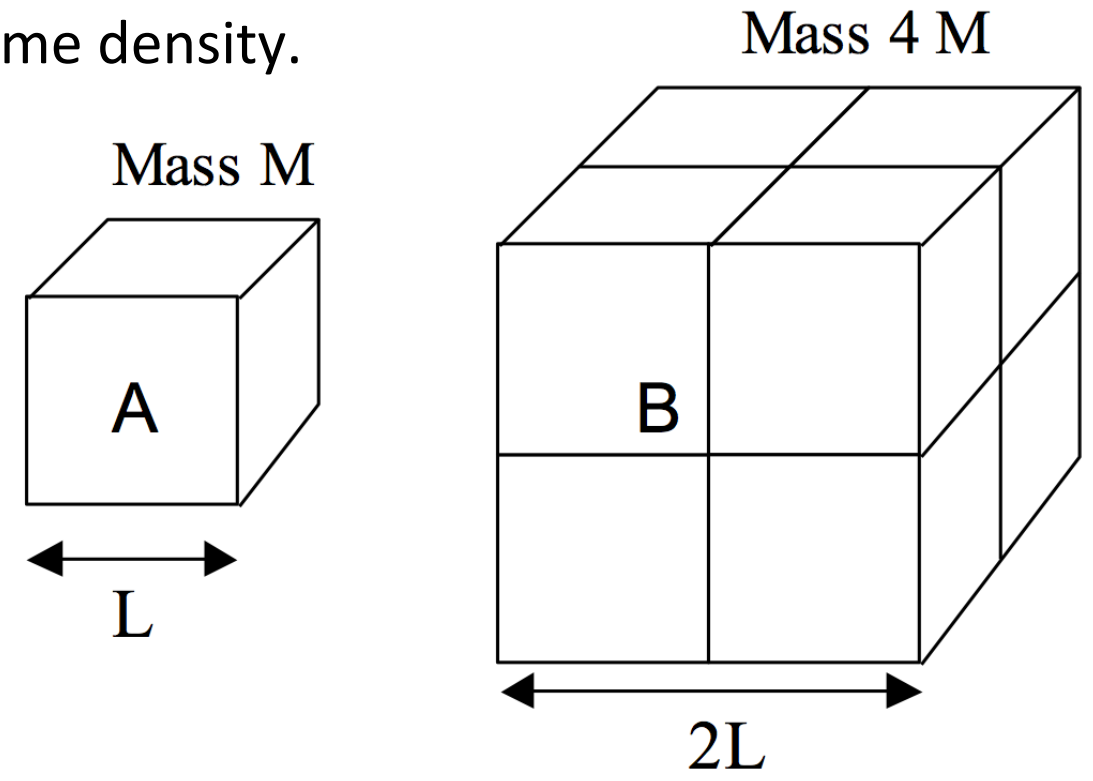
13-1) Cube A has edge length L and mass M. Cube B has edge length 2L and mass 4M. Which has greater density?

A) A has larger density

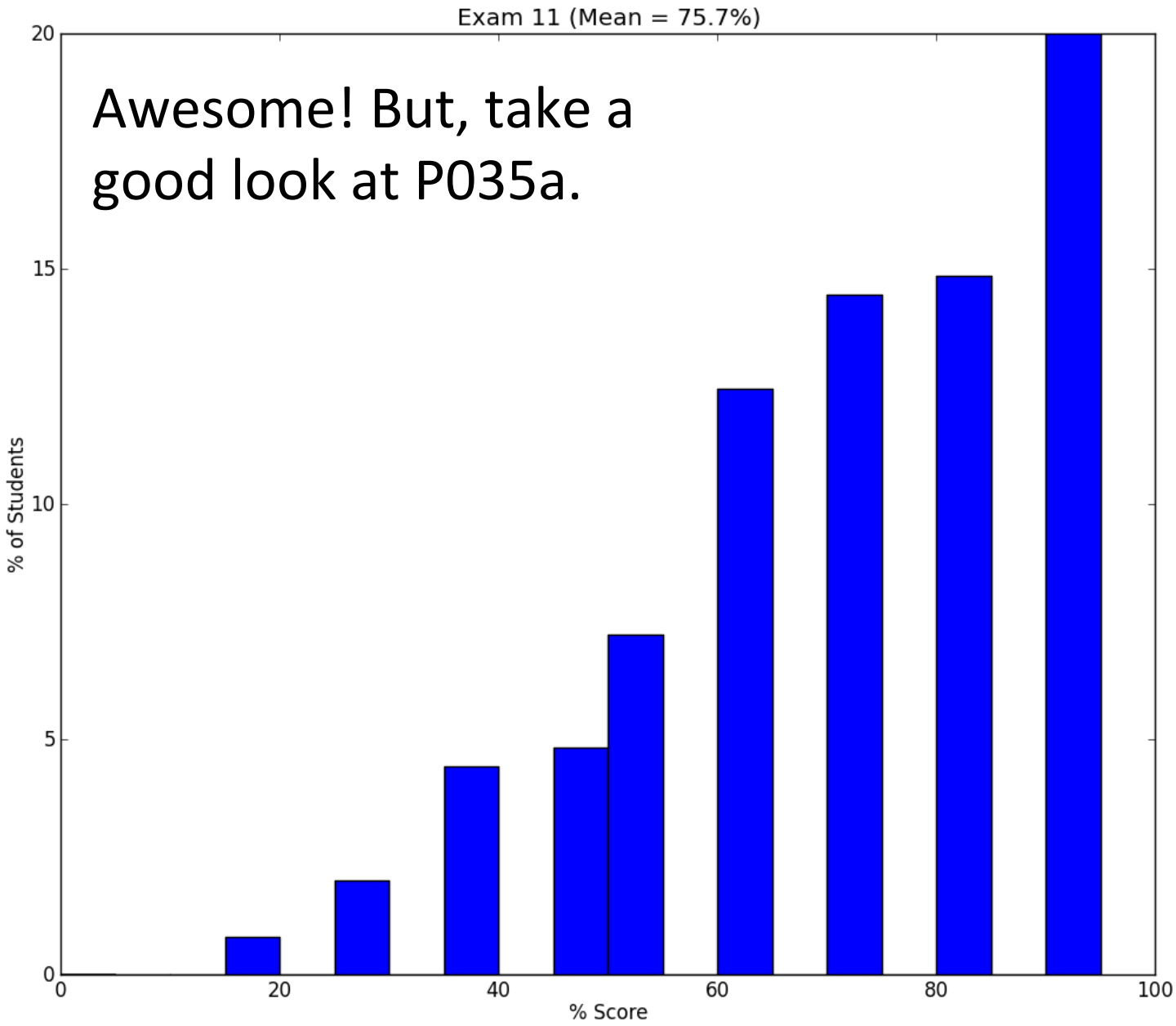
B) B has larger density

C) A and B have the same density.



Announcements

- Final Exam, Thursday Dec. 12th, 8pm-10pm
  - Will include Oscillations and Waves
- Exam 12 is Monday of Thanksgiving week (no makeup)
- Student survey posted (I don't see your responses.) (For us, due with HW 12 and counts as HW)
- Official end-of-course survey online starting Nov 25
  - https://sirsonline.msu.edu
- Optional feedback survey coming soon
  - "What would you suggest to a student taking our class who wants to do well?"


Exam 11 (Mean = 75.7%)
Awesome! But, take a good look at P035a.
% of Students
% Score
0
5
10
15
20
0
20
40
60
80
100

Nobel Prize for University Teaching?

Prof. Steve Pollock (CU Boulder) named
the Carnegie Foundation's
2013 U.S. Professor of the Year

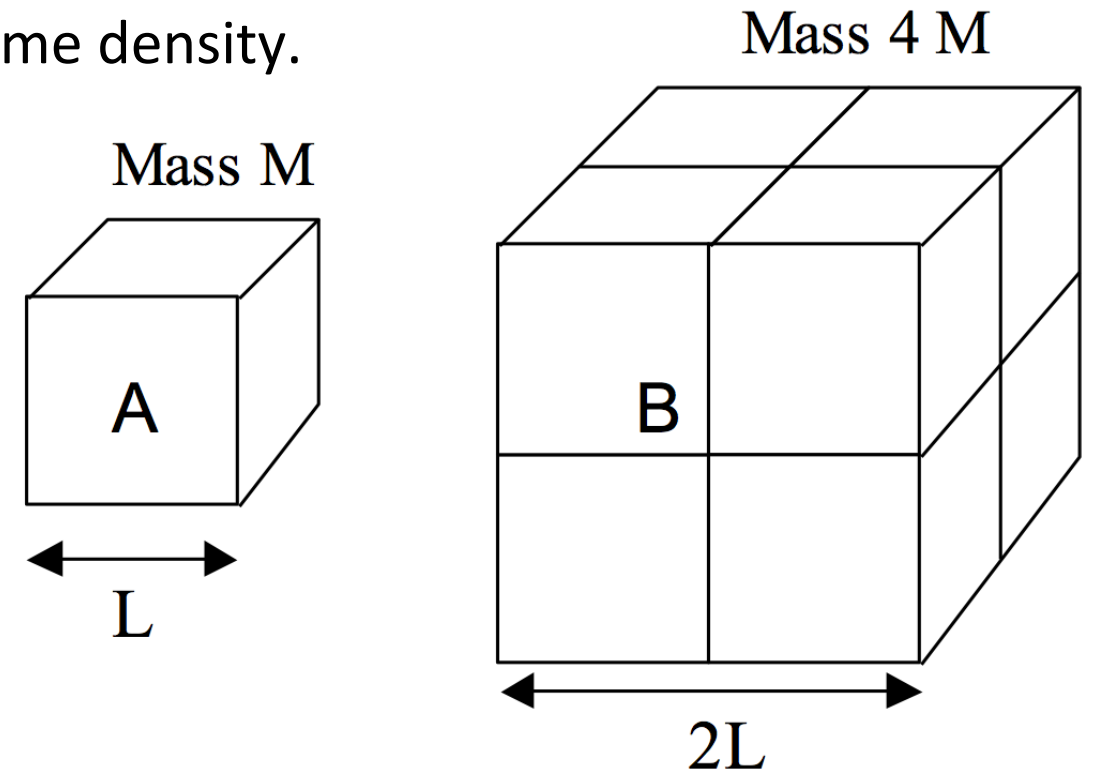
"I care a lot about every student in my class, from introductory non-majors to advanced students. Some of them start out dreading physics, and it's a real pleasure watching them turn on to the topic. It's wonderful to help people see that physics is about their life, that physics is relevant to their future, that it's interesting, a powerful way of examining the world around them, and that they can do it."

13-1) Cube A has edge length L and mass M. Cube B has edge length 2L and mass 4M. Which has greater density?

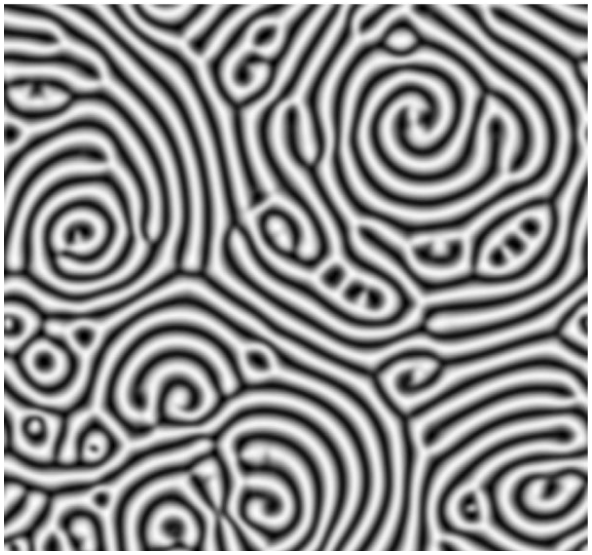
A) A has larger density

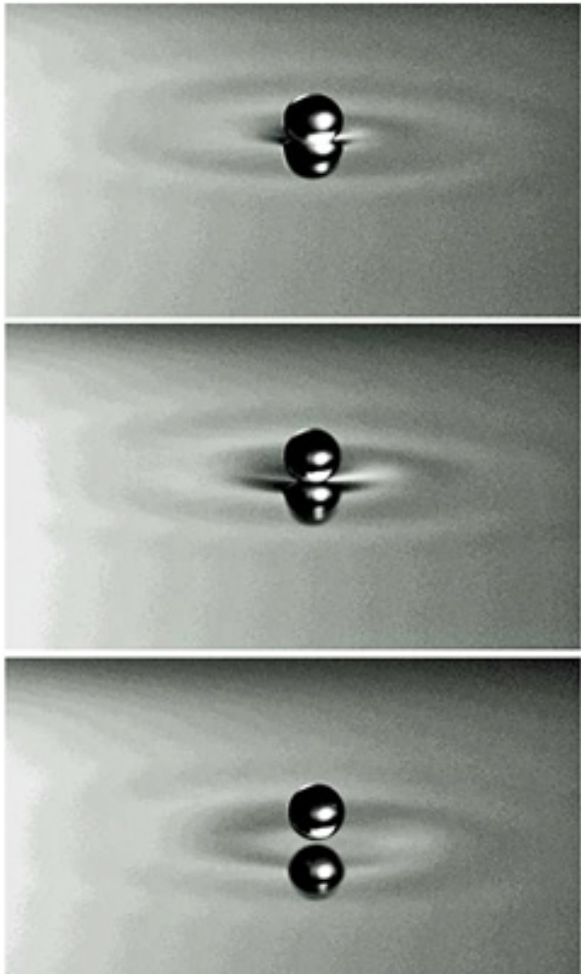
B) B has larger density

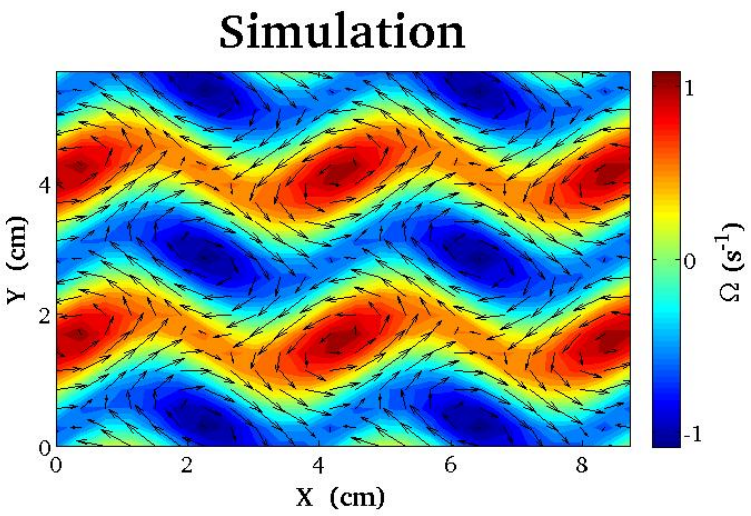
C) A and B have the same density.



Fluids

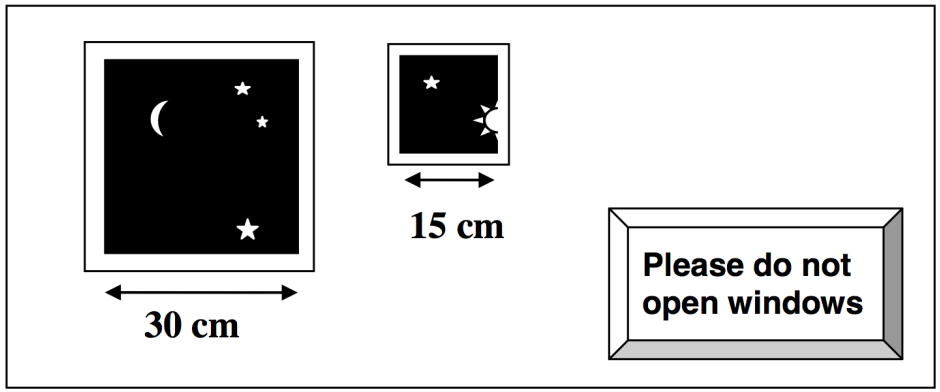






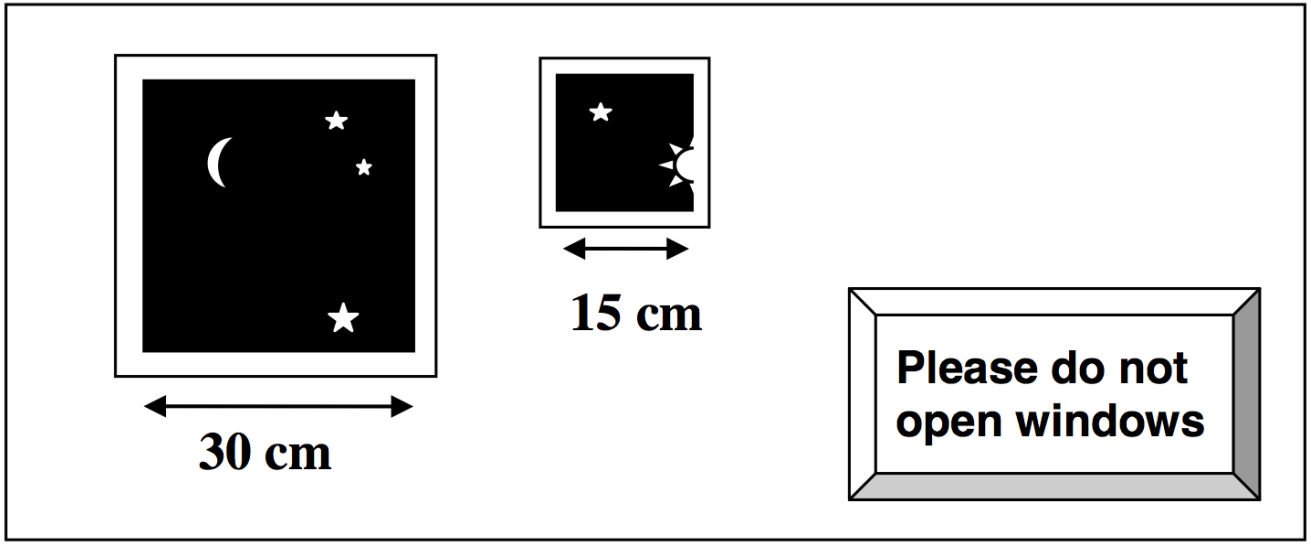
13-2a) The air pressure inside the Space Station is p = 12 pounds per square inch = 12 psi. There are two square windows in the Space Station) a little one and a big one. The big window is 30 cm on a side. The little window is 15 cm on a side. *How does the pressure on the big window compare to the pressure on the little window?*

A) same pressure on both windows
B) 2 times more pressure on the big window
C) 4 times more pressure on the big window
D) 9 times more pressure on the big window
E) None of these



13-2b) How does the force acting on the big window compare to the force acting on the little window?

A) same force acts on both windows
B) 2 times more force acts on the big window
C) 4 times more force acts on the big window
D) 9 times more force acts on the big window
E) None of these



Example: Weight of the air in a room

Your living room is 3.5m by 4.2m and has a height of 2.4m. What is the weight of the air in your living room if the air pressure is 1 atm?

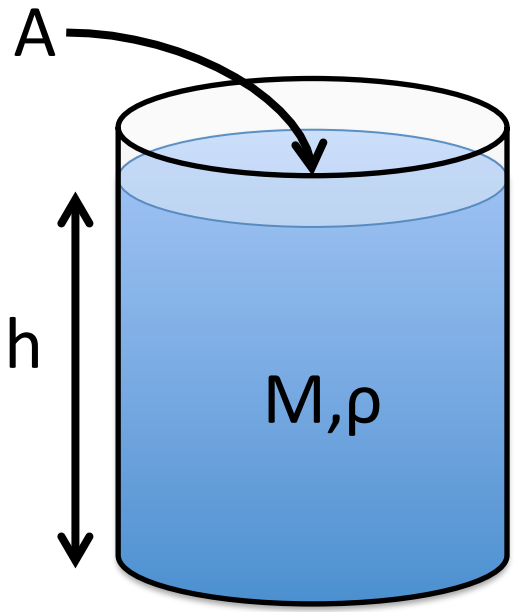
(At 20°C and 1 atm, $\rho_{air} = 1.21\ kg/m^3$)

Example: Weight of the air in a room

Your living room is 3.5m by 4.2m and has a height of 2.4m. What is the force the air in your living room exerts on the ceiling if the air pressure is 1 atm?

Example: Pressure in a bucket

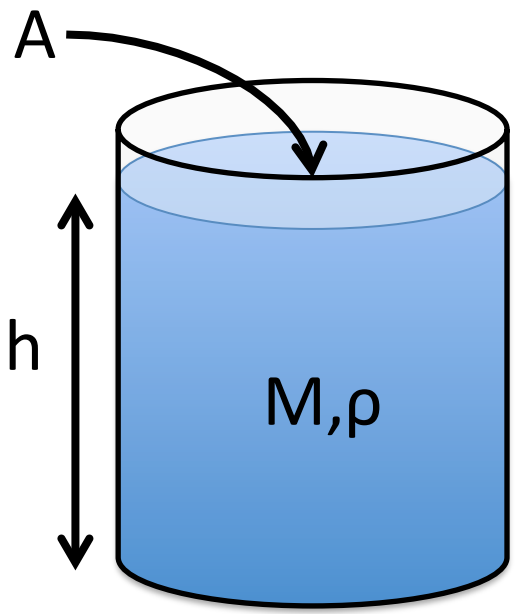
Consider a bucket of water. What is the pressure at the bottom of the bucket *due to the weight of the water?*



Example: Pressure in a bucket

13-3a) The total pressure at the bottom of the bucket is _____ at the surface.

A) greater than
B) less than
C) the same as



Example: Pressure in a bucket

13-3b) The pressure at the bottom of the bucket *due to the weight of the water* is given by…

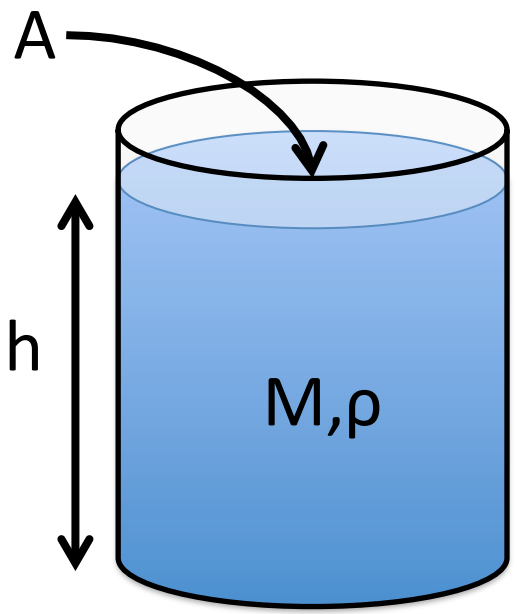
I) mg/A II) mg III) ρg IV) ρg/A V) ρgh

A) None of these

B) One of these

C) Two of these

D) Three of these

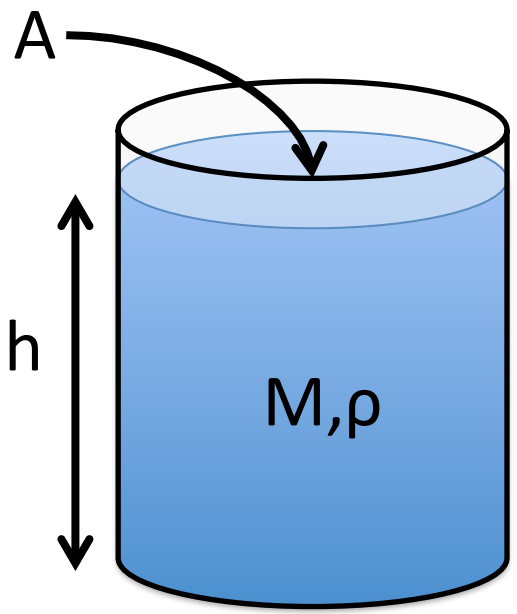


Example: Pressure in a bucket

13-3c) The total pressure at the bottom of the bucket is equal to ρgh.

A) True

B) False



Example: Swimming in a pool

At the surface of a swimming pool, the pressure *due the air* is 1 atm. At what depth does a swimmer experience 2 atm of pressure?

Example: Swimming in a pool

13-4) What is the pressure the water exerts for a swimmer to experience 2 atm of pressure?

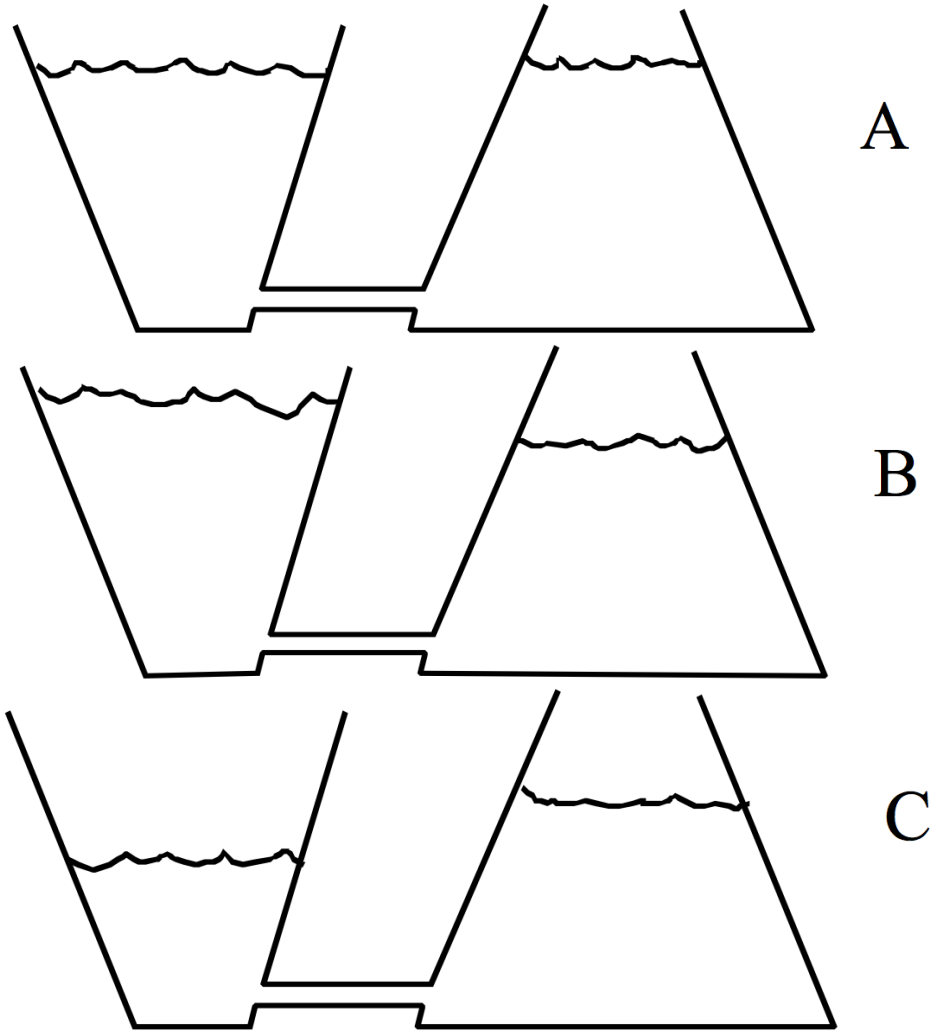
A) 0 atm

B) 1 atm

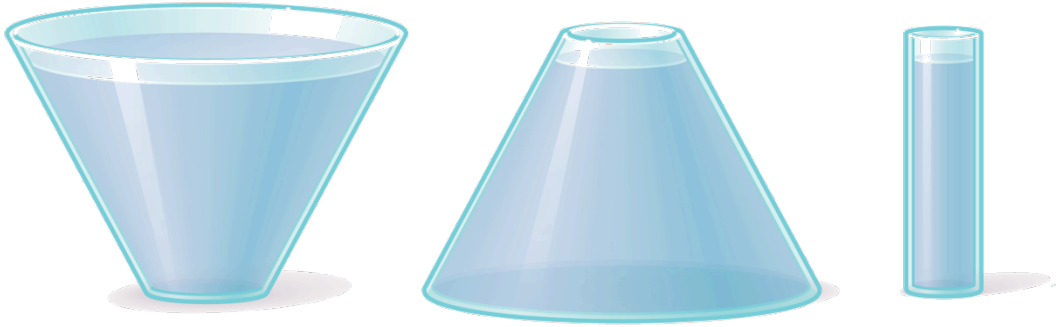
C) 2 atm

D) Something else

13-5) As shown, two containers are connected by a hose and are filled with water. Which picture correctly depicts the water levels?



13-23) Consider these three glasses filled with water to the same height. Which one has the highest total pressure at the bottom?



A B C

D) All are the same
E) Impossible to tell

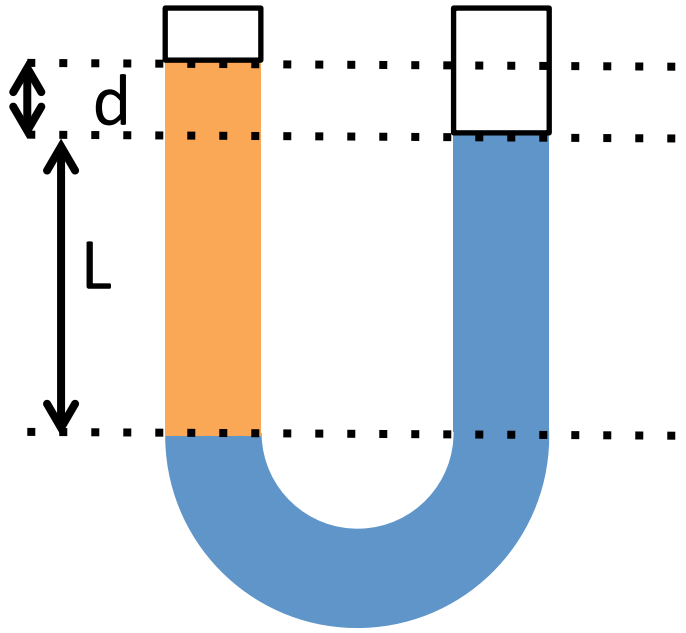
Example: U-Tube with H_20 and Oil

Two liquids (water and oil) are in static equilibrium in a U-shaped tube. Given the measurements shown, what is the density of the oil (ρ_{oil})?

ρ_{water}= 998 kg/m^3

d = 12.3 mm

L = 13.5 cm

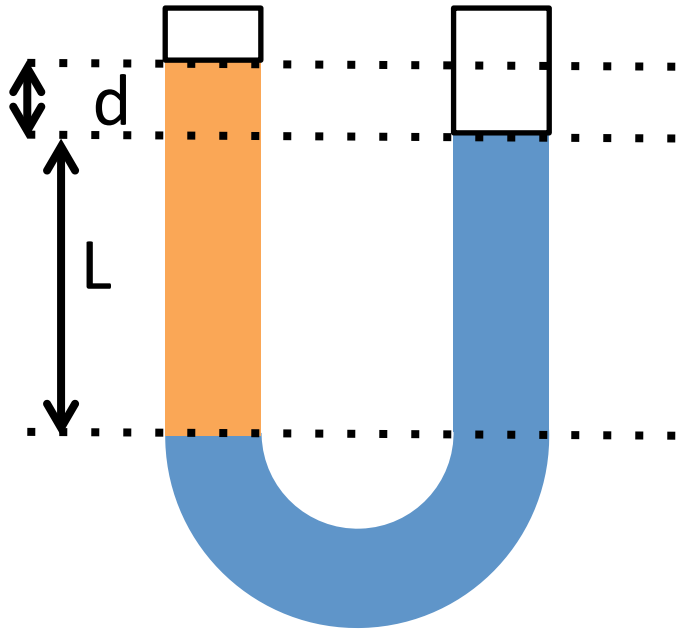


Example: U-Tube with H_20 and Oil

13-6a) The pressure at the depth where the two liquids are in contact is the same (in either side of the tube).

A) True

B) False



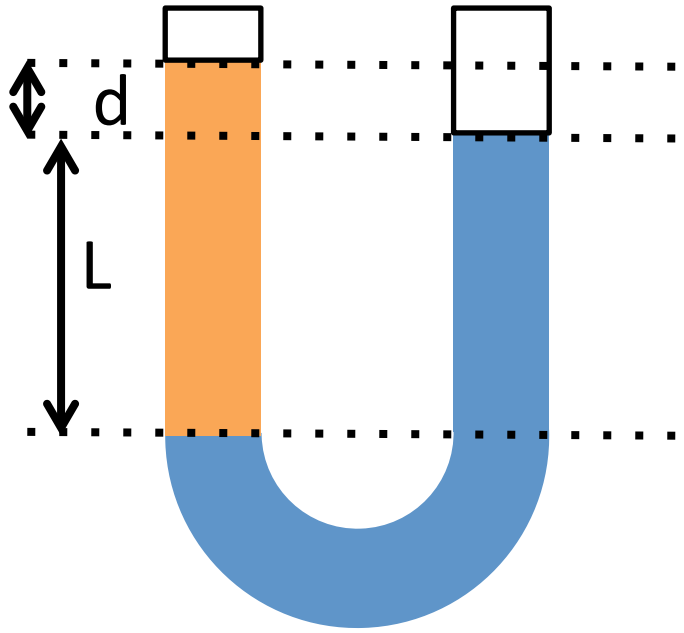
Example: U-Tube with H_20 and Oil

13-6b) The difference in the pressure at the surface and at the depth of the interface is $P_{atm} - P_{int}$. It is …

A) Negative

B) Positive

C) Zero



Example: U-Tube with H_20 and Oil

13-6c) $P_{atm} - P_{int}$ is given by…

I) $-\rho_{oil}\, g\, L$

II) $-\rho_{oil}\, g\, (L+d)$

III) $-\rho_{water}\, g\, L$

IV) $-\rho_{oil}\, g\, (L+d)$

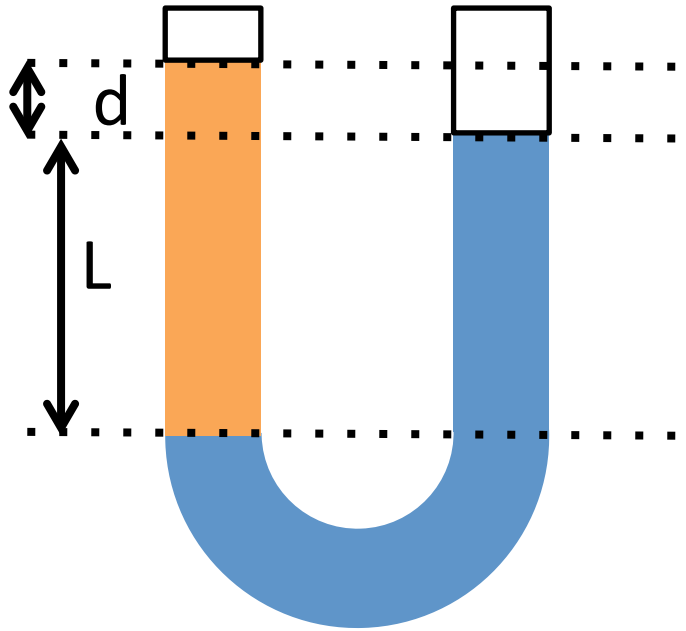
A) None of these

B) One of these

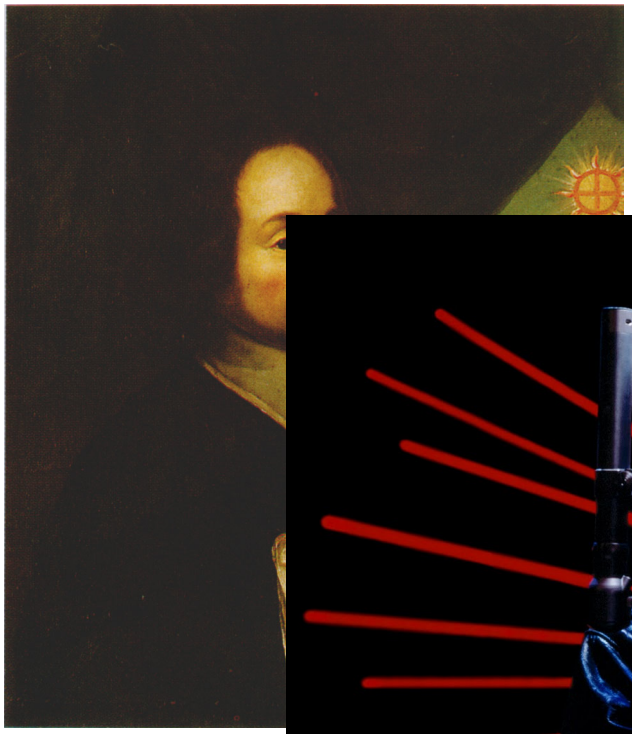
C) Two of these

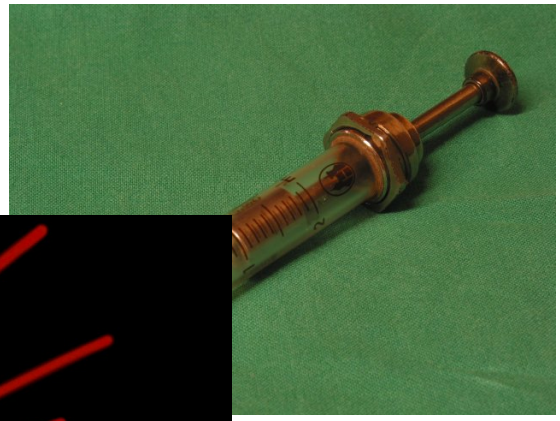
D) Three of these

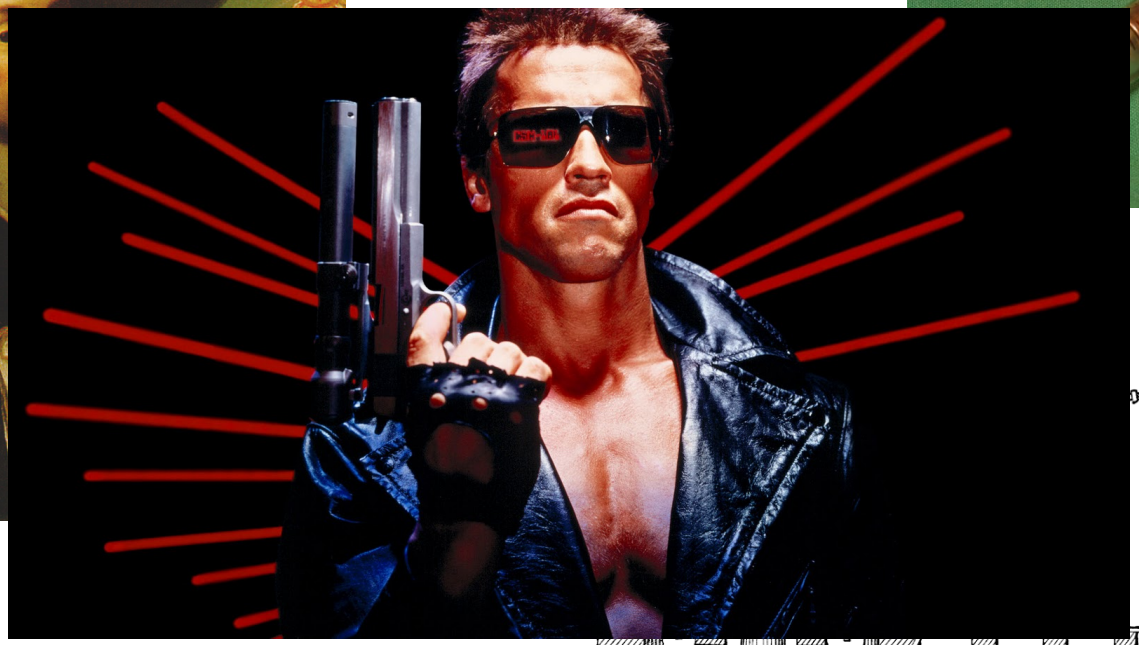
E) All of these



Blaise Pascal (1623 – 1662)





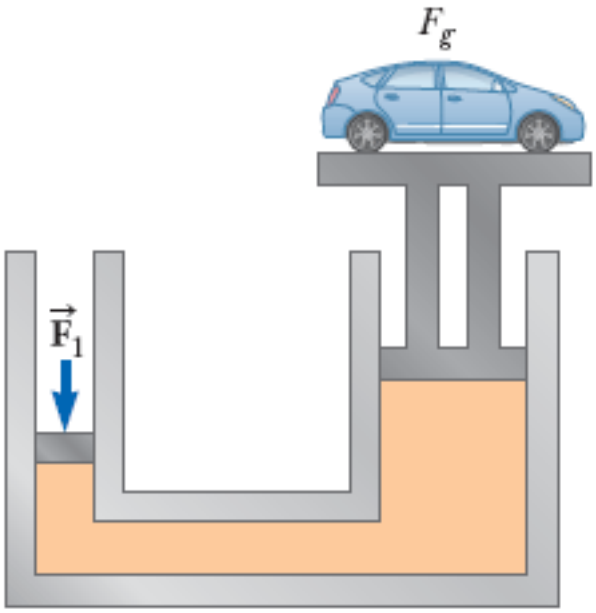


Pascal is directly responsible for the ending of The Terminator

http://www.youtube.com/watch?v=2KeniFoiT-0

Example: The Hydraulic Lift

How can this device lift a car?



Example: The Hydraulic Lift

13-7a) What are your expectations?

A) The applied force and the lifting force are equal.

B) The applied force is greater than the lifting force.

C) The applied force is less than the lifting force.

Example: The Hydraulic Lift

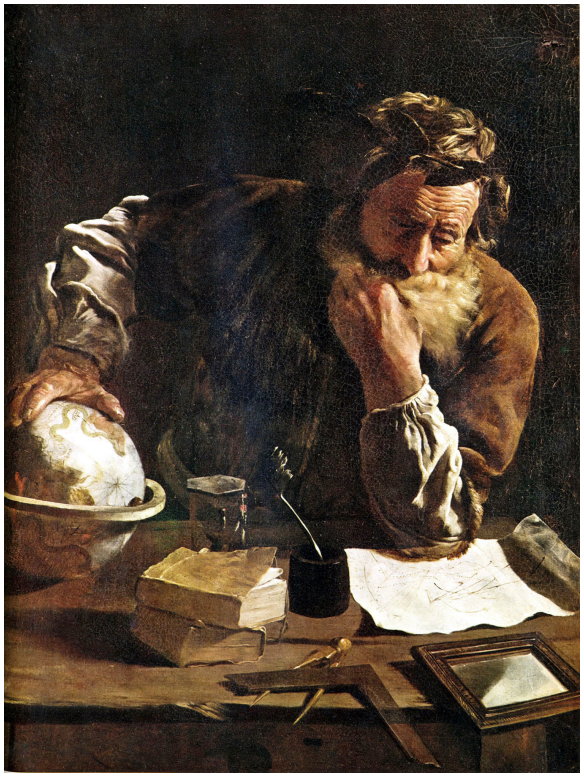
13-7b) What are your expectations?

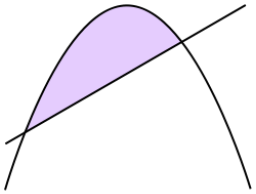
A) The energy input is equal to the energy output.

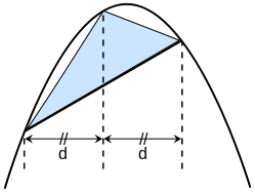
B) The energy input is less than the energy output.

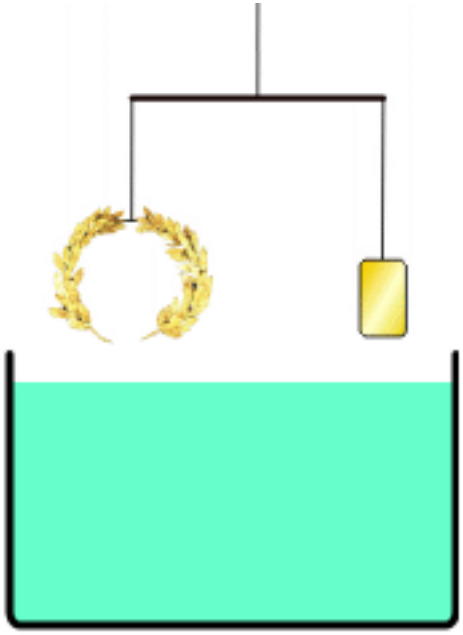
C) The energy input is greater than the energy output.

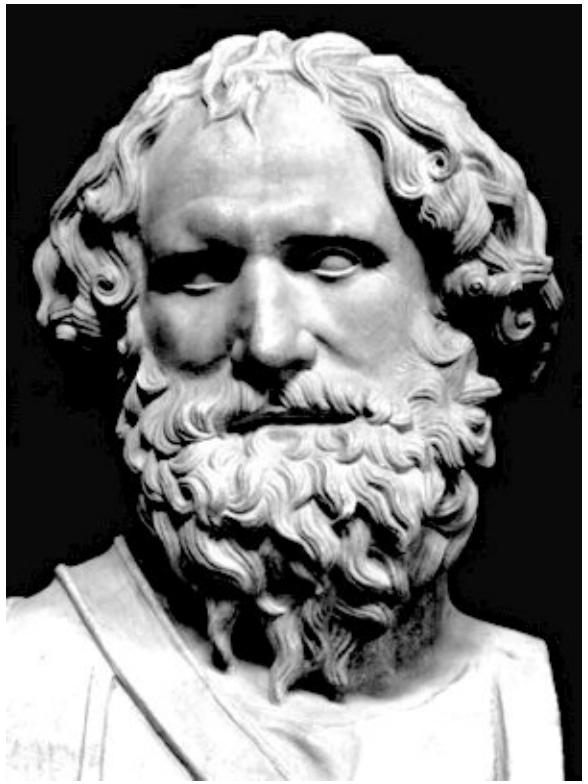
Archimedes (287 BCE – 212 BCE)

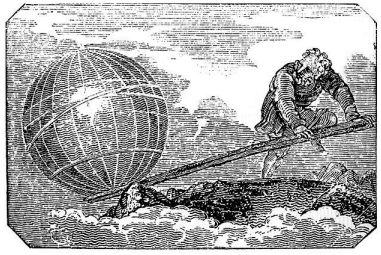


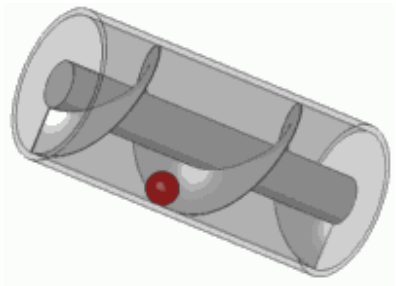






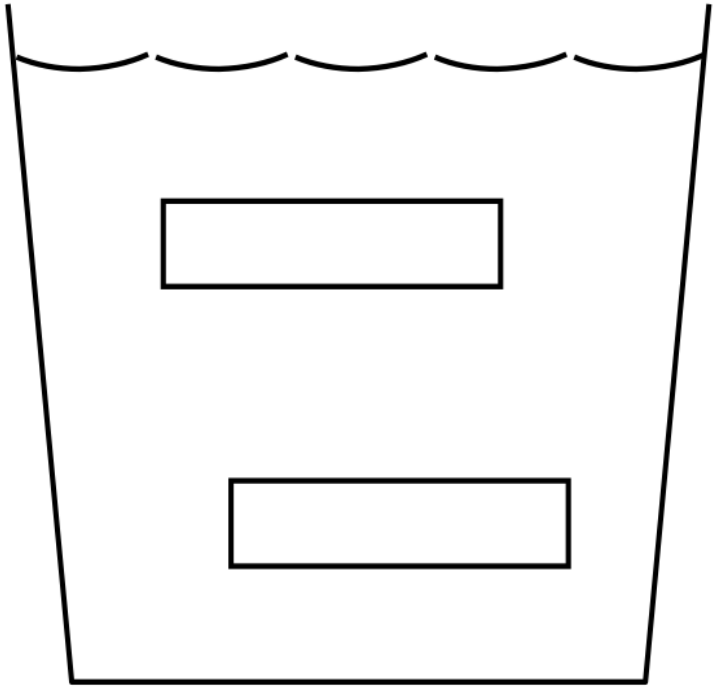




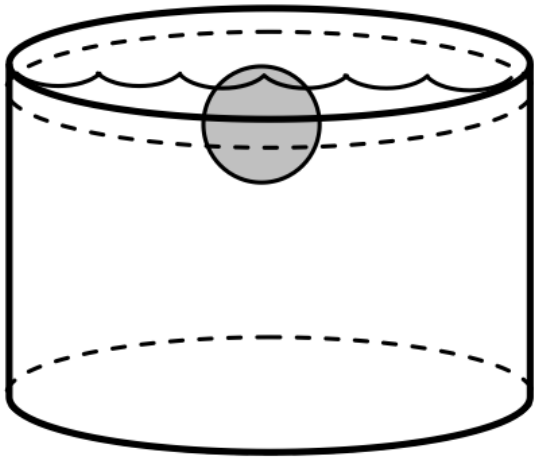


13-8) Two bricks are held under water in a bucket. One of the bricks is lower in the bucket than the other. The upward buoyant force on the lower brick is _____ the buoyant force on the higher brick.

A) greater
B) smaller
C) the same as



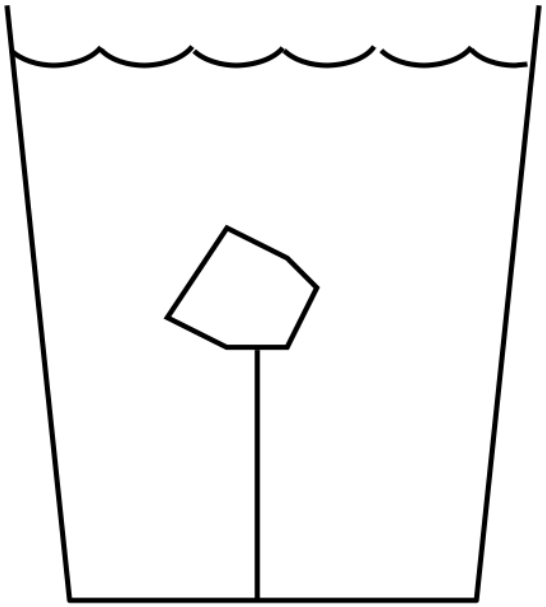
13-9) A plastic sphere of mass m is floating motionless, in a bucket of water. How does the magnitude of the buoyant force F_B compare to the magnitude of the weight mg of the mass?
(Hint: Draw a FBD!)



A) $F_B > mg$
B) $F_B < mg$
C) $F_B = mg$
D) answer depends on the volume of the sphere

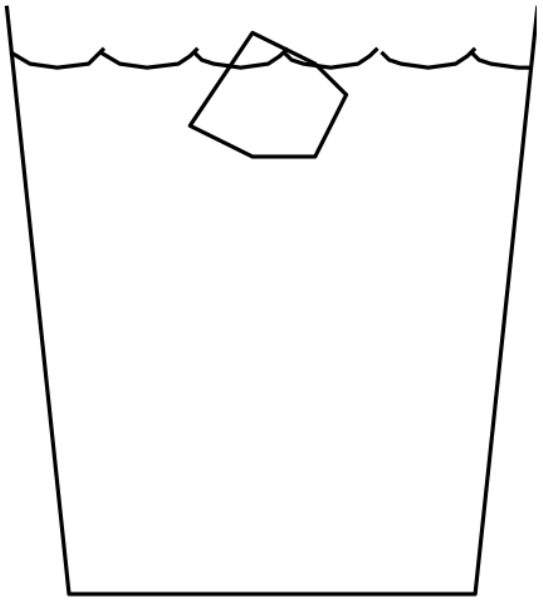
13-10) A solid piece of plastic of volume V, and density $\rho_{plastic}$ would ordinarily float in water, but it is held under water by a string tied to the bottom of bucket as shown. (The density of water is ρ_{water}.) What is the buoyant force on the plastic?

A) Zero
B) $\rho_{plastic}\ V$
C) $\rho_{water}\ V$
D) $\rho_{water}\ V\ g$
E) $\rho_{plastic}\ V\ g$



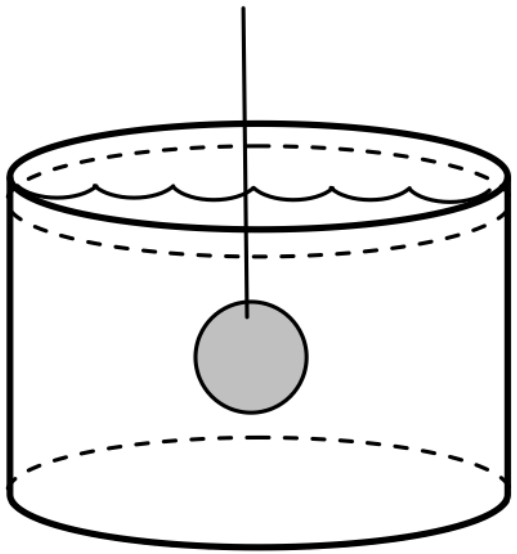
13-11) A solid piece of plastic of volume V, and density $\rho_{plastic}$ is floating in a cup of water. (The density of water is ρ_{water}.) What is the buoyant force on the plastic?

A) Zero
B) $\rho_{plastic}\ V$
C) $\rho_{water}\ V$
D) $\rho_{water}\ V\ g$
E) $\rho_{plastic}\ V\ g$



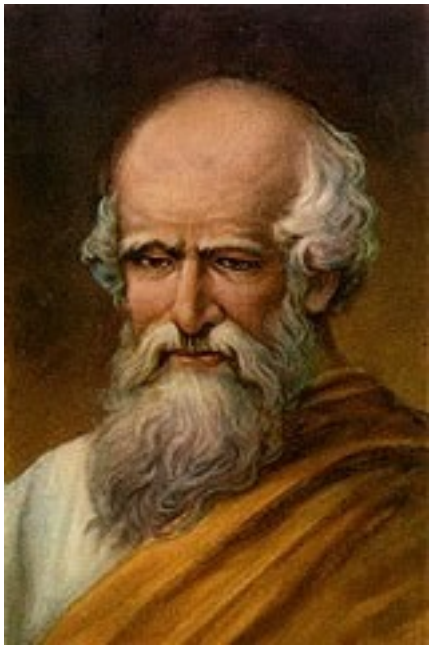
13-12) A solid copper sphere of mass m will sink in water. The sphere is suspended under water by a string as shown. How does the magnitude of the tension F_T in the string compare to the magnitude of the weight mg of the mass? Draw the FBD.

A) $F_T > mg$
B) $F_T < mg$
C) $F_T = mg$
D) answer depends on the volume of the sphere



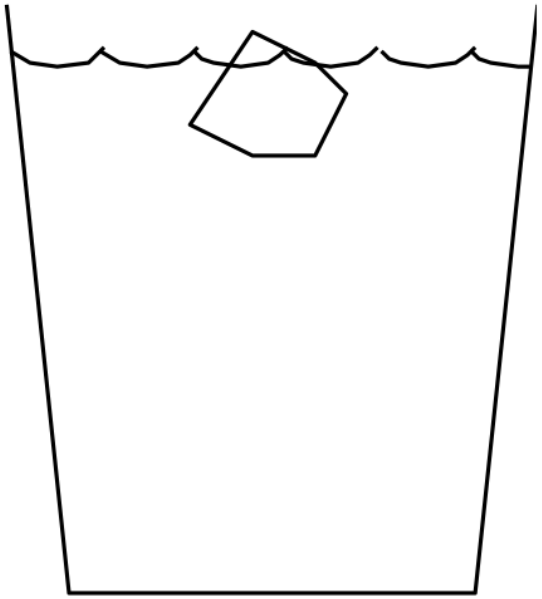
Example: Archimedes and the Crown

King Hiero II of Syracuse supplied pure gold to make a crown. After receiving it, he suspected it wasn't pure gold. Archimedes was tasked with determining if the crown was pure gold without damaging it. How did he do this?



13-14) An iceberg ($\rho_{iceberg}$, $V_{iceberg}$) is floating in the sea (ρ_{sea}). What is the buoyant force on the iceberg?

A) Zero
B) $\rho_{iceberg}\ V_{iceberg}$
C) $\rho_{sea}\ V_{iceberg}$
D) $\rho_{sea}\ V_{iceberg}\ g$
E) $\rho_{iceberg}\ V_{iceberg}\ g$



Announcements

- Screencasts on buoyancy posted. Email me about anything else.
- Survey on LON-CAPA
  (counts as HW, due Sunday
  & Maggie says, “it takes 5 minutes”)
- Homework problem about diver (hint coming)

Physics Colloquium TODAY @4:15pm

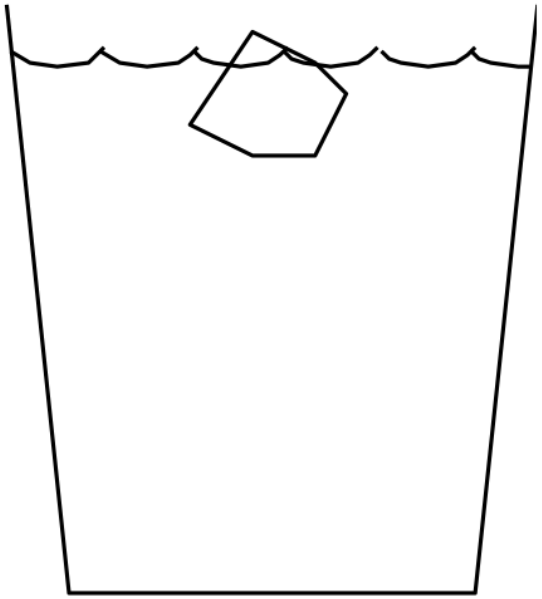
Mike Dubson

"Transforming physics education"

BPS 1415

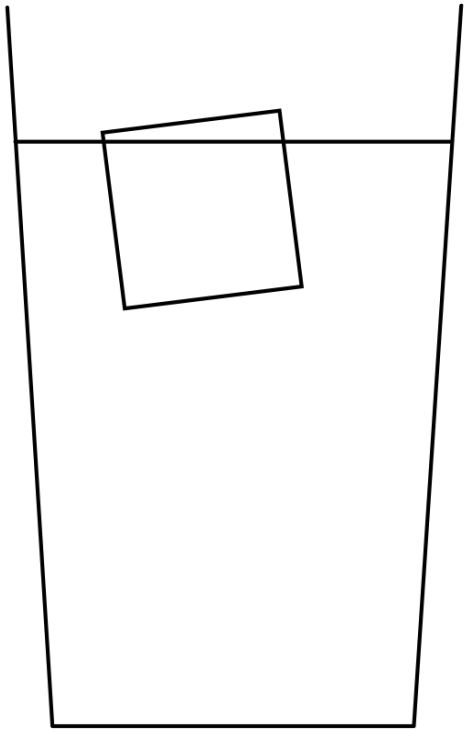
13-14) An iceberg ($\rho_{iceberg}$, $V_{iceberg}$) is floating in the sea (ρ_{sea}). What is the buoyant force on the iceberg?

A) Zero
B) $\rho_{iceberg}\ V_{iceberg}$
C) $\rho_{sea}\ V_{iceberg}$
D) $\rho_{sea}\ V_{iceberg}\ g$
E) $\rho_{iceberg}\ V_{iceberg}\ g$

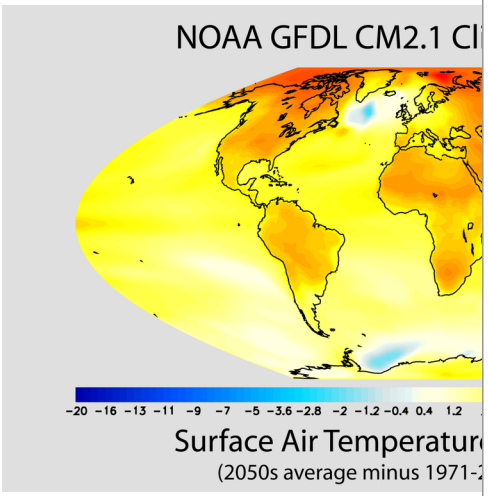


13-13) An ice cube is floating in a glass of water. As the ice cube melts, the level of the water...

A) rises.
B) falls.
C) stays the same.



Global Warming



Melting icebergs cause sea levels to rise by the width of just a human hair every year

By DAILY MAIL REPORTER
UPDATED: 02:15 EST, 5 May 2010

Share Tweet +1 Share 69 View comments

Floating ice equivalent to 1.5 million icebergs the size of the one that sank the Titanic are melting away each year, research has shown.

The lost ice is only raising sea levels annually by a tiny fraction - about a hair's breadth across the world's oceans.

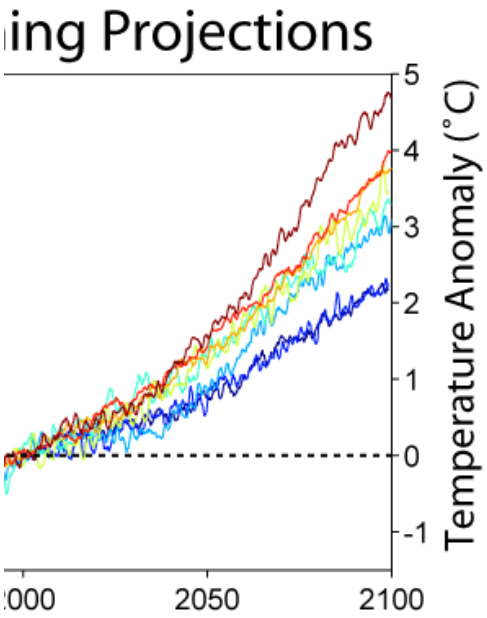
This is despite the fact that, according to Archimedes's principal, floating ice displaces its own volume of fluid and should not add more water when it melts.

Rising tides: Scientists say 1.5million icebergs the size of the one that sank the Titanic melt every year - but sea levels only go up a fractional amount

The melting icebergs cause sea levels spread evenly across the globe to rise by just 49 micrometres a year, about the width of a human hair.

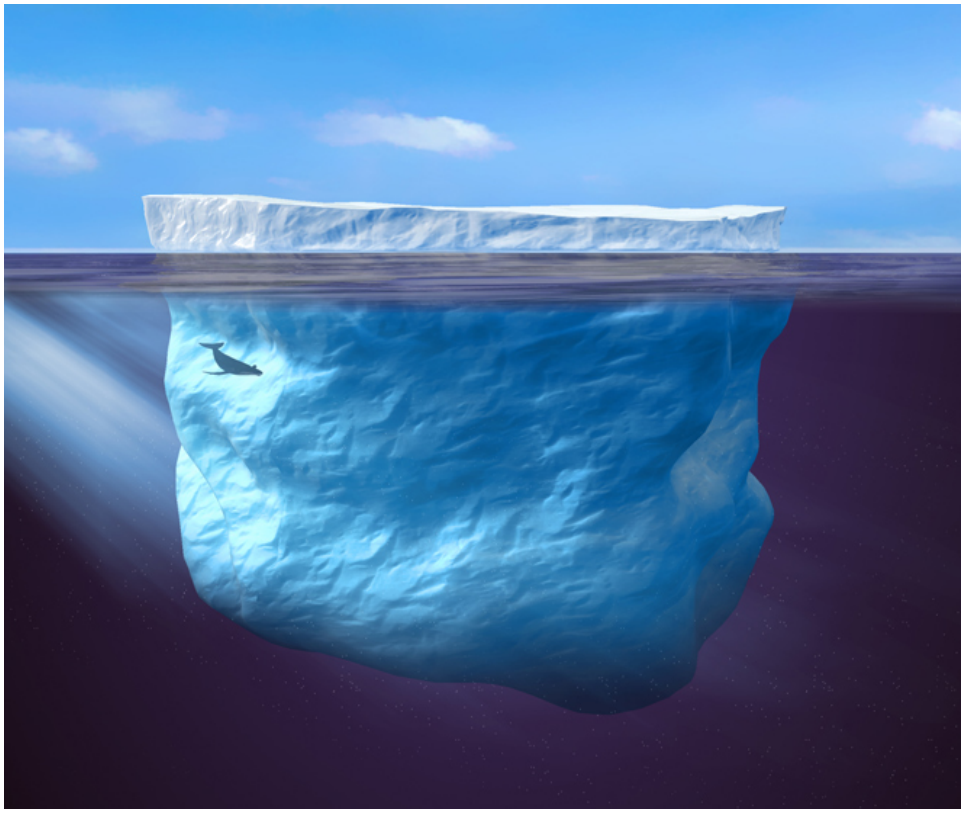
At that rate, it would take 200 years for the oceans to rise by a centimetre and if all the floating ice was to melt sea levels would rise by only 4cm, according to scientists.

If all the ice on land melted, it would raise the levels of oceans by 230ft.



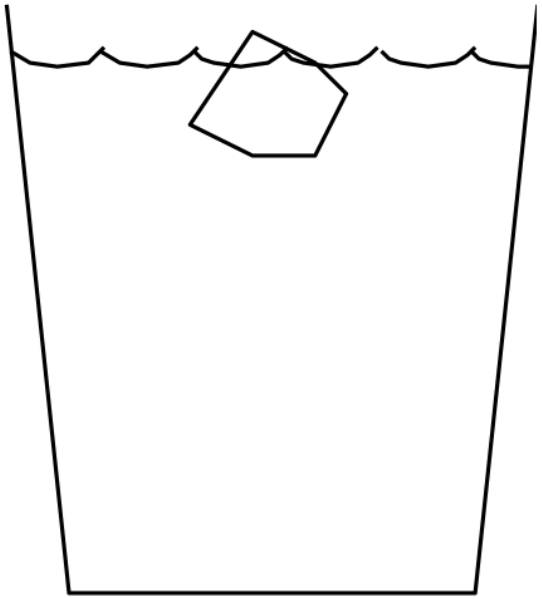
Example: Floating Iceberg

What fraction of a floating iceberg is visible?



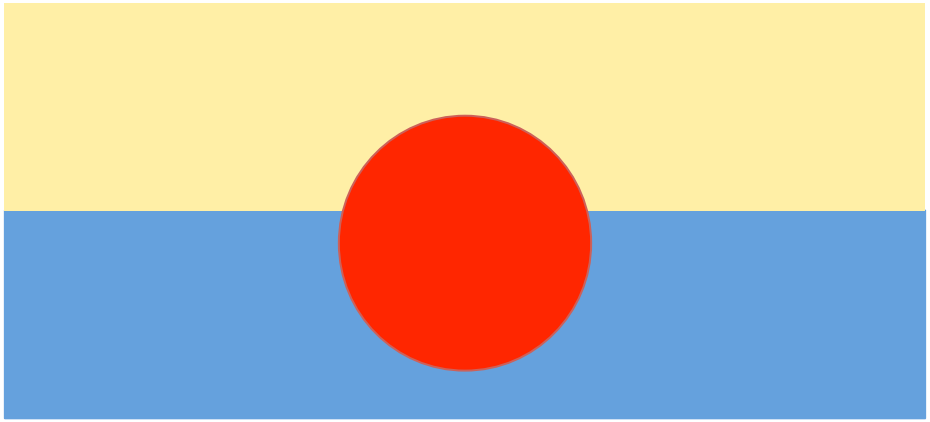
13-14) An iceberg ($\rho_{iceberg}$, $V_{iceberg}$) is floating in the sea (ρ_{sea}). What is the buoyant force on the iceberg?

A) Zero
B) $\rho_{iceberg}\ V_{iceberg}$
C) $\rho_{sea}\ V_{iceberg}$
D) $\rho_{sea}\ V_{iceberg}\ g$
E) $\rho_{iceberg}\ V_{iceberg}\ g$



13-15) A tomato is floating in a glass of water. I pour olive oil on top of the tomato until it covers the tomato completely. Tomatoes sink in olive oil. What happens to the tomato?

A) It moves up
B) It moves down
C) It stays at the same location



Viscous Flow

Superfluid Helium

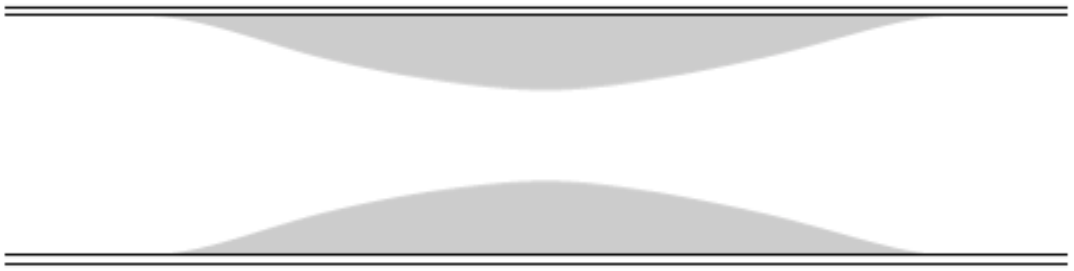
13-16) After a sweet win by the #1 ranked MSU Men's Basketball team. You are watering your yard (maybe after cleaning up or not, your choice). You press your thumb over the end of the hose. What happens to the speed of the water coming out?

A) It goes up.
B) It stays the same.
C) It goes down.

13-17) A circular hoop sits in a stream of water, oriented perpendicular to the current. If the area of the hoop is doubled, the volume flow rate, R_v, (volume of water per unit time) through it.

A) decreases by a factor of 4.
B) decreases by a factor of 2.
C) remains the same.
D) increases by a factor of 2.
E) increases by a factor of 4.

13-18) Blood flows through a coronary artery that is partially blocked by deposits along the artery wall. Through which part of the artery is the flow speed largest?



A) The narrow part.
B) The wide part.
C) The flow speed is the same in both parts.

Example: Necking Down

A stream of water emerging from a faucet "necks down" as it falls. The cross-sectional area of the flow gets smaller. Given the cross-sectional area at two different heights (A_1 @ y_1 and A_2 @ y_2), determine the volume flow rate of the faucet, R_v.

Example: Necking Down

13-19a) Ok, we can start with the continuity equation ($A_1v_1=A_2v_2$).

Do we have enough information to solve the problem right now?

A) Yes

B) No

Example: Necking Down

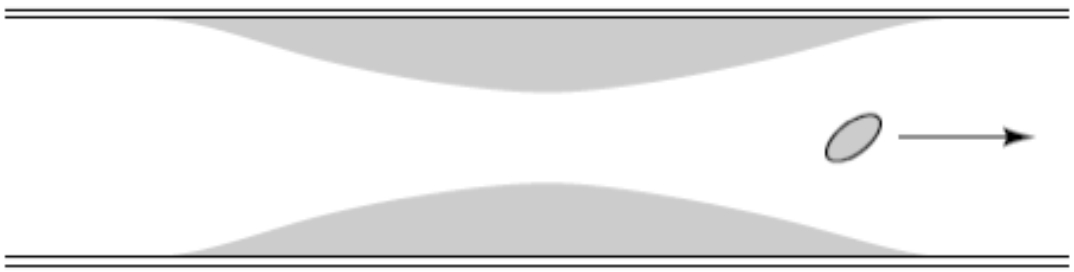
13-19b) What should we use to get another relationship between v_1 and v_2?

A) Kinematics
B) Conservation of energy
C) Something else
D) Wait, we need another equation?!

13-19) Two hoses, one of 20-mm diameter, the other of 15-mm diameter are connected one behind the other to a faucet. At the open end of the hose, the flow of water measures 10 liters per minute. Through which hose does the water flow faster?

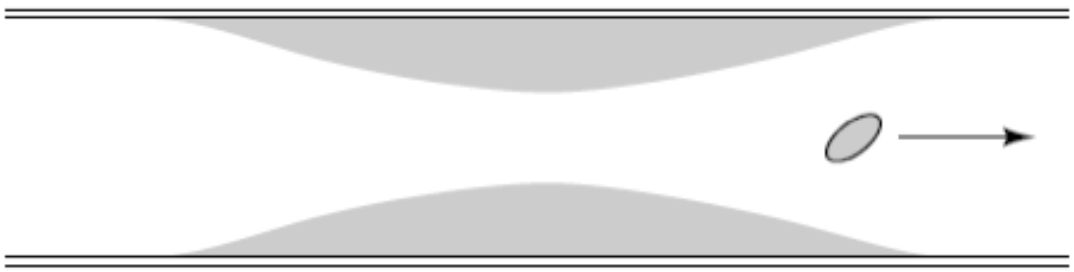
A) the 20-mm hose
B) the 15-mm hose
C) The flow rate is the same in both cases.
D) The answer depends on which of the two hoses comes first in the flow.

13-20a) A blood platelet drifts along with the flow of blood through an artery that is partially blocked by deposits. As the platelet moves from the narrow region to the wider region, its speed



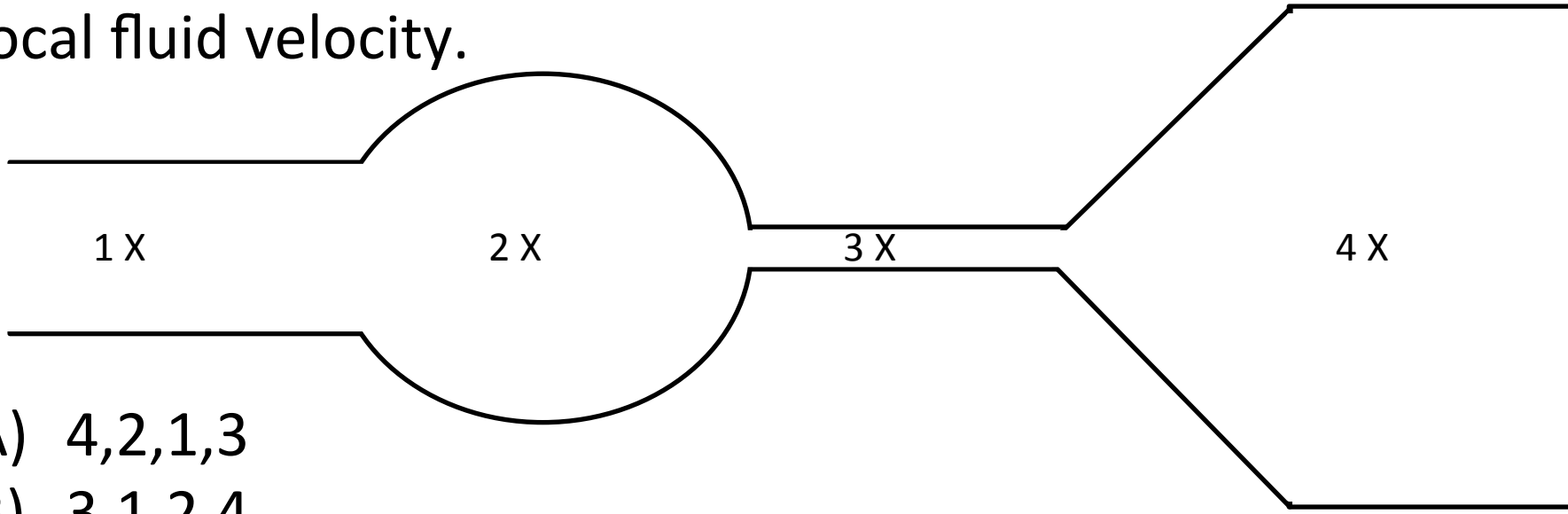
A) increases.
B) remains the same.
C) decreases.

13-20b) A blood platelet drifts along with the flow of blood through an artery that is partially blocked by deposits. As the platelet moves from the narrow region to the wider region, it experiences



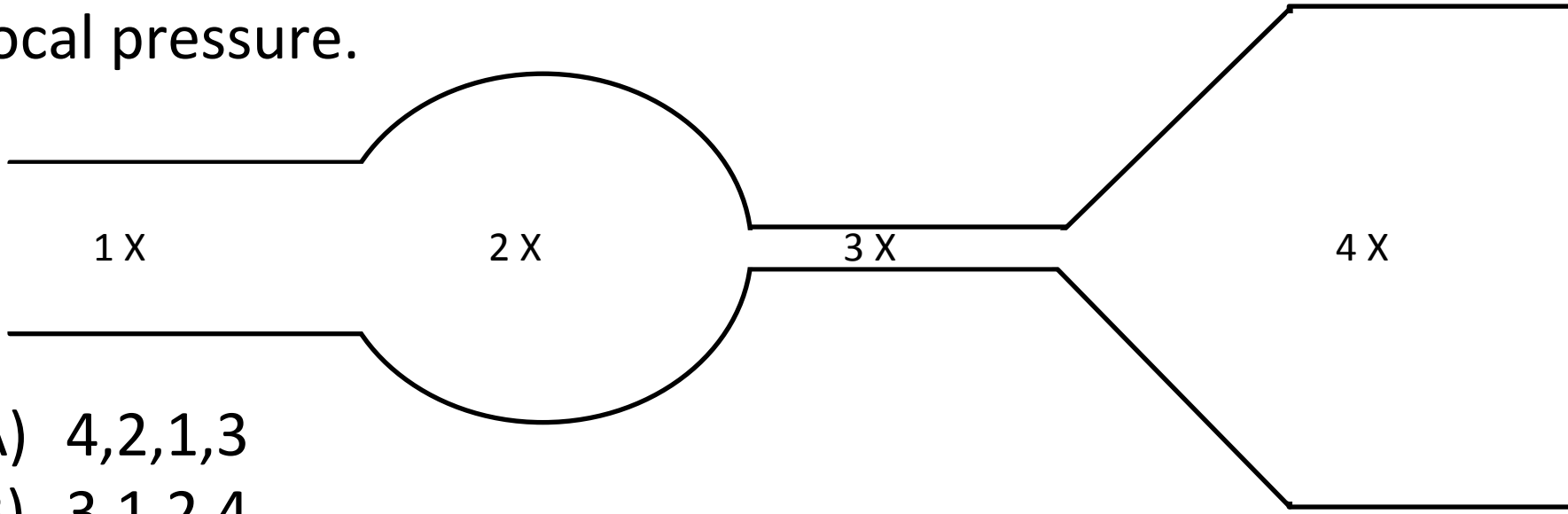
A) an increase in pressure.
B) no change in pressure.
C) a decrease in pressure.

13-21a) An ideal fluid flows through the shown below. Rank the locations (highest to lowest) based on the local fluid velocity.



A) 4,2,1,3
B) 3,1,2,4
C) 4,2,3,1
D) 1,2,3,4
E) Something else

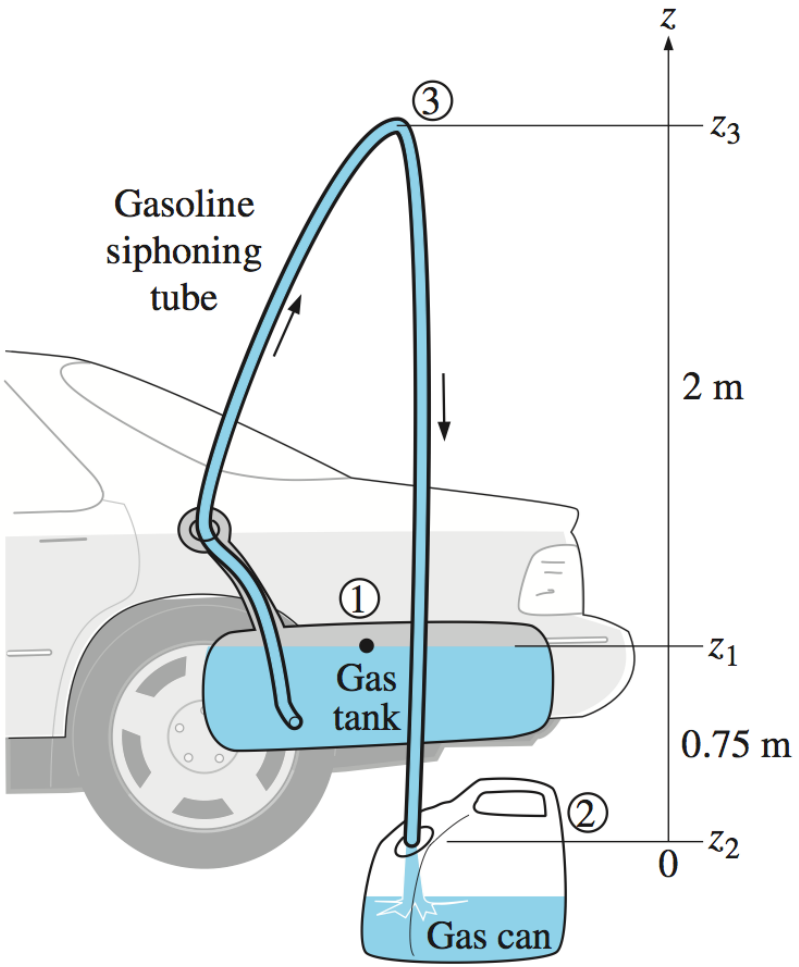
13-21b) An ideal fluid flows through the shown below. Rank the locations (highest to lowest) based on the local pressure.



A) 4,2,1,3
B) 3,1,2,4
C) 4,2,3,1
D) 1,2,3,4
E) Something else

Example: Siphoning Gas

The first time I visited Michigan alone I stayed with friends in Ann Arbor (booooo!) for a week. Some genius siphoned gas out of my truck over the week I was there. How does gas siphoning work?



13-22) When a hole is made in the side of a container holding water, water flows out and follows a parabolic trajectory. If the container is dropped in free fall, the water flow…

A) diminishes.
B) stops altogether.
C) goes out in a straight line.
D) curves upward.