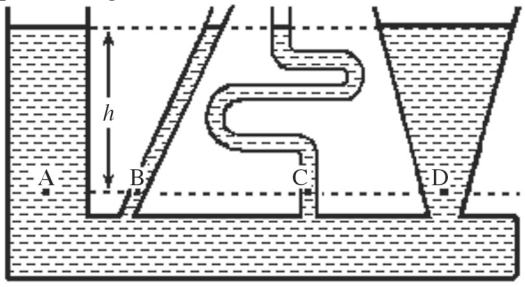
1) A styrofoam sphere of radius R has a density ϱ. You now carefully compress the sphere so its radius is $R/2$. What is the density of the compressed sphere?

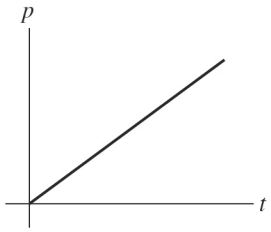
A) $\varrho\sqrt{8}$ B) $\varrho\sqrt{2}$ C) 8 ϱ D) 4 ϱ E) 2 ϱ

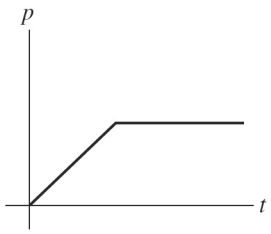
2) As shown in the figure, fluid fills a container having several sections. At which of the indicated points is the pressure greatest?

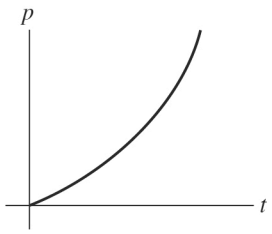


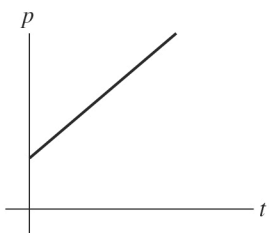
A) A
B) B
C) C
D) D
E) The pressure is the same at each of the labeled points.

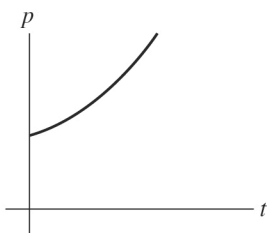
3) A cubical block of stone is lowered at a steady rate into the ocean by a crane, always keeping the top and bottom faces horizontal. Which one of the following graphs best describes the gauge pressure p on the bottom of this block as a function of time t if the block just enters the water at time $t = 0$ s?

A)


B)


D)


C)


E)


4) A closed cubical chamber resting on the floor contains oil and a piston. If you push down on the piston hard enough to increase the pressure just below the piston by an amount Δp, which of the following statements is correct? (There could be more than one correct choice.)

A) The pressure on the sides of the chamber will not increase.
B) The pressure everywhere in the oil will increase by Δp.
C) The pressure at the top of the oil will increase by less than Δp.
D) The increase in the force on the top of the chamber will be the same as the increase in the force on the bottom of the chamber.
E) The pressure at the bottom of the oil will increase by more than Δp.

5) A spherical ball of lead (density 11.3 $\mathrm{g/cm^3}$) is placed in a tub of mercury (density 13.6 $\mathrm{g/cm^3}$). Which answer best describes the result?

A) The lead ball will float with its top exactly even with the surface of the mercury.
B) The lead ball will float with about 83% of its volume above the surface of the mercury.
C) The lead will sink to the bottom of the mercury.
D) The lead ball will float with about 17% of its volume above the surface of the mercury.

6) Salt water has greater density than fresh water. A boat floats in both fresh water and in salt water. Where is the buoyant force greater on the boat?

A) in salt water
B) in fresh water
C) The buoyant force is the same in both cases.

7) A 10–kg piece of aluminum sits at the bottom of a lake, right next to a 10–kg piece of lead, which is much denser than aluminum. Which one has the greater buoyant force on it?

A) Both have the same buoyant force.
B) the aluminum
C) the lead
D) It cannot be determined without knowing their volumes.

8) As a rock sinks deeper and deeper into water of constant density, what happens to the buoyant force on it if it started above the surface of the water?

A) The buoyant force first increases and then remains constant.
B) The buoyant force remains constant.
C) The buoyant force keeps increasing steadily.
D) The buoyant force steadily decreases.

9) When you blow some air above a paper strip, the paper rises. This happens because

A) the air above the paper moves slower and the pressure is lower.
B) the air above the paper moves faster and the pressure is lower.
C) the air above the paper moves slower and the pressure is higher.
D) the air above the paper moves faster and the pressure remains constant.
E) the air above the paper moves faster and the pressure is higher.

10) Two horizontal pipes have the same diameter, but pipe B is twice as long as pipe A. Water undergoes viscous flow in both pipes, subject to the same pressure difference across the lengths of the pipes. If the flow rate in pipe B is $Q = \dfrac{\Delta V}{\Delta t}$ what is the flow rate in pipe A?

A) $2Q$ B) $8Q$ C) $16Q$ D) $4Q$ E) $Q\sqrt{2}$

11) Under standard conditions, the density of air is 1.29 kg/m^3. What is the mass of the air inside a room measuring 4.0 m × 3.0 m × 2.0 m?

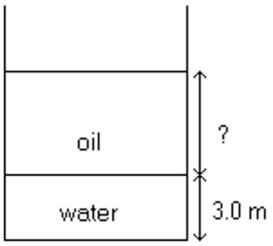
12) A 100–kg person sits on a 5–kg bicycle. The total weight is borne equally by the two wheels of the bicycle. The tires are 2.0 cm wide and are inflated to a gauge pressure of 8.0×10^5 Pa. What length of each tire is in contact with the ground?

13) A brick weighs 50.0 N, and measures 30.0 cm × 10.0 cm × 4.00 cm. What is the *maximum* pressure it can exert on a horizontal surface due to its weight?

14) The deepest point of the Pacific Ocean is 11,033 m, in the Mariana Trench. What is the gauge pressure in the water at that point? The density of seawater is 1025 kg/m^3.

15) A circular window 30 cm in diameter in a submarine can withstand a *net* maximum force of 5.20×10^5 N without damage. What is the maximum depth in a fresh–water lake to which the submarine can go without damaging the window? The density of fresh water is 1000 kg/m^3.

16) As shown in the figure, a large open tank contains a layer of oil (density 450 kg/m^3) floating on top of a layer of water (density 1000 kg/m^3) that is 3.0 m thick, as shown in the sketch. What must be the thickness of the oil layer if the gauge pressure at the bottom of the tank is to be 8.5×10^4 Pa?



17) A 500–N weight sits on the small piston of a hydraulic machine. The small piston has an area of 2.0 cm^2. If the large piston has an area of 40 cm^2, how much weight can the large piston support? Assume the pistons each have negligible weight.

18) A block of metal weighs 40 N in air and 30 N in water. What is the buoyant force on the block due to the water? The density of water is 1000 kg/m^3.

19) What buoyant force does a 0.60–kg solid gold crown experience when it is immersed in water? The density of gold is 19.3×10^3 kg/m^3 and that of water is 1000 kg/m^3.

20) A piece of aluminum with a mass of 1.0 kg and density of 2700 kg/m^3 is suspended from a light cord and then completely immersed in a container of water having density 1000 kg/m^3.
(a) Determine the volume of the piece of aluminum.
(b) Determine the tension in the cord when the aluminum is immersed in the container of water.

21) An object floats with half its volume beneath the surface of the water. The weight of the displaced water is 2000 N. What is the weight of the object? The density of water is 1000 kg/m^3.

22) A wooden raft has a mass of 55 kg. When empty it floats in water (density 1000 kg/m^3) with 64% of its volume submerged. What maximum mass of sand can be put on the raft without sinking it?

23) A solid sphere of mass 8.6 kg, made of metal whose density is 3400 kg/m^3, hangs by a cord. When the sphere is immersed in a liquid of unknown density, the tension in the cord is 38 N. The density of the liquid is closest to which one of the following values?

24) A person who weighs 550 N empties her lungs as much as possible and is then completely immersed in water of density 1000 kg/m^3 while suspended from a harness. Her apparent weight is now 21.2 N. What is her density?

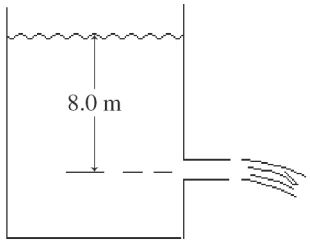
25) Consider a very small hole in the bottom of a tank that is 17.0 cm in diameter and filled with water to a height of 90.0 cm. Find the speed at which the water exits the tank through the hole.

26) Fluid flows at 2.0 m/s through a pipe of diameter 3.0 cm. What is the volume flow rate of the fluid?

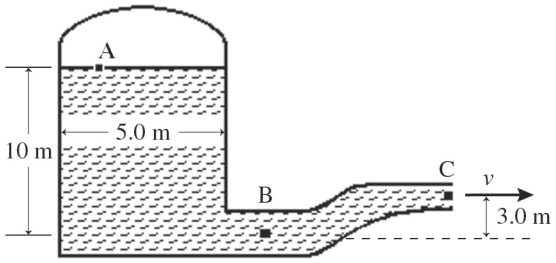
27) Ideal incompressible water flows through a horizontal pipe of cross-sectional area 10.0 cm^2 at a pressure of 0.250 atm with a volume flow rate of 1.00×10^{-3} m^3/s. At a valve, the effective cross-sectional area of the pipe is reduced to 5.00 cm^2. What is the pressure at the valve?

28) Water is flowing in a drainage channel of rectangular cross-section. The width of the channel is 15 m, the depth of water is 8.0 m, and the speed of the flow is 2.5 m/s. What is the mass flow rate of the water? The density of water is 1000 kg/m^3.

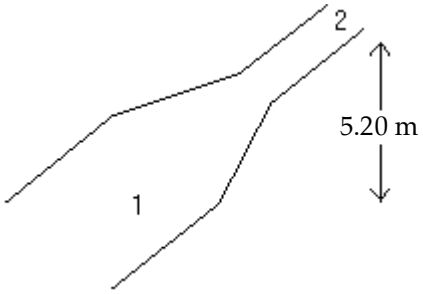
29) Water flows out of a large reservoir through an open pipe, as shown in the figure. What is the speed of the water as it comes out of the pipe?



30) A pressurized cylindrical tank, 5.0 m in diameter, contains water that emerges from the pipe at point C with a speed of 84 m/s, as shown in the figure. Point A is 10 m above point B and point C is 3.0 m above point B. The area of the pipe at point B is 0.080 m^2 and the pipe narrows to an area of 0.070 m^2 at point C. Assume that the water is an ideal fluid in laminar flow. The density of water is 1000 kg/m^3. The rate at which the water level is falling in the tank is closest to



31) As shown in the figure, water (density 1000 kg/m^3) is flowing in a pipeline. At point 1 the water speed is 5.90 m/s. Point 2 is 5.20 m above point 1. The cross-sectional area of the pipe is 0.0800 m^2 at point 1 and 0.0200 m^2 at point 2. What is the pressure *difference* $p1 - p2$ between points 1 and 2? Treat the water as an ideal incompressible fluid.



32) A fluid is flowing with an average speed of 1.5 m/s through a tube that has a radius of 2.0 mm and is 18 cm long. The drop in pressure is 967 Pa. What is the viscosity of the fluid?

Answer Key
Testname: HW_CH10_FLUIDS

1) C
2) E
3) A
4) B, D
5) D
6) C
7) B
8) A
9) B
10) A
11) 31 kg
12) 3.2 cm
13) 12.5 kPa
14) 1.11×10^{8} Pa
15) 750 m
16) 13 m
17) 10000 N
18) 10 N
19) 0.30 N
20) (a) $3.7 \times 10^{-4}\ \mathrm{m}^3$ (b) 6.2 N
21) 2000 N
22) 31 kg
23) $1900\ \mathrm{kg/m^3}$
24) $1040\ \mathrm{kg/m^3}$
25) $4.20\ \mathrm{m/s}$
26) $1.4 \times 10^{-3}\ \mathrm{m^3/s}$
27) 0.235 atm
28) $3.0 \times 10^{5}\ \mathrm{kg/s}$
29) $13\ \mathrm{m/s}$
30) 300 mm/s.
31) 3.12×10^{5} Pa
32) $0.0018\ \mathrm{N \cdot s/m^2}$