AP Physics 1 Name: _____

Unit 8: Fluids Test

Constants and Formulas

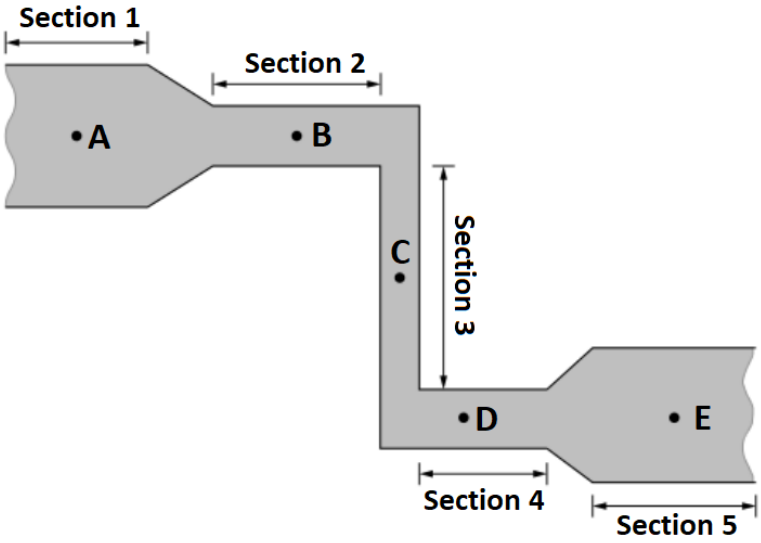
$\rho_{water} = 1000\,\frac{kg}{m^3}$ $P_{ATM} = 1.01x10^5\ Pa$ $g = 10\ m/s^2$

$P_{gauge} = \rho gh$ $P_{ABS} = P_{gauge} + P_{ATM}$ $F_B = \rho gV$

$\rho = \frac{M}{V}$ $\frac{V}{t} = Av$ $P_1 + \frac{1}{2}\rho v_1^1 + \rho g y_1 = P_2 + \frac{1}{2}\rho v_2^1 + \rho g y_2$

1. Water flows from left to right through five sections of cylindrical pipe, as shown in the side view given. The radii are sized such that $r_3 > (r_2 = r_4) < (r_1 = r_5)$.

a) Rank the velocity of the flow fluid at each of the five indicated points.



b) What is the relationship between the pressures at points A and E?

____ $P_A > P_E$ ____ $P_A < P_E$ ____ $P_A = P_E$

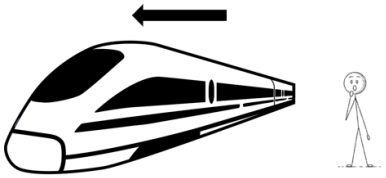
Give a short justification for your answer.

2. A person is standing on a railroad station platform when a high-speed train passes by. The air around the train and the person will cause the person to be:

_____Pushed away from the train ____Pushed up into the air

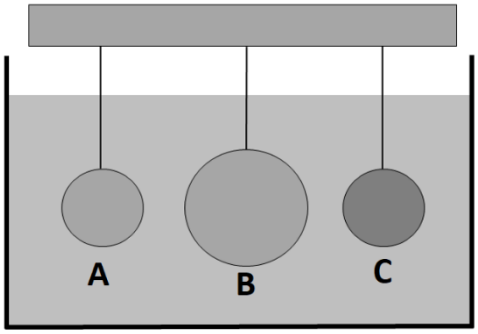
_____Pulled in toward the train ____Pulled down to the ground

Give a short justification for your selection.



3. Three spheres are suspended from light strings and hang in water. The following information is available for the three spheres:

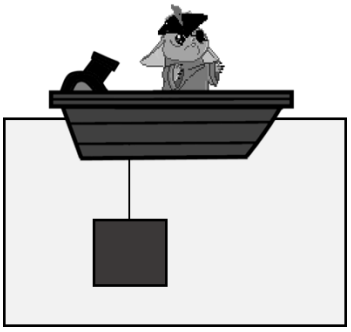
- A: Mass: M Radius: R
- B: Mass: M Radius: 2R
- C: Mass: 2M Radius: R



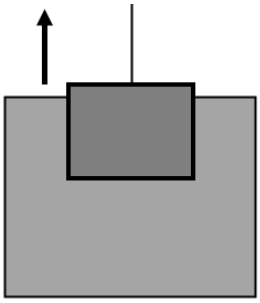
Rank the tension in the spheres on the 3 spheres.

4. A pirate ship is floating on a freshwater inland sea. It has a cube anchor of side length s = 0.2 m. The cube is made of a metal with a density of 3000 kg/m^3 and is supported by a rope. The cube is lowered by a rope with an acceleration of 1.2 m/s^3.

a) Calculate the tension in the rope. Show the steps involved to arrive at your answer, including a free-body diagram.



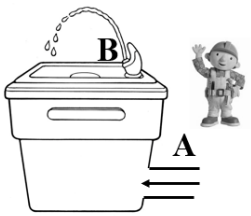
b) Later, the cube is pulled at constant velocity out of the water. From the time the top of the cube goes above the surface of the water until the bottom of the cube goes above the surface, does the tension in the rope increase, decrease, or remain the same during this motion?



_____ Increase _____Decrease _____Remain the same

Give a short justification for your answer.

5. Water flows into a water fountain as a constant rate at point A as shown. It exits at point B and flies as a projectile out of a pipe at point B. The water problem has a problem of shooting too far. Bob Builder makes the following claim:
"Making the pipe diameter at B larger will lead to the fluid traveling out slower and travel a shorter distance, but it will take a longer time to use the water fountain to fill a water bottle."



a) What part of Bob's reasoning is correct?

b) What part of Bob's reasoning is incorrect? Briefly state this is incorrect.

6. A spring scale is used to determine the density of a Funko pop specimen. The reading on the spring scale is 5.0 N when the specimen is suspended in air and 3.0 N when the specimen is fully submerged in water.

a) What is the value of the buoyant force on the Funko pop?

b) What is the density of the Funko pop?

7. A tank of fresh water with density ρ_0 contains a block of cylindrical block of ice floating as shown in Figure 2. The cylinder of ice has a density of $0.9\rho_0$ a radius r and a height h. The tank is an enclosure with penguins. Each penguin has a mass of M.

a) In terms of the quantities given above (ρ_0, r, h and M), determine an expression for the number of penguins the ice can hold before becoming submerged. Show your work.

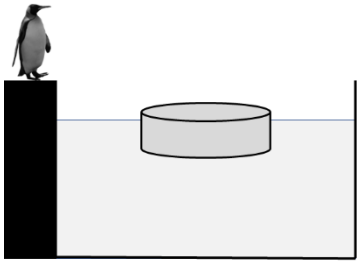


Figure 1

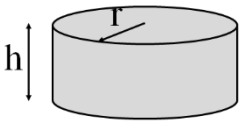
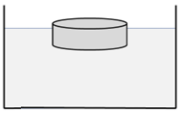


Figure 2

As a result of climate change the penguins all leave Earth on rockets built by PASA (Penguin Aeronautics and Space Administration). The ice is made of solid fresh water and is floating in a tank composed of fresh water. Over time the ice slowly melts.



b) Does the pressure on the bottom of the tank increase, decrease, or remain the same as the ice melts?

_____ Increase _____Decrease _____Remain the same

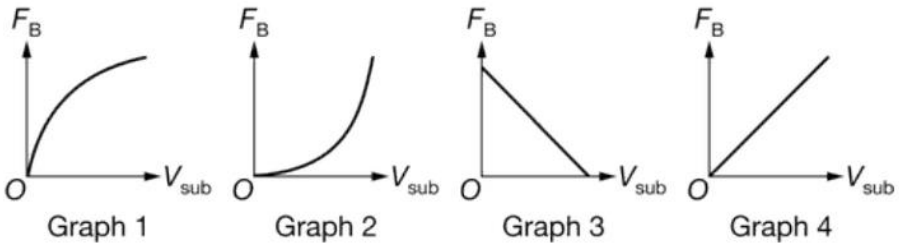
Give a short justification for your answer.

c) Does the water level in the tank increase, decrease, or remain the same as the ice melts?

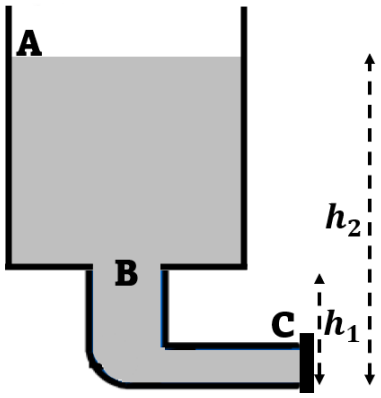
_____ Increase _____Decrease _____Remain the same

Give a short justification for your answer.

d) Students draw the following graphs to represent the buoyant force F_B exerted on the ice as it melts as a function of the volume of ice V_{sub} that is submerged in water. Circle that graph below that is correct.

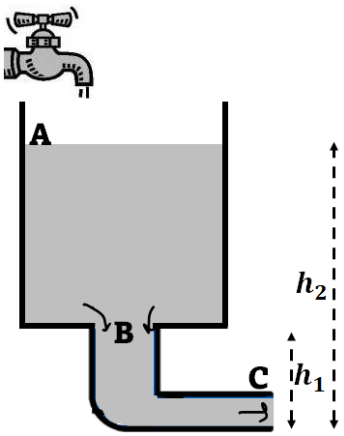


8. A tank of water is shown with three label points, A at the very top of the water, B is in a pipe of radius 9 cm directly below the tank and C is at the bottom of bottom in a pipe with a radius of 3 cm. The water is initially capped at C so not water flows out. Point A is a height $h_2 = 40\ cm$ above point C and point B is a height of $h_1 = 8\ cm$ above point C. Point A is open to the atmosphere.



a) Calculate the pressure on the cap at C, assuming is a circular with a radius of 3 cm.

The cap is now removed at C so it is now open to the atmosphere and fluid flows out at C. Water is supplied to the top of the tank so that the level of water in the tank is constant.



b) Calculate the speed at which water leaves the tank at C.

c) Calculate how much water (in kg) must be supplied to the tank every second to keep the water level constant.

d) Calculate the pressure at point B while the water is flowing.