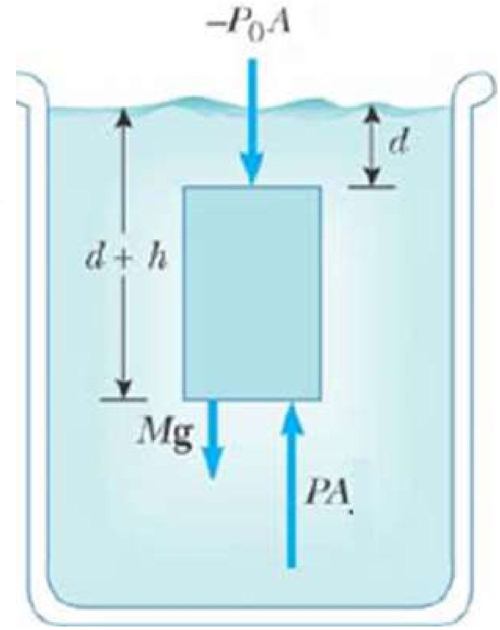
- Since the net force must be zero:
  - This chooses upward as positive

$$\Sigma F_y = 0 = PA - P_o A - Mg$$

Pressure & Depth

P = F/A or F=PA





- The three forces are: *(vertical direction)*
  - Downward force on the top, P_0A
  - Upward on the bottom, PA
  - Gravity acting downward, $M\mathbf{g}$
    - The mass can be found from the density: $M = \rho V = \rho A h$

- Since the net force must be zero:
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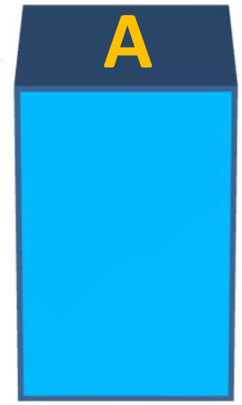
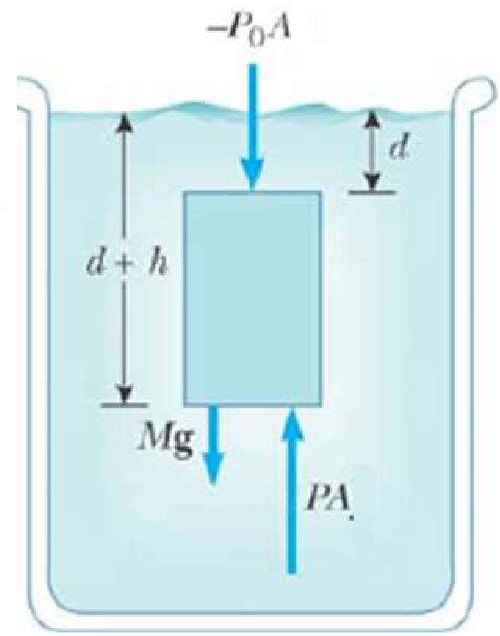
$$\Sigma F_y = 0 = PA - P_oA - Mg$$

$$0 = PA - P_oA - \rho Ahg$$

Pressure & Depth

$$P = F/A \text{ or } F = PA$$





- The three forces are: *(vertical direction)*
  - Gravity acting downward, Mg
- Since the net force must be zero:
  - This chooses upward as positive

$$\Sigma F_y = 0 = PA - P_oA - Mg$$
$$0 = PA - P_oA - \rho Ahg$$

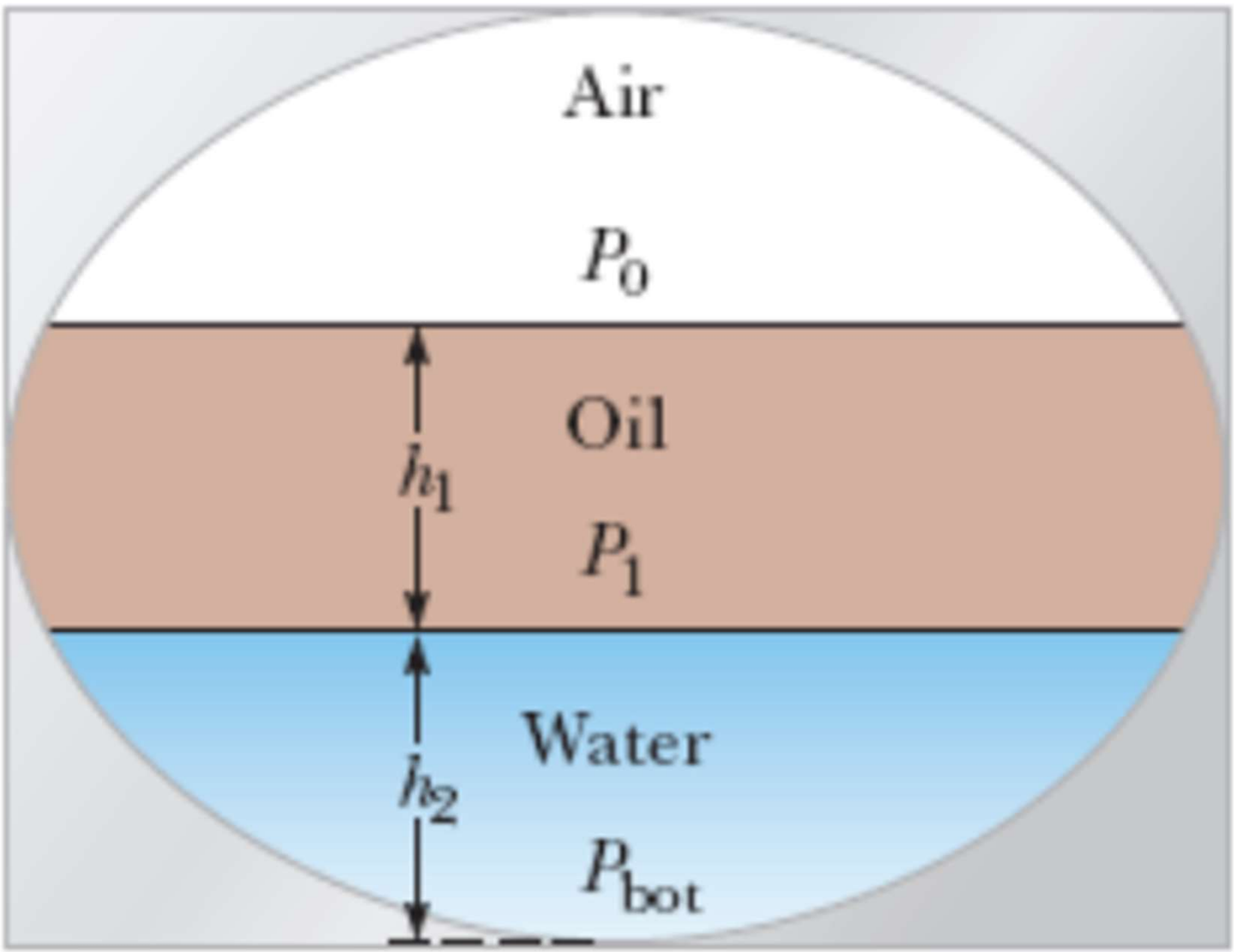
- Solving for the pressure gives
  - $P = P_0 + \rho gh$
- The pressure P at a depth h below a point in the liquid at which the pressure is P_0 is greater by an amount ρgh

Pressure at Bottom of Lake

Calculate the absolute pressure at the bottom of a freshwater lake at a depth of 27.5 m. Assume the density of the water is 1000 kg/m^3 and the air above is at a pressure of 101.3 kPa.

Homework Hint

You have to break it up. Formula only applies where density is constant.



Or

Air

Water

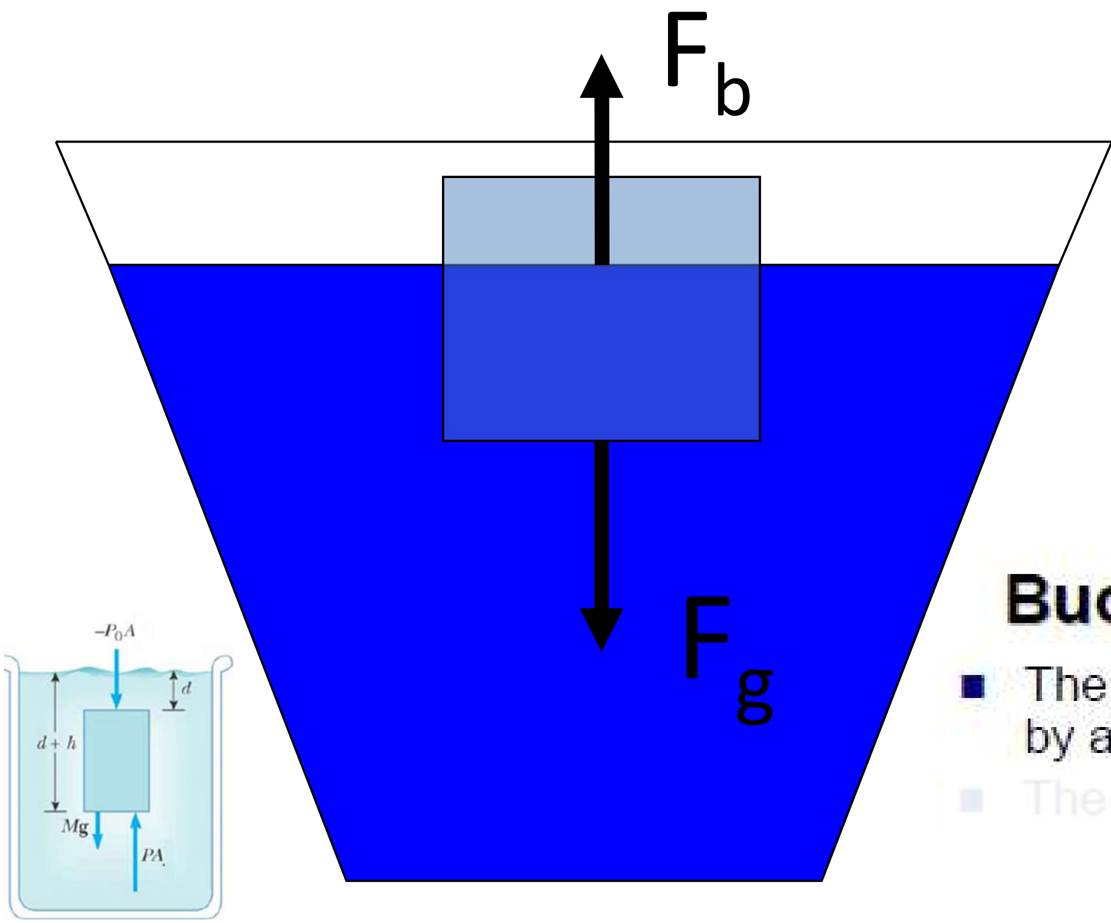
Mud

Good Ideas Come To You When Relaxed

- https://www.youtube.com/watch?v=ijj58xD5fDI

Archimedes' Principle

If the weight of the displaced fluid equals the weight of the object, the object floats.



$$F_b = F_g$$

Floating Object Only

Buoyant Force

- The **buoyant force** is the upward force exerted by a fluid on any immersed object
- The parcel is in equilibrium

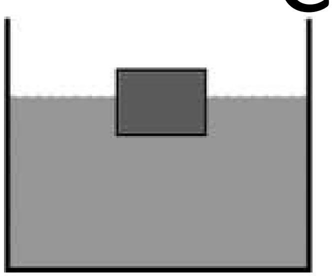
$$F_b = W_{FluidDisplaced}$$

Any object <u>completely or partially</u> submerged in a fluid is buoyed up by a force equal to the weight of the fluid displaced.

Two blocks (A and B) have the same size and shape. Block A floats in the water, but Block B sinks in the same water. Which block has the larger buoyant force on it?

$$F_b = W_{FluidDisplaced}$$

A. Block A has the larger buoyant force on it.
B. Block B has the larger buoyant force on it.
C. Neither; they have the same.
D. Not enough information



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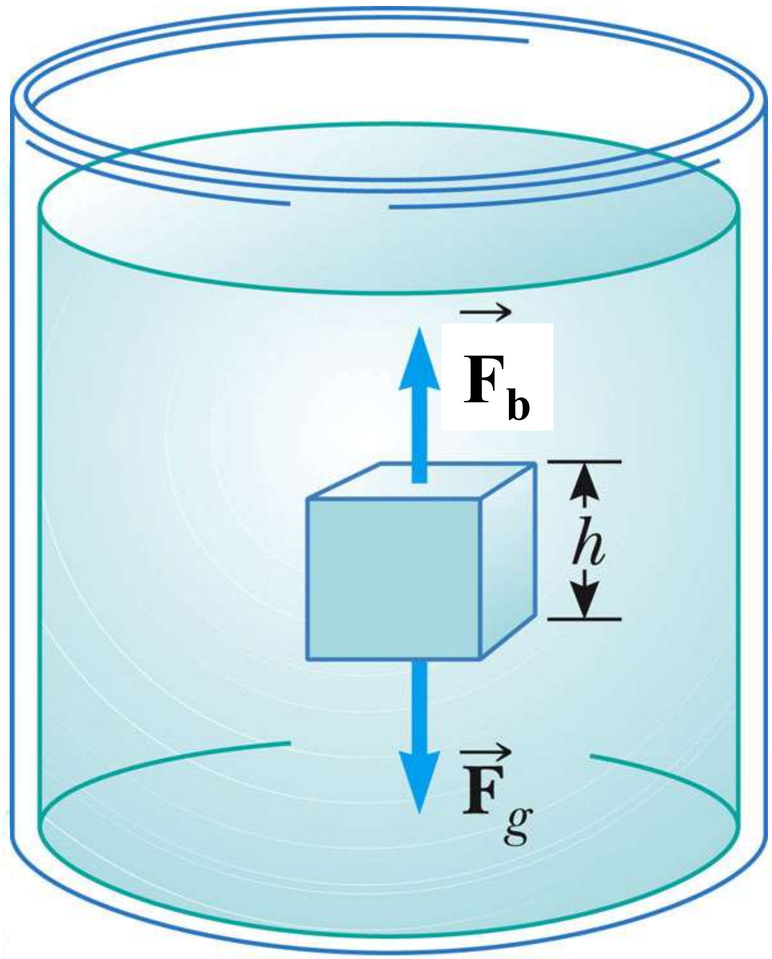
Archimedes's Principle

$$\rho = M / V$$

- The magnitude of the buoyant force always equals the weight of the fluid displaced by the object $F_b = M_{WaterDisplaced}\, g = \rho_{fluid}\, gV$

- Archimedes's Principle does not refer to the makeup of the object experiencing the buoyant force

Two ways to find F_B

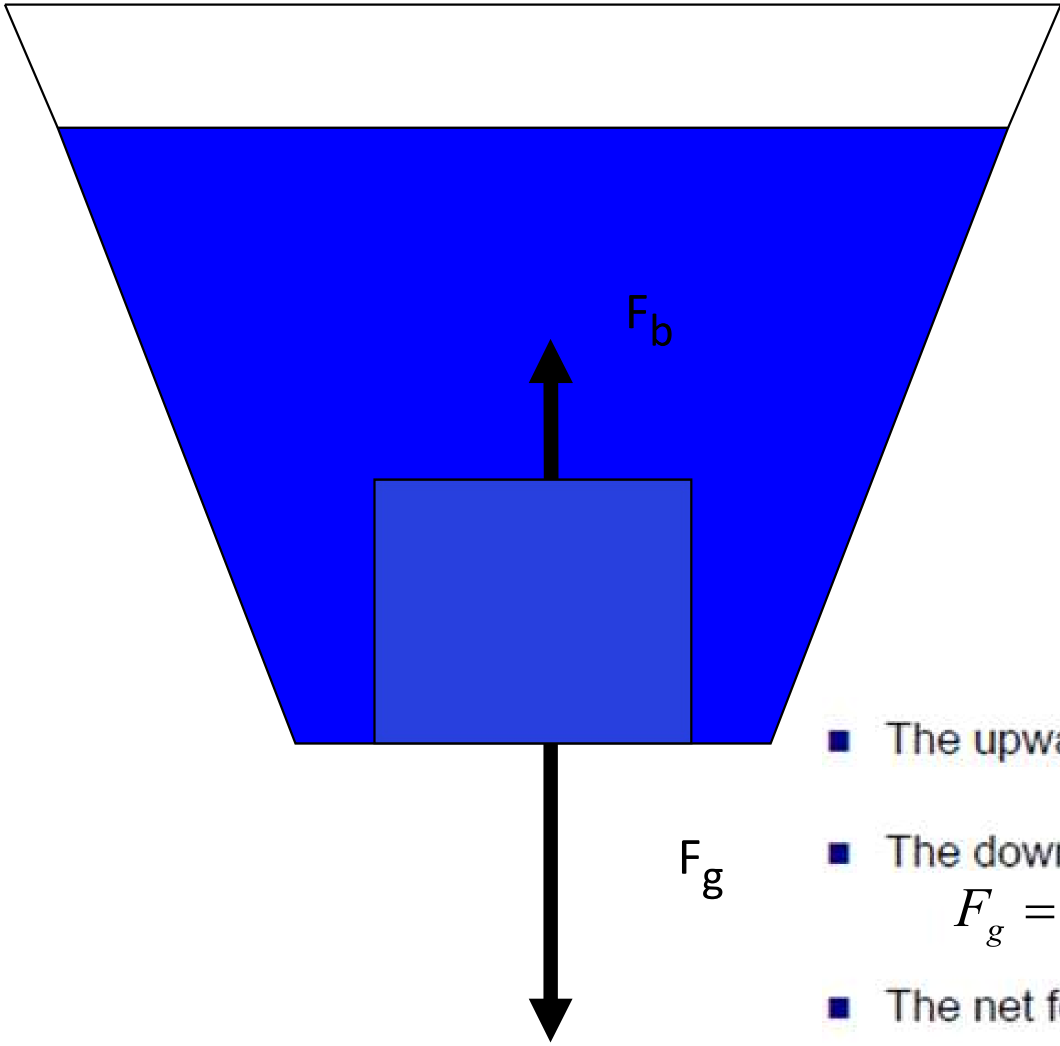


As stated before:

$$F_b = (P_b - P_t)A = \rho_{fluid} V . g$$

If the weight of the displaced water is less than the weight of the object, the object sinks.

Therefore, if the average density of the object is more than the density of water, it sinks.

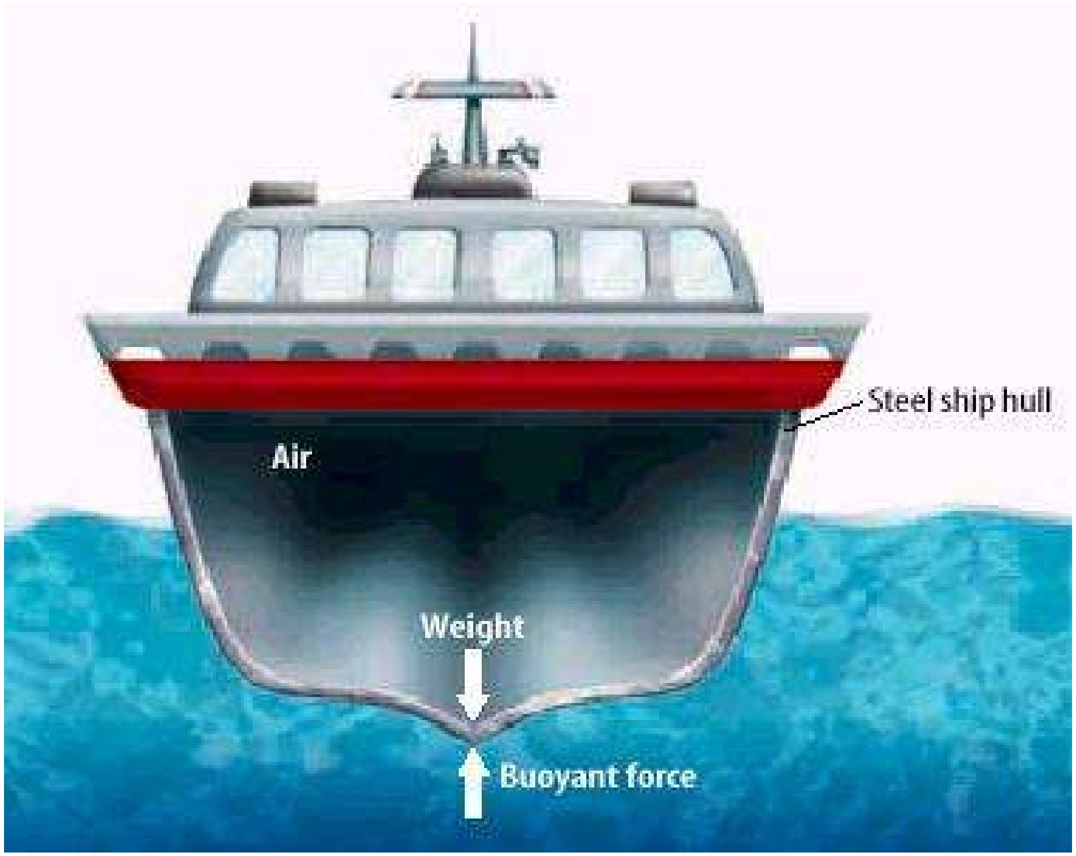


$F_g > F_b$

Object sinks

- The upward buoyant force is $F_b = \rho_{fluid} g V = \rho_{fluid} g V_{object}$
- The downward gravitational force is $F_g = \rho_{object} g V_{object}$
- The net force is $F_b - F_g = (\rho_{fluid} - \rho_{object}) g V_{object}$

How can a steel ship float?



The hull contains mostly air and displaces a lot of water...enough so that $F_b = F_g$ and it floats.

Summary for a **Floating Object**

- Object in equilibrium
- Buoyant force is balanced by force of gravity
- Volume of the fluid displaced corresponds to volume of the object beneath the fluid level

$$F_b = F_g$$

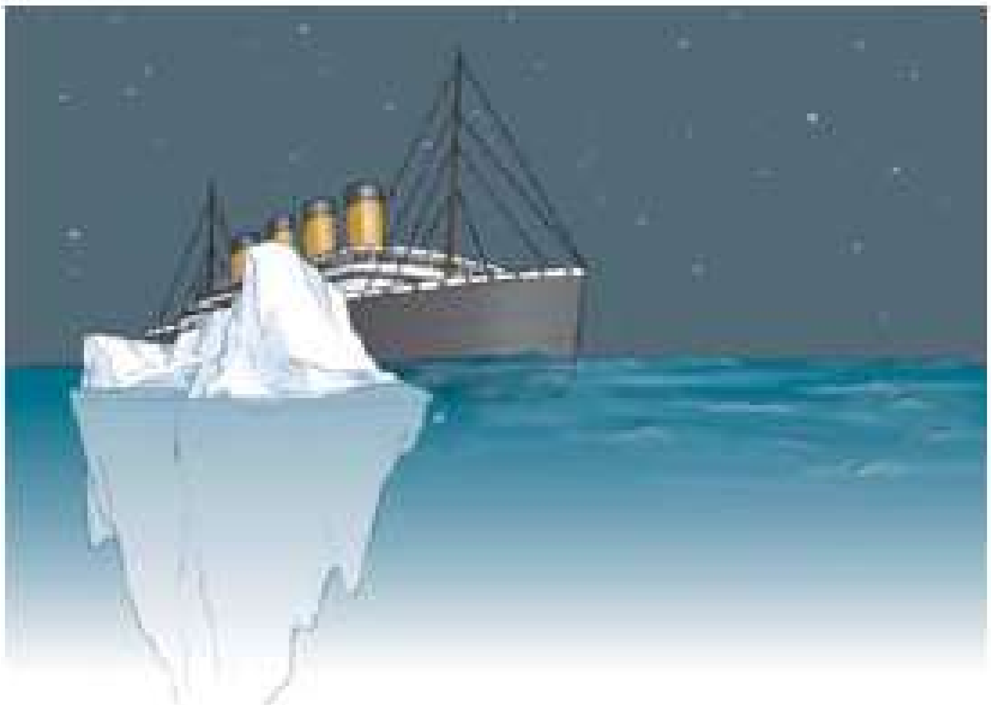
$$\rho_{fluid} g V_{fluid} = \rho_{object} g V_{object}$$

% submerged

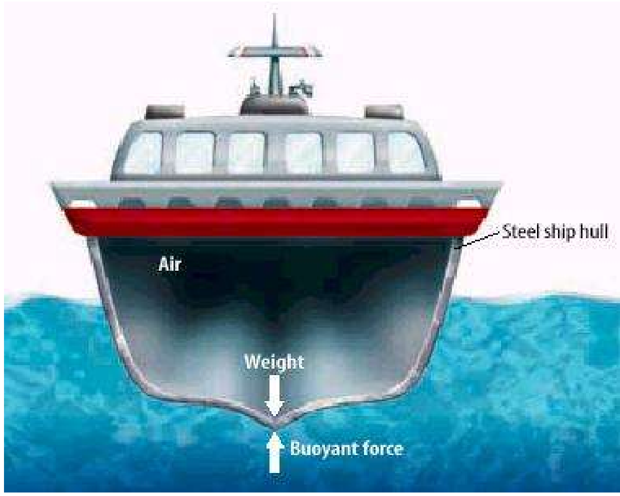
$$\frac{V_{fluid}}{V_{object}} = \frac{\rho_{object}}{\rho_{fluid}}$$

Archimedes's Principle,
Iceberg Example

- What fraction of the iceberg is below water?



Past Homework Floating Object



The average human has a density of 945 kg/m^3 after inhaling and 1020 kg/m^3 after exhaling. Without making any swimming movements, what percentage of the human body would be above the surface in the Dead Sea (a lake with a water density of about 1230 kg/m^3) after inhaling and after exhaling?

$$\frac{\rho_{fluid}}{\rho_{object}} = \frac{V_{object}}{V_{fluid}}$$

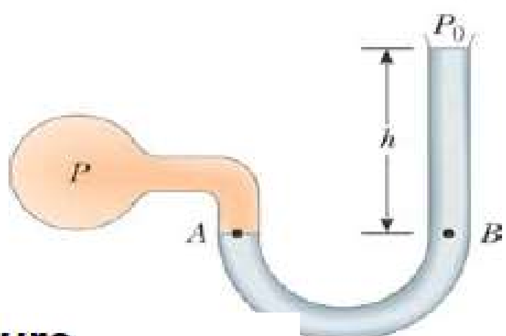
You hold a 0.54 kg rubber ball with a diameter of 25 cm just below the water's surface in your swimming pool. With what force do you have to apply to keep the ball from popping back up above the water?

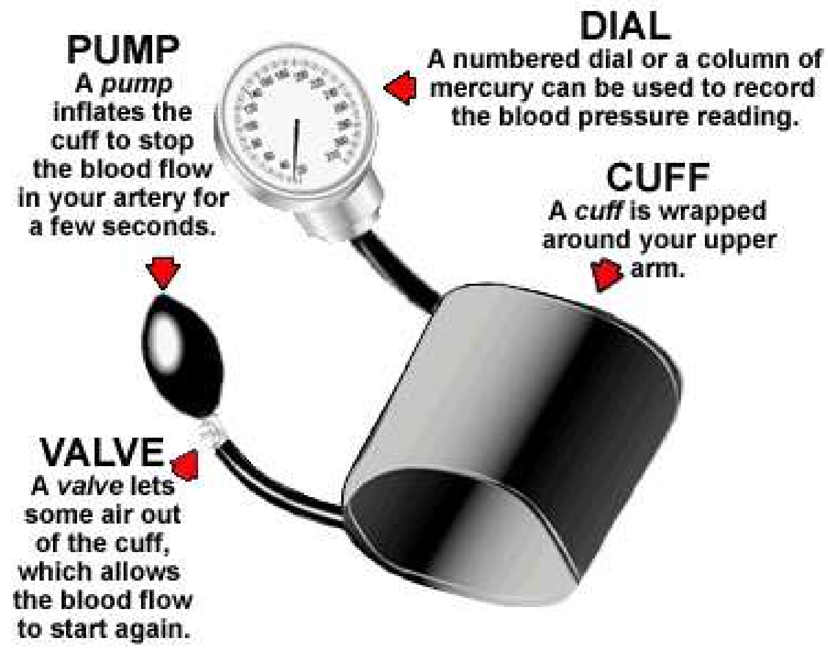
Density of freshwater = 1000 kg/m^3

Pressure Measurements:

Manometer

- A device for measuring the pressure of a gas contained in a vessel
- One end of the U-shaped tube is open to the atmosphere
- The other end is connected to the pressure to be measured
- Pressure at B is $P_0 + \rho g h$





Absolute vs. Gauge Pressure

- $P = P_0 + \rho g h$
- P is the **absolute pressure**
- The **gauge pressure** is $P - P_0$
  - This is also $\rho g h$
  - This is what you measure in your tires

Absolute versus gauge pressure is not on the test