Fluids Homework — Physics

Assignment #1 — Read pages 383-388.

1. What is a fluid?

2. A block of Brown Ebony wood is 50 cm long, 20 cm wide, and 15 cm tall. It has a mass of 18 kg. Find the block's density in grams per cm^3.

3. Use the chart on page 384 to calculate the mass of each object:
    a. A 0.5 cm^3 gold filling
    b. A pint (470 cm^3) of blood
    c. A quart (946 cm^3) of crude oil

4. Convert 1.42 atm of pressure to:
    a. Pascals
    b. torr
    c. millibars
    d. psi
    e. mmHg

5. Write the definition of pressure.

6. What instrument is used to measure atmospheric pressure?

7. A 500-N woman balances on one heel of a pair of high-heeled shoes. If the heel is circular and has a radius of 0.5 cm, what pressure does she exert on the floor?

8. If the top of your head has a surface area of 100 cm^2, what is the weight of the air above your head? Normal atmospheric pressure is 101,300 N/m^2

9. The four tires of a car are inflated to a gauge pressure of 200 kPa. Each tire has an area of 0.024 m^2 in contact with the ground. Determine the weight of the car.

10. What is the difference between gauge pressure and absolute pressure?

11. The tire gauge says the pressure inside your tire is 34 psi. The atmospheric pressure that day is 14.8 psi. What is the absolute pressure of the air in your tire?

12. A salt water pool is 2.5 meters at the deep end. Find the pressure at the bottom of the pool when the atmospheric pressure is 1 atm (101,300 Pa). Density of sea water = 1025 kg/m^3.

13. Honors: Two drinking glasses of the same weight but of different shape and different cross-sectional area are filled to the same level with water. According to the expression $P = P_o + \rho gh$, the pressure at the bottom of both glasses is the same. In view of this, why does one glass weigh more than the other?

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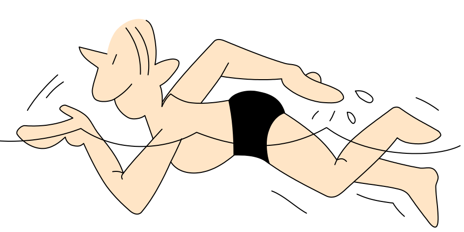
Assignment #2 — Read pages 389 - 395.

14. Write Pascal's Principal.
15. The small piston of a hydraulic lift has a cross-sectional area of 3.0 cm^2, and its large piston has a cross-sectional area of 200 cm^2. What force must be applied to the small piston for it to raise a load of 15,000 N?
16. Lead has a greater density than iron, and both metals are denser than water. Is the buoyant force on a lead object greater than, less than or equal to the buoyant force on an iron object of the same volume?
17. When is the buoyant force on a swimmer greater – after exhaling or after inhaling? Explain why.
18. Steel is much denser than water. In view of this fact, how do steel ships float?
19. A light balloon is filled with 400 m^3 of helium at 0°C.
    a. What is the buoyant force on the balloon? (Density of air = 1.29 kg/m^3)
    b. The density of helium at 0°C is 0.179 kg/m^3. What is the weight of the balloon? (Ignore the actual balloon and just use the weight of the helium.)
    c. What is the mass of the payload that the balloon can lift?
20. A priceless vase falls off a ship into sea water. The volume of the vase is 0.12 m^3.
    a. What is the buoyant force on the vase?
    b. If the vase has a mass of 100 kg, will it sink or float?
21. Big Bubba has a volume of 0.5 m^3. When Bubba jumps in the swimming pool:
    a. What is the buoyant force on Bubba?
    b. If Bubba has a mass of 800 kg, will Bubba sink or float?
22. An iceberg is floating in sea water (density = 1030 kg/m^3). The total volume of the iceberg is 500 m^3. If the density of the ice is 920 kg/m, what volume of the iceberg is floating under water?
23. Honors: A Styrofoam slab has a thickness of 10.0 cm and a density of 300 kg/m^3. When a 75.0-kg swimmer is resting on it, the slab floats in fresh water with its top at the same level as the water's surface. Find the area of the slab. The density of water is 1000 kg/m^3.
24. Honors: A piece of aluminum with mass 1.0 kg and density of 2700 kg/m^3 is suspended from a string and then completely immerse in a container of water. Calculate the tension in the string before and after the metal is immersed.



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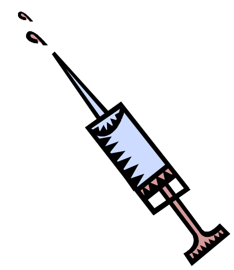
Assignment #3 Read pages 396 - 401.

25. List the four properties of an ideal fluid.
26. Calculate the flow rate for each problem:
    a. Cross-sectional area of pipe = 0.4 m^2, Velocity = 26 m/s
    b. Cross-sectional area of pipe = 6 in^2, Velocity = 150 in/minute
27. The flow rate through a pipe (radius = 0.05 meters) is 2.4 m^3/s.
    a. What is the cross-sectional area of the pipe?
    b. Find the velocity of the fluid as it moves through the pipe.
28. As water flows from a faucet at a moderate rate, explain why the stream of water become narrower as it descends.
29. Each second 5525 m^3 of water flows over the 670-meter wide cliff of the Horseshoe Falls portion of Niagara Falls. The water is approximately 2 meters deep as it reaches the cliff.
    a. Which number in the problem tells you the flow rate?
    b. Calculate the area through which the water flows.
    c. Calculate the speed of the water as it passes over the cliff.



30. The barrel of a hypodermic syringe has a cross-sectional area of 2.5 x 10^{-5} m^2, and the needle has a cross-sectional area of 1.00 x 10^{-8} m^2. If the medicine in the barrel moves at a speed of 0.10m/s when the plunger is pushed, what is the speed of the medicine when it exits the tip of the needle? Use the continuity equation.
31. List the three variables of fluid flow that are used in the Bernoulli equation.
32. A fluid flows through a Venturi tube. When the fluid reaches the narrow area:
    a. What happens to the velocity of the fluid?
    b. What happens to the pressure in the tube?
33. A large tank of water is elevated 20 meters above the ground. The pressure inside the tank is equal to the atmospheric pressure. A hose used to drain the tank has an area of 0.03 m2. Find the velocity of the water coming out of the hose.

P_1 =	P_2 =
v_1 =	v_2 =
h_1 =	h_2 =

34. A pipe that has an area of 0.07 m^2 is used to pump water from the Colorado River up to Grand Canyon Village, located on the rim of the canyon. The river is at an elevation of 564 m, and the village is at an elevation of 2096 m.
    a. What is the minimum pressure at which the water must be pumped if it is to arrive at the village? Assume that the water is under zero pressure at the end of the pipe. The velocity of the water is the same at the beginning and end of the pipe. Use Bernoulli's equation.

P_1 =	P_2 =
v_1 =	v_2 =
h_1 =	h_2 =

    b. If 4500 m^3 are pumped per day, what is the speed of the water in the pipe? Hint: Change the flow rate to cubic meters <u>per second</u> and use the flow rate formula.