Fluid Mechanics Worksheet 2
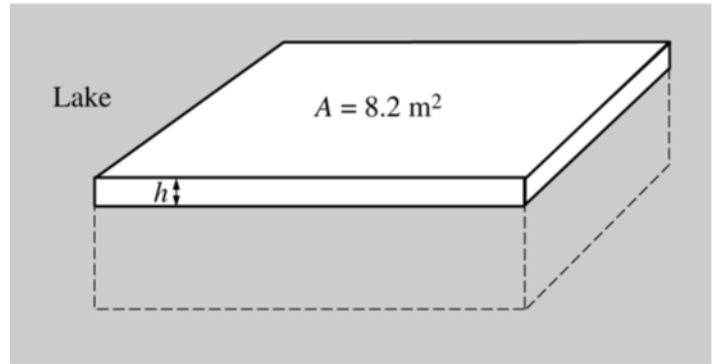
1. A large rectangular raft (density 650 kg/m³) is floating on a lake. The surface area of the top of the raft is 8.2 m² and its volume is 1.80 m³. The density of the lake water is 1000 kg/m³.

    Lake   A = 8.2 m²

    h

    Note: Figure not drawn to scale.

    a. Calculate the height h of the portion of the raft that is above the surrounding water.

    b. Calculate the magnitude of the buoyant force on the raft and state its direction.

    c. If the average mass of a person is 75 kg, calculate the maximum number of people that can be on the raft without the top of the raft sinking below the surface of the water. (Assume that the people are evenly distributed on the raft.)

2. A T-shaped tube with a constriction is inserted in a vessel containing a liquid, as shown to the right. What happens if air is blown through the tube from the left, as shown by the arrow in the diagram?
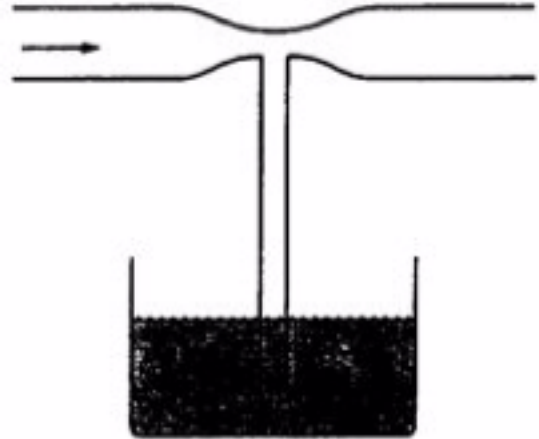
   (A) The liquid level in the tube rises to a level above the surface of the liquid surrounding the tube.

   (B) The liquid level in the tube falls below the level of the surrounding liquid.

   (C) The liquid level in the tube remains where it is.

   (D) The air bubbles out at the bottom of the tube.

   (E) Any of the above depending on how hard the air flows

3. The radius of the aorta is about 1 cm and the blood flowing through it has a speed of about 30 $\frac{cm}{s}$. Calculate the average speed of the blood in the capillaries given the total cross section of all the capillaries is about 2000 cm^2.

4. How large must a heating duct be if air moving 3 $\frac{m}{s}$ along it can replenish the air in a room of 300 m^3 volume every 15 minutes? Assume the air's density remains constant.

5. Water circulates throughout a house in a hot water heating system. If the water is pumped at a speed of $0.5 \frac{m}{s}$ through a 2 cm diameter pipe in the basement under a pressure of 3 atm, what will be the flow speed and pressure in a 1.3 cm diameter pipe on the second floor 5 m above?

6. The side of an above ground pool is punctured, and water gushes out through the hole. If the total depth of the pool is 2.5 m, and the puncture is 1 m above the ground level, what is the efflux speed of the water?
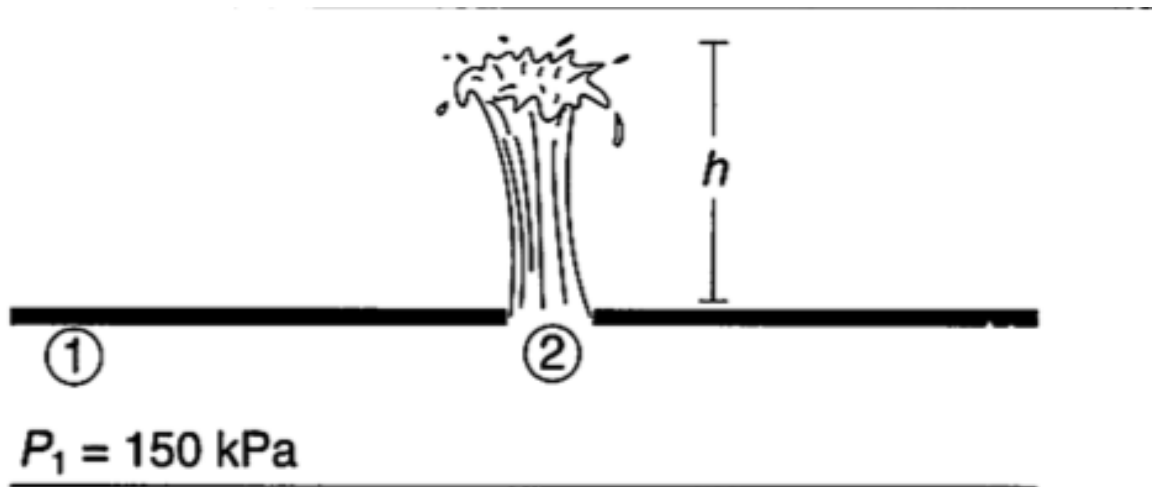
$P_1 = 150$ kPa

7.   In a town's water system, pressure gauges in still water at street level read 150 kPa. If a pipeline connected to the system breaks and shoots water straight up, how high above the street does the water shoot?