AP Physics 1

Unit 8 Test: Fluids

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1. A swashbuckling pirate puts a raft in a pond full of coins as shown in Figure 1 below. The pond contains water with $\rho = 1000\,\frac{kg}{m^3}$. Each coin has a mass of $m = 3.0\ kg$. The raft is rectangular prism as shown in Figure 2 with a density of 700 kg/m^3 and dimensions of width $w = 2.0\ m$, length $l = 4.0\ m$ and $h = 1.0\ m$.

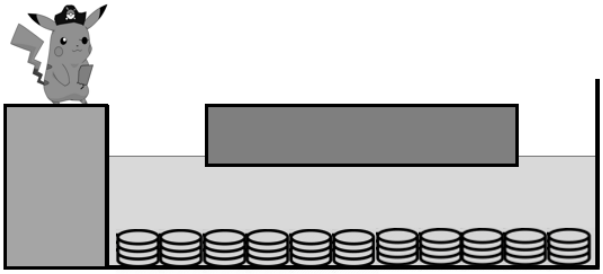


Figure 1

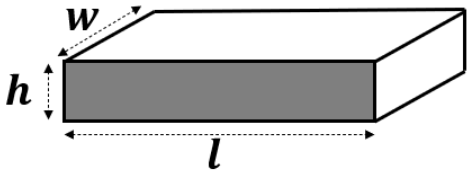


Figure 2

a) Suppose a single coin is moved from the bottom of the pond to the raft. Does the total force exerted on the bottom of the pond increase, decrease, or remain the same as a result of the coin being moved?

_____Increase _____Decrease _____Remain the Same

Give a short justification for your answer.

b) Calculate the number of coins that can fit on the raft until the raft becomes submerged.

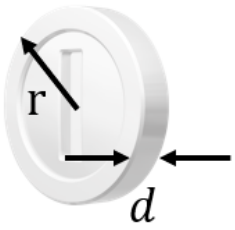
Once the coins are all on the raft, a rival pirate knocks all the coins off the raft until they sink back to the bottom of the pond.

c) Is the pond level higher when the coins are on the raft or at the bottom of the pool?

_____Higher when the coins are on the raft
_____Higher when the coins at the bottom
_____Equal Level for Each

Give a short justification for your answer.

d) Calculate the acceleration of a single coin as it sinks in the pond after falling off the raft. Each coin is a cylinder with mass of $m = 3.0\ kg$, a thickness of $d = 0.04$ m and a radius of $r = 0.06\ m$.

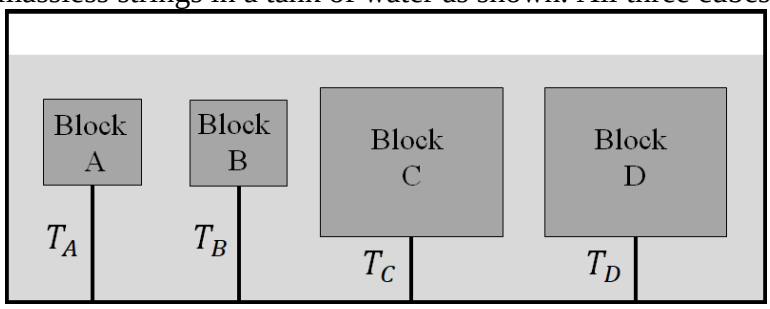


2. Equal sized of 50 cm^3 blocks of wood (less dense than water) and iron (more dense than water) are both thrown into a pool of water and allowed to come to rest (the wood floats and the iron sits at the bottom). Which block will experience a greater buoyant force?

_____Wood _____Iron _____The buoyant forces are the same

Give a short justification for your answer.

3. Three cubes are tied to massless strings in a tank of water as shown. All three cubes are less dense than water.

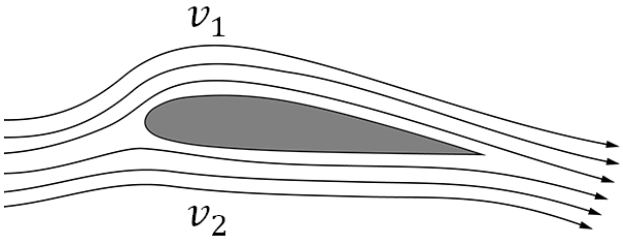


The density and volumes of the cubes are given below:

A: $\rho = \rho_0,\ s = V_0$ B: $\rho = 2\rho_0,\ s = V_0$ C: $\rho = \rho_0,\ s = 2V_0$ D: $\rho = 2\rho_0,\ s = 2V_0$

Rank the tensions holding the cubes in place.

4. The picture below shows an aircraft wing with air of velocity v_1 flowing above it and air of velocity v_2 blowing below it. Suppose the plan flies through the air at a constant altitude high above the ground.

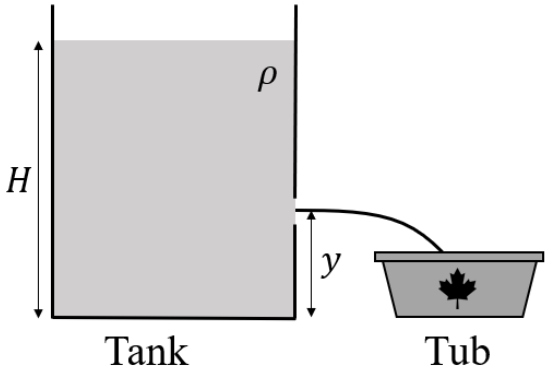


How are the velocities on the top and bottom of the wing related?

_____$v_1 > v_2$ _____$v_1 < v_2$ _____$v_1 = v_2$

Give a short justification for your answer.

5. To save Canada from certain destruction, the government releases syrup from its Strategic Maple Syrup Reserve. Maple Syrup ($\rho = 1400\ kg/m^3$) is stored in a tank of height $H = 12\ m$. Maple syrup flows out of the container at a height of $y = 3\ m$ above the ground as shown. The hole is a circle with a radius of 0.2 m.



a) Calculate the speed at which the syrup leaves the container. Show your work.

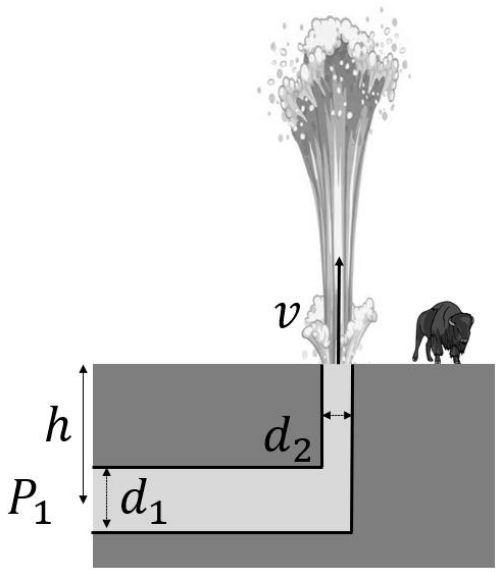
b) Calculate the time required for the syrup to fill up a tub with a total volume of $30\ m^3$.

c) Suppose the hole is given a wider diameter. Would the tube now fill faster or slower?

_____Faster _____Slower _____It would take the same time

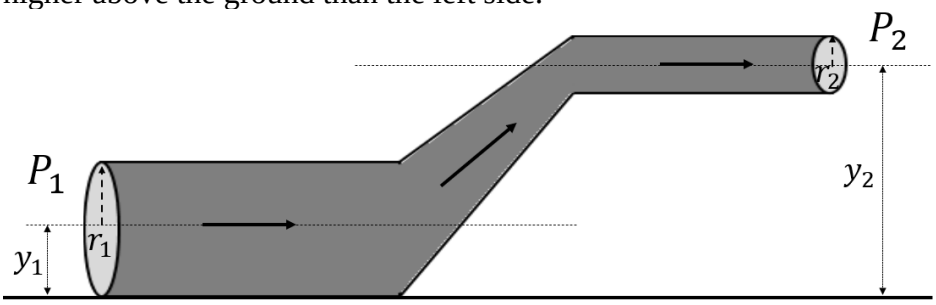
6. A geyser at Yellowstone National Park has water come out of a vent in the ground vertically at a speed of $v = 225\frac{m}{s}$. The vent has a diameter of $d_2 = .4\ m$ and is open to the air above it. The water comes from an underground chamber through a pipe at point 1 shown in the diagram. The pipe is a height of $h = 200$ m below the ground and leaves the chamber via a tunnel with a diameter of $d_1 = 1.2\ m$.

a) Calculate the pressure, P_1, that the water undergoes when leaving traveling through the underground tunnel shown.



b) Suppose the air above the geyser wind is extremely windy on a particular day. Does the water coming out of the vent travel faster or slower than when there is no wind out. Give a short justification for your answer.

7. An ideal fluid flows from left to right through a pipe of varying cross section as shown below. r_1 and r_2 represent the radii of left and right end of the pipe, respectively, with $r_1 > r_2$, and the right side of the pipe is higher above the ground than the left side.



How are the pressures on the two ends of the pipe related?

_____$P_1 > P_2$ _____$P_1 < P_2$ _____$P_1 = P_2$

Give a short justification for your answer.

8. An olympic swimming pull is filled with jello, a liquid of unknown density. The ***absolute*** pressure 1 m under the jello is found to be $4.0x10^5\ Pa$. What is the ***absolute*** pressure 2 m under the jello?