FLUID MECHANICS

1) A piece of iron rests on top of a piece of wood floating in a bath. If the iron is removed from the wood, what happens to the water level in the tub?
A) It goes up.
B) It goes down.
C) It does not change.
D) impossible to determine from the information given
Answer: B

2) When you blow some air above a paper strip, the paper rises. This is because
A) the air above the paper moves faster and the pressure is higher.
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 slower and the pressure is lower.
Answer: B

3) What is the absolute pressure at a location 15.0 m below the surface of sea? (The density of seawater is 1.03x10³ kg/m³.)
A) 1.01 x 10⁵ N/m²
B) 1.51 x 10⁵ N/m²
C) 2.48 x 10⁵ N/m²
D) 2.52 x 10⁵ N/m²
Answer: D

4) A rectangular box of negligible mass measures 5.0 m long, 1.0 m wide, and 0.50 m high. How many kilograms of mass can be loaded onto the box before it sinks in a lake?
A) 0.5 x 10³ kg
B) 1.5 x 10³ kg
C) 2.5 x 10³ kg
D) 3.5 x 10³ kg
Answer: C

5) A 200-N object floats with three-fourths of its volume beneath the surface of the water. What is the buoyant force on the object?
A) 50 N
B) 150 N
C) 200 N
D) 267 N
Answer: C

6) Liquid flows through a pipe of diameter 3.0 cm at 2.0 m/s. Find the flow rate.
A) 1.4 x 10⁻³ m³/s
B) 5.7 x 10⁻³ m³/s
C) 14 m³/s
D) 57 m³/s
Answer: A

7) Water flows at 12 m/s in a horizontal pipe with a pressure of 3.0 x 10⁴ N/m². If the pipe widens to twice its original radius, what is the pressure in the wider section?
A) 3.0 x 10⁴ N/m²
B) 4.9 x 10⁴ N/m²
C) 7.4 x 10⁴ N/m²
D) 9.8 x 10⁴ N/m²
Answer: D

Example: The Figure shows the Venturi meter use to measure the flow rate of a fluid. A tube has liquid of density ρ_F and cross-sectional area A_2 is connected to the pipe the fluid rate to be measured. The tube cross-sectional area is A_1. Find the speed of the fluid V_1 in the pipe.

Solution: Assume the pressure in the pipe is P_F. Then there is a drop in the pressure at the surface of the liquid because the area has been changed. Assume the pressure at A_F is P_F. The apply Bernoulli’s equation, we have:

\[ P_1 + \frac{1}{2} \rho_L V_1^2 = P_2 + \frac{1}{2} \rho_L V_2^2 \]

but \( y_L = y_F \). and the pressure drop is

\[ P_L - P_F = -\rho_L g (y_2 - y_1) = -\rho_L g h, \]

where \( h = (y_2 - y_1) \). \( V_2 = \frac{A_1}{A_2} V_1 \)

\[ -\rho_L g h + \frac{1}{2} \rho_L \left( \frac{A_1}{A_2} V_1 \right)^2 = \frac{1}{2} \rho_L V_1^2 \]

\[ V_1 = \sqrt{\frac{2 \rho_L g h}{\rho_L \left( \frac{A_1}{A_2} \right)^2 - 1}} \]