

Chapter 2. Mechanical Properties of fluids

MCQ's (1 Mark Each)

1) Insect moves over surface of water because of

- a) Elasticity
- b) Surface tension
- c) Friction
- d) Viscosity

Ans.: b) Surface tension

2) The water droplets are spherical in free fall due to

- a) gravity
- b) intermolecular attraction
- c) Surface tension
- d) Viscosity

Ans.: c) Surface tension

3) Surface tension of a liquid at critical temperature is

- a) Infinity
- b) Zero
- c) Same as any other temperature
- d) Cannot be determined

Ans: b) Zero

4) Unit of coefficient of viscosity is

- a) Ns/m
- b) Ns²/m
- c) Ns²/m²
- d) Ns/m²

Ans: d) Ns/m²

5) Two capillary tubes of radii 0.6 cm and 0.3 cm are dipped in the same liquid. The ratio of heights through which the liquid will rise in the tubes is

- a) 2:1
- b) 1:2
- c) 4:1
- d) 1:4

Ans.: b) 1:2

6) The energy stored in a soap bubble of diameter 6 cm and $T = 0.04$ N/m is nearly

- a) 0.9×10^{-3} J
- b) 0.4×10^{-3} J
- c) 0.7×10^{-3} J
- d) 0.5×10^{-3} J

Ans: a) 0.9×10^{-3} J

7) Two stones with radii 1:2 fall from a great height through the atmosphere. Their terminal velocities are in the ratio

- a) 2:1
- b) 1:4
- c) 4:1
- d) 1:2

Ans.: b) 1:4

Very Short Answer (VSA) (1 MARK Each)

- 1) What is surface film?
- 2) What are cohesive forces?
- 3) What will be the shape of liquid meniscus for obtuse angle of contact?
- 4) What is the net weight of a body when it falls with terminal velocity through a viscous medium?
- 5) What is the common unit of measuring pressure of a gas?
- 6) State equation of continuity.
- 7) A square metal plate of area 100 cm^2 moves parallel to another plate with a velocity of 10 cm/s , both plates immersed in water. If the viscous force is 200 dyne and viscosity of water is 0.01 poise , what is the distance between them? (**Ans: 0.05 cm**)
- 8) The relative velocity between two parallel layers of water is 8 cm/s and perpendicular distance between them is 0.1 cm . Calculate the velocity gradient. (**Ans: 80 per second**)
- 9) Water rises to a height of 20 mm in a capillary tube. If the radius made $1/3^{\text{rd}}$ of its previous value, to what height will the water now rise in the tube? (**Ans: 60 mm**)

Short Answer I (SA1) (2 MARKS Each)

- 1) State properties of an ideal fluid.
- 2) Compare streamline flow and Turbulent flow.
- 3) Define surface tension and angle of contact.
- 4) Define pressure of a fluid.
- 5) State any two applications of pascals law.
- 6) State Pascal's law of fluid pressure.
- 7) Calculate the rise of water inside a clean glass capillary tube of radius 0.1 mm , when immersed in water of surface tension $7 \times 10^{-2} \text{ N/m}$. The angle of contact between water and glass is zero, density of water is 1000 kg/m^3 , $g = 9.8 \text{ m/s}^2$
(**Ans: $h = 0.1428 \text{ m}$**)
- 8) A rain drop of radius 0.3 mm falls through air with a terminal velocity of 1 m/s . The viscosity of air is $18 \times 10^{-6} \text{ N-s /m}^2$. Find the viscous force on the rain drop.

(Ans: $F = 1.017 \times 10^{-7} \text{ N}$)

- 9) Two soap bubbles have radius in the ratio 2:3. Compare the work done in blowing these bubbles. (Ans.: 4:9)

Short Answer II (SA2) (3 MARKS Each)

- 1) Explain the phenomena of surface tension on the basis of molecular theory.
- 2) Obtain an expression for the capillary rise or fall using forces method.
- 3) State Stoke's law and give two factors affecting angle of contact.
- 4) Explain: Hydrostatic paradox.
- 5) Explain: Gauge pressure.
- 6) State Bernoulli's principle. Derive Bernoulli's equation.
- 7) State any two applications of Bernoulli's equation.
- 8) Explain the working of the Venturi tube.
- 9) Explain the working of an atomizer.
- 10) Twenty-seven droplets of water, each of radius 0.1 mm coalesce into a single drop. Find the change in surface energy. Surface tension of water is 0.072 N/m.

(Ans.: $W = 1.628 \times 10^{-7} \text{ J}$)

- 11) A u-tube is made up of capillaries of bore 1 mm and 2 mm respectively. The tube is held vertically and partially filled with a liquid of surface tension 49 dyne/cm and zero angle of contact. Calculate the density of liquid, if the difference in the levels of the meniscus is 1.25 cm. take $g = 980 \text{ cm/s}^2$ (Ans.: *density of liquid = 0.8 g/cm³*)
- 12) A rectangular wire frame of size 2 cm x 2 cm is dipped in a soap solution and taken out. A soap film is formed, if the size of the film is changed to 3 cm x 3 cm, Calculate the work done in the process. The surface tension of soap film is $3 \times 10^{-2} \text{ N/m}$.

(Ans: $W = 3 \times 10^{-5} \text{ J}$)

Long Answer (LA) (4 marks Each)

- 1) Derive the relation between surface energy & surface tension.
- 2) Obtain Laplace's law of spherical membrane.
- 3) Derive an expression for terminal velocity of the sphere falling under gravity through a viscous medium.