Type: Single Date:__________

Objective: Fluid Dynamics Review

Homework: Study for Test #8: Fluid Dynamics!

AP Physics Date ___________
Mr. Mirro

Fluid Dynamics Review

1) Using the value of atmospheric pressure at sea level, 1.0×10^5 Pascal's, estimate the total mass of the Earth's atmosphere above a flat building rooftop with an area of 5.0 m^2.

a) 5.0×10^4 kg b) 9.0×10^2 kg c) 2.0×10^{-4} kg
d) 4.0×10^{-2} kg e) 5.0×10^5 kg.

2) The statement based on observed fact,

"**An object submerged in a fluid displaces its own volume of fluid**."

is:

a) an *exact* statement of Zeno's paradox
b) an *exact* statement of Archimedes' principle
c) an *exact* statement of Pascal's principle
d) a *true* statement, but is none of the above
e) a *false* statement.

3) A student standardizes the concentration of a salt water solution by slowly adding salt until an egg will just float. This procedure is based on the assumption that

a) all eggs have the same volume
b) all eggs have the same weight
c) all eggs have the same density
d) all eggs have the same shape
e) the salt tends to neutralize the cholesterol in the egg.

4) A loaded ship passes from a lake (which is fresh) water to the open sea (which is salt water). Salt water is more dense than the fresh water, and thus, as a result, the ship will

a) ride higher in the water
b) settle lower in the water
c) ride at the same level in the water
d) displace more water
e) experience a decrease in buoyant force.

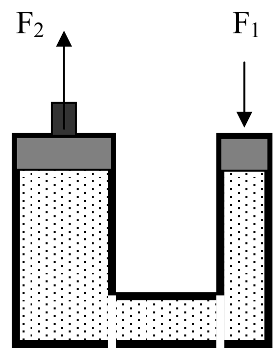
5) The apparent weight of a steel sphere immersed in various liquids is measured using a spring scale. The greatest reading is obtained for that liquid

a) having the smallest density
b) having the largest density
c) subject to the greatest atmospheric pressure
d) having the greatest displaced volume
e) in which the sphere was submerged to the greater depth.

6) A balloon inflated with helium gas (density = 0.2 kg/m^3) has a volume of 6.0 x 10^{-3} m^3. If the density of air is 1.5 kg/m^3, what is the approximate buoyant force exerted on the balloon?

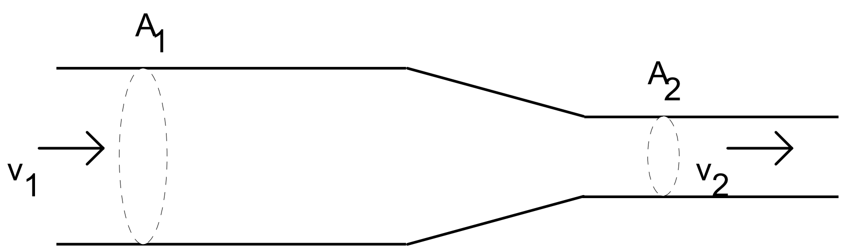
a) 0.012 N
b) 0.09 N
c) 1.0 N
d) 1.5 N
e) 8.0 N.

7) In a hydraulic press such as the one shown, the large piston has a cross-sectional area of A_2 = 100 cm^2 and the small piston has a cross-sectional area A_1 = 10 cm^2. If a force of 200 N is applied to the small piston, find the force F_2 on the large piston.



a) 0.2 N
b) 20 N
c) 200 N
d) 2000 N
e) 20000 N

8) An incompressible liquid flows along the pipe as shown, in which A_1 is the area of the pipe segment shown, v_1 is the fluid speed at A_1. The fluid then passes into a different pipe segment which has area A_2, yielding the fluid speed v_2. The ratio of the speeds v_2 to v_1 is



a) $\frac{A_1}{A_2}$ b) $\frac{A_2}{A_1}$ c) $\sqrt{\frac{A_1}{A_2}}$ d) $\sqrt{\frac{A_2}{A_1}}$ e) $\frac{v_1}{v_2}$

9) Water flows through a constriction in a horizontal pipe. As it enters the constriction, the water's

a) speed increases and the lateral pressure decreases
b) speed increases and the lateral pressure remains constant
c) speed increases and the lateral pressure increases
d) speed decreases and the lateral pressure increases
e) speed decreases and the lateral pressure decreases.

10) A non-viscous incompressible liquid is flowing through a horizontal pipe of constant cross section. Bernoulli's equation predicts that the drop in pressure along the pipe

a) depends on the height of the pipe
b) depends on the length of the pipe
c) depends on the fluid velocity
d) depends on the cross sectional area of the pipe
e) is zero

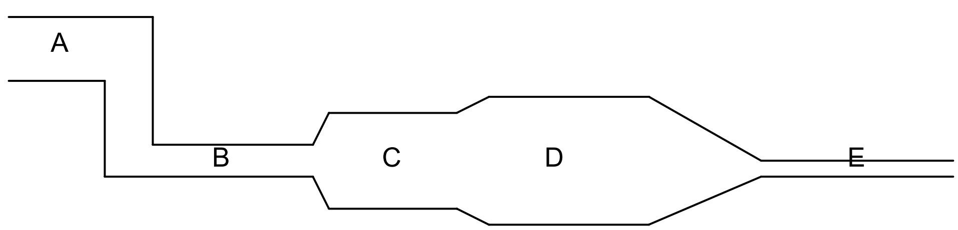
11) Consider a pipe containing a fluid and the fluid is at rest. To apply Bernoulli's equation to this situation

a) set P equal to the atmospheric pressure
b) set g equal to zero because there is no acceleration
c) set v equal to zero because there is no liquid motion
d) set both v and g equal to zero
e) can not be done, as Bernoulli's equation applies only to fluids in motion.

12) Water enters a pipe of diameter 0.03 m with a velocity of 3.0 m/s. The water encounters a constriction where its velocity is 12.0 m/s. What is the diameter of the constricted portion of the pipe?

a) 3.3×10^{-3} m
b) 7.5×10^{-3} m
c) 1.0×10^{-2} m
d) 1.5×10^{-2} m
e) 0.12 m

13) A horizontal piping system that delivers a constant flow of water is constructed from pipes with different diameters as shown,

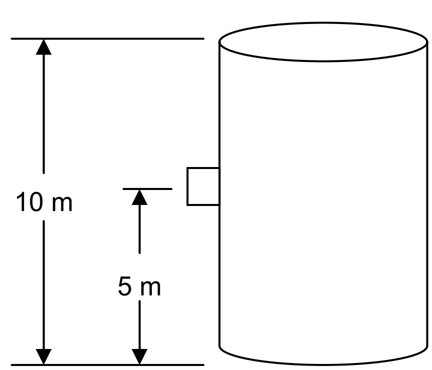


At which of the labeled points is the water in the pipe under the greatest pressure ?

a) A b) B c) C d) D e) E

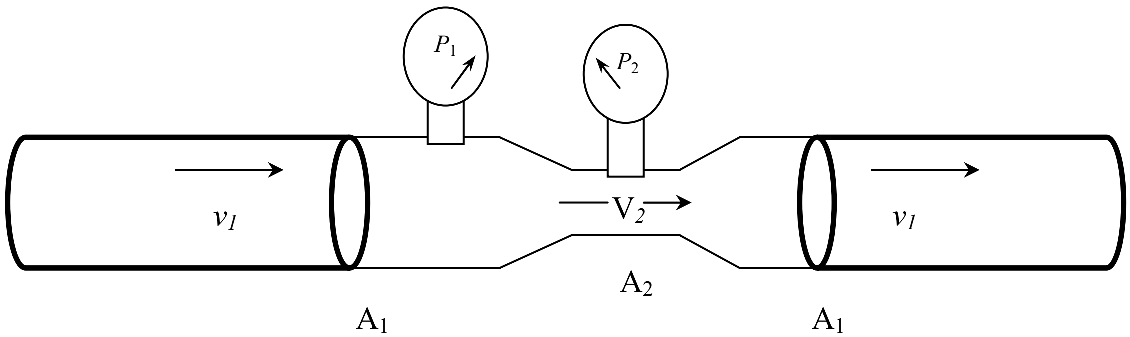
14) A large tank is filled with water to a depth of 10 m. A spout located 5 m above the bottom of the tank is then opened as shown in the drawing. With what speed will water emerge from the spout ?

a) 3 m/s
b) 10 m/s
c) 15 m/s
d) 17 m/s
e) 30 m/s



15) There is a class of situations in which the change in gravitational potential energy is ignorably small and Bernoulli's equation then relates differences in pressure to differences in kinetic energy, and therefore speed.

Consider the device shown below used to measure and relate the pressure differential to the speed of the fluid in the pipe.

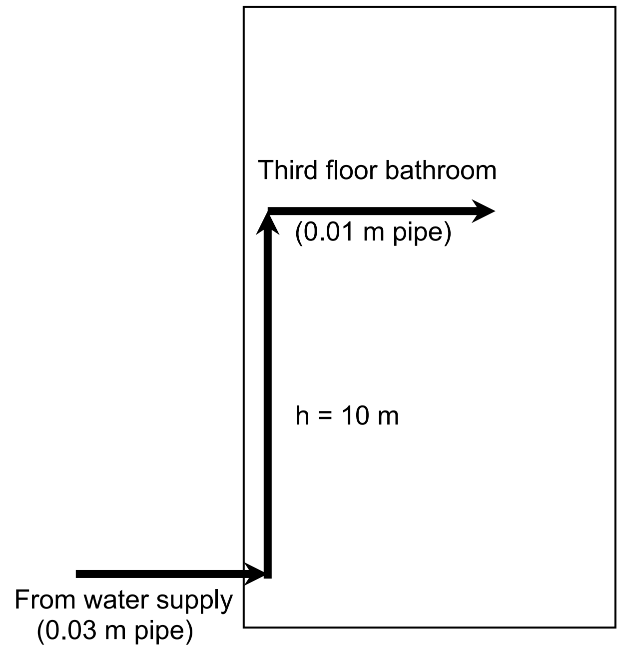


The device shown is an application of

a) Pascal's principle b) Archimedes' principle c) Venturi effect d) Turbulent flow e) Continuity

16. Water enters a house through a pipe with an inside diameter of 0.03 m at an absolute pressure of 3 atm (3×10^5 Pa). A 0.01 m diameter pipe leads to the third floor bathroom 10.0 m above. When the flow speed at the inlet pipe is 2 m/s, find

a. Flow speed in the bathroom



b. Pressure in the bathroom

c. How many liters per second could leave the faucet in the bathroom ?

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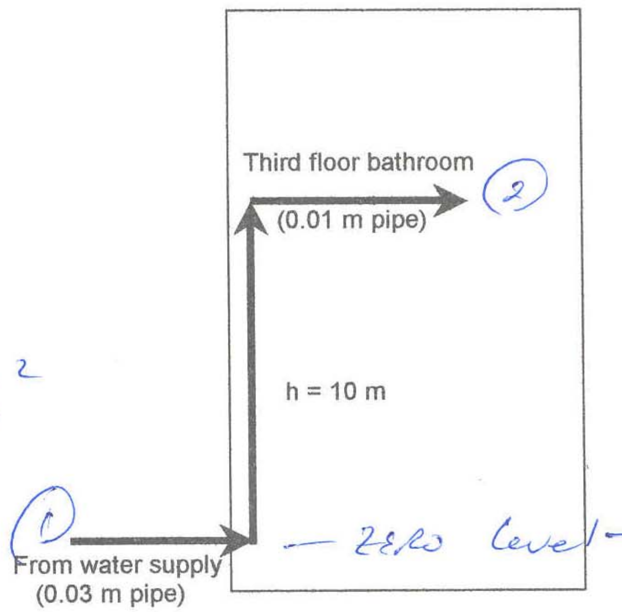

a. Flow speed in the bathroom

$A_1 V_1 = A_2 V_2$

So $V_2 = \frac{A_1}{A_2} V_1 = \frac{\pi (.015)^2}{\pi (.005)^2} (2)$

$V_2 = 9(2) = 18 \frac{m}{s}$

b. Pressure in the bathroom

$P_1 + \rho g y_1 + \frac{1}{2}\rho V_1^2 = P_2 + \rho g y_2 + \frac{1}{2}\rho V_2^2$

$P_1 + \frac{1}{2}\rho V_1^2 = P_2 + \rho g y_2 + \frac{1}{2}\rho V_2^2$

$P_2 = P_1 + \frac{1}{2}\rho V_1^2 - \rho g y_2 - \frac{1}{2}\rho V_2^2$

$P_2 = 3\times10^5 + \frac{1}{2}(1000)(2)^2 - (1000)(10)(10) - \frac{1}{2}(1000)(18)^2$

$P_2 = 3\times10^5 + 2\times10^3 - 1\times10^5 - 1.62\times10^5$

$P_2 = 40{,}000$ Pa

c. How many liters per second could leave the faucet in the bathroom ?

$Q = AV = \pi R^2 V$

$Q = \pi (.005)^2 (18)$

$Q = 1.4\times10^{-3} \frac{m^3}{s} \left(\frac{1 L}{1\times10^{-3} m^3}\right) = 1.4$ L/sec