

Mechanical Properties of Fluids — Assignment 1

Class 11 Physics · Topic-wise question bank covering every concept of the chapter · Narayan Gurukul Academy

Instructions: (1) Attempt all questions. This worksheet walks through every concept of the chapter, topic by topic.
 (2) The interactive MCQ version of these questions (with instant answer reveal) is available on the notes page.
 (3) Universal values: $g = 10 \text{ m/s}^2$ unless stated. Give answers with correct SI units.

Pressure and Its Variation with Depth

MCQ Questions (choose the correct option)

- The SI unit of pressure is —
 - pascal
 - joule
 - watt
 - newton
- Pressure at a depth h in a liquid of density ρ is —
 - ρgh above atmospheric pressure
 - ρgh
 - $\rho g/h$
 - $h/\rho g$
- The pressure at a point inside a liquid at rest —
 - acts equally in all directions
 - acts only upward
 - acts only downward
 - is zero
- Gauge pressure is —
 - pressure above atmospheric pressure
 - absolute pressure
 - atmospheric pressure
 - vacuum pressure

1 Mark Questions

- Define pressure. Write its SI unit.
- Write the expression for pressure at a depth h in a liquid.
- Define gauge pressure.

2 Mark Questions

- Find the pressure at a depth of 10 m below the surface of water. ($\rho = 1000 \text{ kg m}^{-3}$, $g = 10 \text{ m/s}^2$, atmospheric pressure = 10^5 Pa .)
- Why is a dam wall thicker at the bottom than at the top?
- Distinguish between absolute pressure and gauge pressure.

3 Mark Questions

- Derive an expression for the pressure at a depth h inside a liquid at rest, taking atmospheric pressure into account.

2. A rectangular tank is filled with water up to a height of 2 m. Find the total force on a wall of dimensions 2 m × 3 m due to the water. ($\rho = 1000 \text{ kg m}^{-3}$, $g = 10 \text{ m/s}^2$.)

Pascal's Law and Hydraulic Machines

MCQ Questions (choose the correct option)

- Pascal's law is valid for —
 - a fluid at rest
 - a fluid in turbulent motion
 - only gases
 - only viscous fluids
- A hydraulic lift multiplies force in proportion to the —
 - ratio of the piston areas
 - ratio of the piston heights
 - density of the liquid
 - length of the pipe
- Hydraulic machines work because liquids are —
 - practically incompressible
 - highly compressible
 - inviscid
 - transparent
- If the area of the output piston is five times that of the input piston, a force of 50 N produces an output force of —
 - 250 N
 - 10 N
 - 50 N
 - 5 N

1 Mark Questions

- State Pascal's law.
- Name two machines that work on Pascal's law.
- Write the formula for the force amplification in a hydraulic press.

2 Mark Questions

- A hydraulic lift has pistons of areas 10 cm^2 and 200 cm^2 . What force is needed on the small piston to lift a car of weight 2000 N?
- Explain the working of hydraulic brakes using Pascal's law.
- State Pascal's law and explain why it is the basis of the hydraulic press.

3 Mark Questions

- State and explain Pascal's law, and derive the force amplification in a hydraulic lift.
- The small piston of a hydraulic press has a diameter of 2 cm and the large piston a diameter of 20 cm. If a force of 10 N is applied to the small piston, find the force on the large piston.

Archimedes' Principle and Floatation

MCQ Questions (choose the correct option)

1. The buoyant force on a body immersed in a fluid equals —
(A) the weight of the displaced fluid
(B) the weight of the body
(C) the density of the body
(D) the volume of the body
2. A body floats if its average density is —
(A) less than the density of the fluid
(B) greater than the density of the fluid
(C) equal to twice the density of the fluid
(D) independent of density
3. The fraction of a floating body submerged is —
(A) ratio of its density to the fluid's density
(B) ratio of the fluid's density to its density
(C) always one half
(D) always zero
4. An iceberg floats because —
(A) ice is slightly less dense than water
(B) ice is denser than water
(C) the sea water pushes it up without limit
(D) ice expands on freezing to displace more water

1 Mark Questions

1. State Archimedes' principle.
2. What is the condition for a body to float?
3. State the condition for a body to sink in a liquid.

2 Mark Questions

1. A body of volume $2 \times 10^{-3} \text{ m}^3$ is fully immersed in water. Find the buoyant force on it. ($\rho = 1000 \text{ kg m}^{-3}$, $g = 10 \text{ m/s}^2$.)
2. Explain why a solid steel ball sinks in water but a steel ship floats.
3. A body floats with one quarter of its volume above water. Find the ratio of its density to that of water.

3 Mark Questions

1. State Archimedes' principle and use it to show the condition for floatation.
2. A cube of side 5 cm floats in water with 60% of its volume submerged. Find the density of the cube. ($\rho_{\text{water}} = 1000 \text{ kg m}^{-3}$.)

Equation of Continuity and Bernoulli's Principle**MCQ Questions (choose the correct option)**

1. For an incompressible fluid in steady flow, $A_1 v_1 = A_2 v_2$ is the —
(A) equation of continuity
(B) Bernoulli's equation
(C) Pascal's law

- (D) Archimedes' principle
2. Where the cross-section of a pipe narrows, the speed of an incompressible fluid —
- (A) increases
 - (B) decreases
 - (C) stays the same
 - (D) becomes zero
3. Bernoulli's principle states that where fluid speed is higher, the pressure is —
- (A) lower
 - (B) higher
 - (C) the same
 - (D) zero
4. The lift on an aeroplane wing is explained by —
- (A) Bernoulli's principle
 - (B) Archimedes' principle
 - (C) Pascal's law
 - (D) Stokes' law

1 Mark Questions

1. State the equation of continuity for an incompressible fluid.
2. Write Bernoulli's equation for a horizontal pipe.
3. State Bernoulli's principle.

2 Mark Questions

1. Water flows in a pipe of area 40 cm^2 at 2 m/s . Find the speed in a section of the pipe of area 10 cm^2 .
2. State and explain Bernoulli's principle, and give one application.
3. Derive the equation of continuity for an incompressible fluid.

3 Mark Questions

1. Derive Bernoulli's equation for the steady flow of an ideal incompressible fluid and state the assumptions made.
2. Water flows through a horizontal pipe of cross-section 30 cm^2 where its speed is 2 m/s and pressure $2 \times 10^5 \text{ Pa}$. In a narrower section of area 10 cm^2 the speed rises; find the pressure there. ($\rho = 1000 \text{ kg m}^{-3}$.)

Viscosity and Stokes' Law

MCQ Questions (choose the correct option)

1. The property of a fluid that resists relative motion between its layers is called —

 - (A) viscosity
 - (B) surface tension
 - (C) buoyancy
 - (D) compressibility

2. The SI unit of coefficient of viscosity is —

 - (A) poiseuille (Pa s)
 - (B) N m
 - (C) kg m^{-3}
 - (D) watt

3. Stokes' law for a falling sphere gives the viscous force as —
 - (A) $6\pi\eta rv$
 - (B) $4\pi\eta rv$
 - (C) $2\pi\eta rv$
 - (D) $\pi\eta rv$
4. Terminal velocity is the constant speed at which —
 - (A) the viscous force balances the weight of the falling body
 - (B) the body stops moving
 - (C) the fluid stops moving
 - (D) acceleration is maximum

1 Mark Questions

1. Define viscosity.
2. State Stokes' law.
3. Define terminal velocity.

2 Mark Questions

1. A sphere of radius 1 mm falls through water of viscosity 0.001 Pa s at a terminal velocity of 2 cm/s. Find the viscous force on it.
2. Why does the viscosity of liquids decrease with temperature but that of gases increase?
3. Explain how a parachute achieves a constant terminal velocity.

3 Mark Questions

1. State Stokes' law and derive an expression for the terminal velocity of a sphere falling through a viscous fluid.
2. A rain drop of radius 0.1 mm falls through air with viscosity 1.8×10^{-5} Pa s. Estimate its terminal velocity. ($\rho_{\text{water}} = 1000 \text{ kg m}^{-3}$, $\rho_{\text{air}} \approx 0$, $g = 10 \text{ m/s}^2$.)

Surface Tension and Capillarity

MCQ Questions (choose the correct option)

1. Surface tension is the —
 - (A) force per unit length along the free surface
 - (B) force per unit area
 - (C) pressure per unit area
 - (D) energy per unit volume
2. The SI unit of surface tension is —
 - (A) N m^{-1}
 - (B) N m^{-2}
 - (C) J
 - (D) W m^{-2}
3. A small liquid drop is spherical because —
 - (A) a sphere has the minimum surface area for a given volume
 - (B) gravity pulls it inward
 - (C) the liquid is compressible
 - (D) of viscous forces

4. In a capillary tube, the height of liquid rise is —

- (A) inversely proportional to the radius
- (B) directly proportional to the radius
- (C) independent of the radius
- (D) proportional to the square of the radius

1 Mark Questions

1. Define surface tension. Write its SI unit.
2. Write the expression for the capillary rise of a liquid.
3. Why are small liquid drops spherical?

2 Mark Questions

1. Water rises to 4 cm in a capillary tube of radius 0.5 mm. Find the surface tension of water. ($\rho = 1000 \text{ kg m}^{-3}$, $\cos\theta \approx 1$, $g = 10 \text{ m/s}^2$.)
2. Explain why a needle can float on the surface of water although steel is denser than water.
3. State the factors on which the capillary rise of a liquid depends.

3 Mark Questions

1. Explain the phenomenon of surface tension and derive the ascent of a liquid in a capillary tube.
2. A liquid of surface tension 0.072 N m^{-1} rises to 2 cm in a capillary tube of radius 0.36 mm. Find the density of the liquid. ($\cos\theta = 1$, $g = 10 \text{ m/s}^2$.)