

Chapter 10

Terms

Be able to define or discuss the following terms and ideas, with their SI units if appropriate.

1. density
2. pressure (i.e. absolute pressure)
3. gauge pressure
4. buoyant force
5. Archimedes' Principle
6. volume of fluid displaced
7. weight of fluid displaced
8. laminar flow
9. turbulent flow
10. cross-sectional area
11. volume flow rate
12. the continuity principle (or principle of continuity)

Equations

Understand the meaning and know the SI units of all symbols in these equations; know how to perform each mathematical operation, such as trig functions; know how to solve for any unknown quantity; understand how changing one quantity affects another quantity (if all other quantities remain constant); be able to apply one or more equations to solve a problem.

- density

$$\rho = \frac{m}{V} \quad (1)$$

- pressure as a function of depth in the fluid

$$p_{bottom} = p_{top} + \rho gh \quad (2)$$

- buoyant force

$$F_B = \rho_{fluid} g V_{fluid\ displaced} \quad (3)$$

- volume flow rate

$$\frac{dV}{dt} = Av \quad (4)$$

- principle of continuity: volume flow rate is constant, even if the pipe's cross-sectional area changes

$$A_1 v_1 = A_2 v_2 \quad (5)$$

Skills

1. know that when an object is submerged in a fluid, there is a difference in pressure between the top of the object and the bottom of the object; this difference in pressure creates an upward net force due to the fluid on the object, which we call the buoyant force.
2. calculate the buoyant force on an object that is wholly or partially submerged in a fluid.
3. calculate the pressure at a certain depth h in a fluid.
4. apply Newton's second law and Archimedes' Principle to an object that is in equilibrium in a fluid or is accelerating in a fluid and solve for an unknown force, unknown mass, or some other unknown variable.
5. calculate the volume flow rate of a fluid.
6. identify whether a fluid will speed or slow down as it flows from one radius pipe to a different radius pipe.