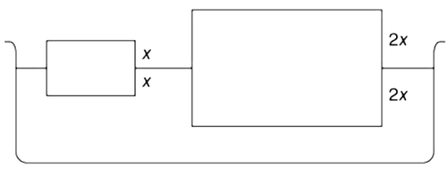
Student #: _____ Student Name: _____

AP PHYSICS 2: FLUID MECHANICS

Directions: Each of the questions or incomplete statements below is followed by five suggested answers or completions. Select the one that is best in each case and place the letter of your choice in the corresponding box on the student answer sheet.

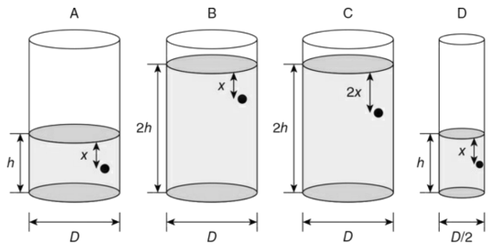
Note: To simplify calculations, you may use $g = 10\,\text{m/s}^2$ in all problems.

1. Two blocks of different sizes and masses float in a tray of water. Each block is half submerged, as shown in the figure. Water has a density of $1000\,\text{kg/m}^3$. What can be concluded about the densities of the two blocks?



(A) The two blocks have different densities, both of which are less than $1000\,\text{kg/m}^3$.
(B) The two blocks have the same density of $500\,\text{kg/m}^3$.
(C) The two blocks have the same density, but the density cannot be determined with the information given.
(D) The larger block has a greater density than the smaller block, but the densities of the blocks cannot be determined with the information given.

2. The figure shows four cylinders of various diameters filled to different heights with water. A hole in the side of each cylinder is plugged by a cork. All cylinders are open at the top. The corks are removed. Which of the following is the correct ranking of the velocity of the water (v) as it exits each cylinder?

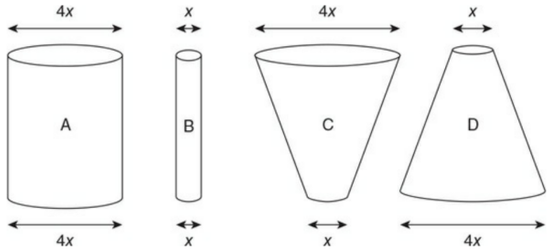


(A) $v_A > v_D > v_C > v_B$
(B) $v_A = v_D > v_C > v_B$
(C) $v_B > v_C > v_A = v_D$
(D) $v_C > v_A = v_B = v_D$

3. A 1 cm diameter pipe leads to a showerhead with twenty 1 mm diameter exit holes. The velocity of the water in the pipe is v. What is the velocity of the water exiting the holes?

(A) $0.05v$
(B) $0.5v$
(C) $5v$
(D) $100v$

Questions 4 and 5
Four differently shaped sealed containers are completely filled with alcohol, as shown below. Containers A and B are cylindrical. Containers C and D are truncated conical shapes. The top and bottom diameters of the containers are shown.



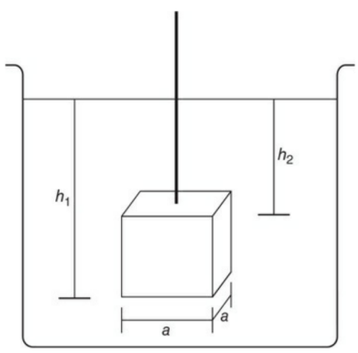
4. Which of the following is the correct ranking of the pressure (P) at the bottom of the containers?

(A) $P_A = P_B = P_C = P_D$
(B) $P_A = P_D > P_C = P_B$
(C) $P_A > P_D > P_C > P_B$
(D) $P_D > P_A > P_C > P_B$

5. The force on the bottom of container A due to the fluid inside the container is F. What is the force on the bottom of container B due to the fluid inside?

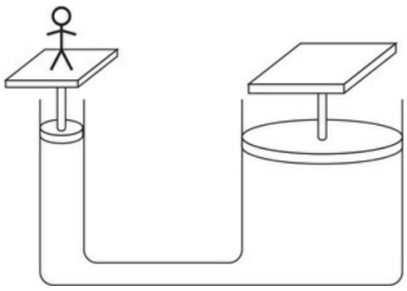
(A) F
(B) $F/4$
(C) $F/8$
(D) $F/16$

6. A mass m is suspended in a fluid of density ρ by a string, as shown in the figure below. The tension in the string is T. Which of the following is an appropriate equation for the buoyancy force? Select two answers.



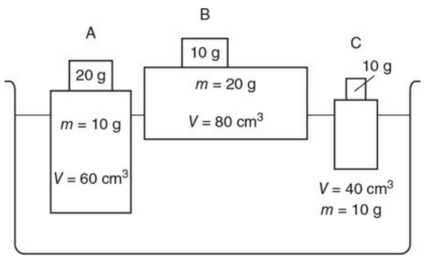
(A) $F_b = mg$
(B) $F_b = mg - T$
(C) $F_c = a_2\rho g h_1$
(D) $F_d = a\rho g(h_1 - h_2)$

7. Two cylinders filled with a fluid are connected by a pipe so that fluid can pass between the cylinders, as shown in the figure. The cylinder on the right has 4 times the diameter of the cylinder on the left. Both cylinders are fitted with a movable piston and a platform on top. A person stands on the left platform. Which of the following lists the correct number of people that need to stand on the right platform so neither platform moves. Assume that the platform and piston have negligible mass and that all the people have the same mass.



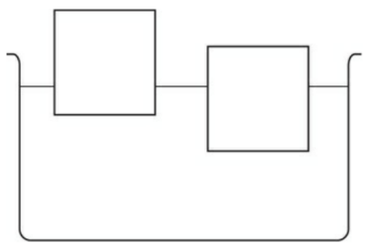
(A) 16 people
(B) 4 people
(C) 1 person
(D) It is impossible to balance the system because you need 1/16 of a person on the right side.

8. Three wooden blocks of different masses and sizes float in a container of water, as shown in the figure. Each of the masses has a weight on top. Which of the following correctly ranks the buoyancy force on the wooden blocks?



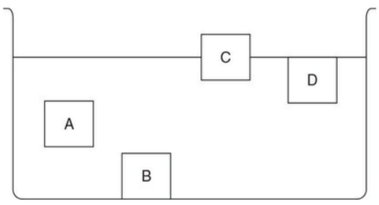
(A) $A > B = C$
(B) $A = B > C$
(C) $B > A = C$
(D) $B > A > C$

9. Two blocks of the same dimensions are floating in a container of water, as shown in the figure. Which of the following is a correct statement about the two blocks?



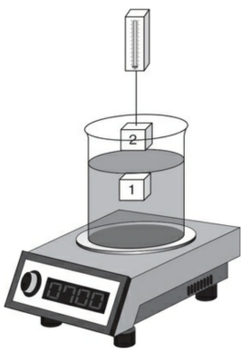
(A) The net force on both blocks is the same.
(B) The buoyancy force exerted on both blocks is the same.
(C) The density of both blocks is the same.
(D) The pressure exerted on the bottom of each block is the same.

10. The figure shows four cubes of the same volume at rest in a container of water. Cube C is partially submerged. Cubes A, B, and D are fully submerged, with B resting on the bottom of the container. Which of the following correctly ranks the densities (ρ) of the cubes? Assume the water to be incompressible.



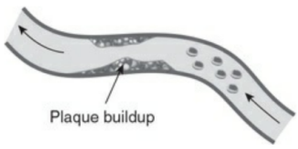
(A) $\rho_C > \rho_D > \rho_A > \rho_B$
(B) $\rho_B > \rho_A > \rho_D > \rho_C$
(C) $\rho_B > \rho_A = \rho_D > \rho_C$
(D) $\rho_B > \rho_A = \rho_D = \rho_C$

11. A beaker of water sits on a balance. A metal block with a mass of 70 g is held suspended in the water by a spring scale in position 1, as shown. In this position, the reading on the balance is 1260 g, and the spring scale reads 120 g. When the block is lifted from the water to position 2, what are the readings on the balance and spring scale?



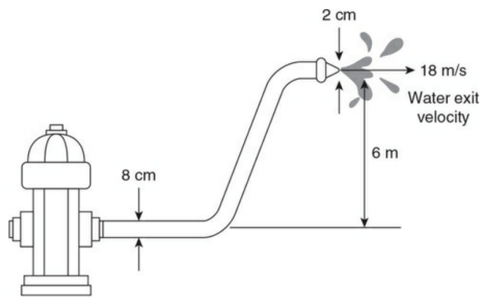
	Balance reading	**Spring scale reading**
(A)	1190 g	120 g
(B)	1190 g	190 g
(C)	1260 g	120 g
(D)	1330 g	120 g

12. Blood cells pass through an artery that has a buildup of plaque along both walls, as shown in the figure. Which of the following correctly describes the behavior of the blood cells as they move from the right side of the figure through the area of plaque? Assume the blood cells can change volume.



(A) The blood cells increase in speed and expand in volume.
(B) The blood cells increase in speed and decrease in volume.
(C) The blood cells decrease in speed and expand in volume.
(D) The blood cells decrease in speed and decrease in volume.

13. Firefighters use a hose with a 2 cm exit nozzle connected to a hydrant with an 8 cm diameter opening to attack a fire on the second floor of a building 6 m above the hydrant, as shown in the figure. What pressure must be supplied at the hydrant to produce an exit velocity of 15 m/s? (Assume the density of water is $1000\,\text{kg/m}^3$, and the exit pressure is 1×10^5 Pa.)



(A) 1.7×10^5 Pa
(B) 2.0×10^5 Pa
(C) 2.6×10^5 Pa
(D) 3.2×10^5 Pa