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ENGINEERS ACADEMY PUBLICATIONS

Corporate Office: # 100-102, Ram Nagar, Bambala Puliya, Toll Tax,
Tonk Road, Pratap Nagar, Jaipur (Rajasthan)-302033

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ISBN : 978-93-93531-88-9

First Edition : 2020

Second Edition : 2021

Third Edition : 2023

Fourth Edition : 2025

Fifth Edition : 2026

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Price : ₹1620.00

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UNIT-I

FLUID MECHANICS

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CHAPTER

1

PROPERTIES OF FLUIDS

OBJECTIVE QUESTIONS

1. An ideal fluid
 - (a) Is very viscous
 - (b) Obeys newton's law of viscosity
 - (c) Is assumed in conduit flow
 - (d) Frictionless and incompressible
2. The density of air at 10°C is 1 MPa abs. in SI units is
 - (a) 12.31 (b) 1.231 (c) 118.4 (d) 65.0
3. The viscosity of a fluid varies with
 - (a) Temperature
 - (b) Temperature and pressure
 - (c) Pressure
 - (d) Density
4. A fluid is a substance that
 - (a) Is essentially incompressible
 - (b) Always moves when subjected to a shearing stress
 - (c) Has a viscosity that always increases with temperature
 - (d) Has a viscosity that always decreases with temperature
5. With decrease in temperature, the viscosity in gases generally
 - (a) Increases linearly
 - (b) Increases exponentially
 - (c) Remain unaffected
 - (d) Decreases
6. Viscosity of a fluid with specific gravity 1.3 is measured to be 0.0034 Ns/m². Its kinematic viscosity, in m²/s, is
 - (a) 2.6×10^{-6} (b) 4.4×10^{-6}
 - (c) 5.8×10^{-6} (d) 7.2×10^{-6}
7. Viscosity is the most important property in the
 - (a) Travel of a bullet through air
 - (b) Water jet issuing from a fire air
 - (c) Formation of soap bubbles
 - (d) Flow of castor oil through a tube
8. If the mass density of a liquid is 1000 kg/cum and its dynamic viscosity is 1 Ns/sq.m, then its kinematic viscosity (sq.m/s) will be :
 - (a) 0.1 (b) 1 (c) 0.001 (d) 0.01
9. A fluid in which resistance to deformation is linerly dependent of the shear stress, is known as
 - (a) Bingham plastic fluid
 - (b) Pseudo plastic fluid
 - (c) Dilatant fluid
 - (d) Newtonian fluid
10. Which of the following is not dimensionless quantity?
 - (a) Specific gravity
 - (b) Pressure coefficient
 - (c) Darcy weisbach friction factor
 - (d) Kinematic viscosity
11. One poise is equivalent to
 - (a) 3600 kg/m-hr (b) 1 dyne sec/cm²
 - (c) 10⁻¹ kg./m-sec (d) All the above
12. In a flowing fluid, a particles may posses
 - (a) Inertial energy (b) Pressure energy
 - (c) Kinetic energy (d) All of the above
13. When the rheogram for a fluid at any temperature and pressure is a straight line passing through origin, the fluid is said to be
 - (a) Ideal plastic (b) Bingham
 - (c) Newtonian (d) Non-newtonian
14. A pressure of 500 kPa applied to 2m³ of liquid results in a volume change of 0.004 m³. The bulk modulus, in MPa, is
 - (a) 2.5 (b) 25 (c) 250 (d) 2500
15. SI unit of kinematic viscosity is : –
 - (a) N.s/m² (b) m²/s (c) N/m (d) N.s/m
16. A fluid, which satisfies the relations ' $\tau = \mu (du/dy)$ ', where ' τ ' is shear stress, μ constant of proportionality and (du/dy) is the rate of deformation, is known as : –
 - (a) Newtonian fluid
 - (b) Non – Newtonian fluid
 - (c) Thixotropic fluid/ substance
 - (d) Plastic

[RPSC]

[UKPSC-JE - 2020]

[CGPSC - 2018]

[RPSC-VPITI, Haryana JE, ISRO - 2018]

[DDA JE - 2018]

[RPSC-VPITI, CGPSC-2018, DSSB-2019]

17. Which of the following fluids can be classified as non-newtonian ?
 (a) Kerosene oil and Diesel oil
 (b) Human blood and Toothpaste
 (c) Diesel oil and water
 (d) Kerosene oil and water
[LMRC-JE]
18. Which of the following fluid is incompressible and is having no viscosity?
 (a) Real fluid (b) Non-Newtonian fluid
 (c) Ideal fluid (d) Newtonian fluid
[PEB-SUB ER. - 2017, Haryana JE - 2018]
19. Poise is a unit for which of the following?
 (a) Specific volume (b) Viscosity
 (c) Kinematic viscosity (d) Mass density
[PEB-SUB ER. - 2017]
20. Specific gravity is also called as _____.
 (a) Relative density (b) Mass density
 (c) Specific weight (d) Weight density
[PEB-SUB ER. - 2017]
21. In CGS system, the unit of kinematic viscosity is stoke, where 1 stoke = _____.
 (a) $10^6 \text{ cm}^2/\text{s}$ (b) 10^{-2} m^2
 (c) $10^4 \text{ cm}^2/\text{s}$ (d) $10^{-4} \text{ m}^2/\text{s}$
[PEB-SUB ER. - 2017]
22. The ratio of the mass of a fluid to its volume is known as _____.
 (a) Mass density (b) Viscosity
 (c) Specific weight (d) Weight density
[PEB-SUB ER. - 2017]
23. Dynamic viscosity (μ) has the dimension as :
 (a) MLT^{-2} (b) $\text{ML}^{-1}\text{T}^{-1}$
 (c) $\text{ML}^{-1}\text{T}^{-2}$ (d) $\text{M}^{-1}\text{L}^{-1}\text{T}^{-1}$
[MPSC - 2012, AEC - 2017, MPSC - 2018, RSSB JE - 2020]
24. The drag on a very small sphere falling in a highly viscous fluid varies
 (a) Inversely with the velocity
 (b) Directly with the velocity
 (c) As the square root of the velocity
 (d) As the square of the velocity
[LBS-ASST.PROF. - 2017]
25. A fluid in equilibrium can't sustain
 (a) Shear stress (b) Compressive stress
 (c) Tensile stress (d) Bending stress
[ISRO - 2015]
26. One kilo Pascal is equivalent to :
 (a) 10 N/mm^2 (b) 1000 N/m^2
 (c) 100 N/mm^2 (d) 1000 N/cm^2
[NBCC - 2017]
27. Fluids undergo volume change under external pressure due to
 (a) Plasticity (b) Viscosity
 (c) Tenacity (d) Compressibility
[ISRO - 2018]
28. 1 centipoise = _____ poise.
 (a) 1/10 (b) 1/100 (c) 1/50 (d) 1/25
[Haryana JE - 2018]
29. The viscosity of water at 20°C is
 (a) 0.05 poise (b) 0.1 poise
 (c) 0.01 poise (d) 0.1 centipoise
[Haryana JE - 2018]
30. A vessel of 4 m^3 contains oil which weight 30 kN. The specific weight of the oil is
 (a) 4.5 kN/m^3 (b) 6 kN/m^3
 (c) 7.5 kN/m^3 (d) 10 kN/m^3
[ISRO - 2017]
31. The variation in the volume of a liquid with the variation of pressure is called its
 (a) Surface tension (b) Compressibility
 (c) Capillarity (d) Viscosity
[ISRO - 2017]
32. Newton's law of viscosity is a relationship between
 (a) Pressure, velocity and temperature
 (b) Shear stress and rate of shear strain
 (c) Shear stress and velocity
 (d) Rate of shear strain and temperature
[ISRO - 2017]
33. Pascal-sec is the unit of
 (a) Pressure (b) Kinematic viscosity
 (c) Dynamic viscosity (d) Surface tension
[PMB JE - 2018]
34. If the volume of a liquid weighing 3000 kg is 4 cubic metres, 0.75 is its
 (a) Specific weight (b) Specific mass
 (c) Specific gravity (d) Specific volume
[ISRO - 2013]
35. The property of a fluid which offers resistance to the movement of one layer to another adjacent layer is called _____.
 (a) Viscosity (b) Slip
 (c) Opacity (d) Velocity
[DMRC - 2018, JSSC - JE]

36. "Eddy Viscosity" means that it is
(a) Physical property of the fluid
(b) Same as the kinematic viscosity
(c) Always associated with laminar flow
(d) An apparent viscosity due to turbulent flow
[HPSC - 2014]
37. When a matter resists applied shear stress by static deformation, it is :
(a) Liquid (b) Gas (c) Fluid (d) Solid
[DDA JE - 2018]
38. Surface tension has the dimensions
(a) FL^{-1} (b) F (c) FL^{-2} (d) FL^{-3}
[UK Combined AE - 2012, SSC JE - 2011, CGPSC - 2018]
39. If salt is added in water, the surface tension of water will :
(a) Increase (b) Decrease
(c) Will not change (d) None of the above
[UPSSSC JE - 2015]
40. The weight per unit volume of a liquid at standard temperature and pressure is called :
(a) Specific weight (b) Specific mass
(c) Mass density (d) Specific gravity
[F.C.I. JE - 2015]
41. Surface tension of water
(a) Increases with decreases in temperature
(b) Decreases with decreases in temperature
(c) Independent of temperature
(d) None of these
[MP SUB Eng. - 2016, GMB-AEn - 2021]
42. The stress, which is responsible for retaining water in a capillary tube above the free water surface of the water body in which the capillary tube is inserted, is called the
(a) Capillary compression
(b) Capillary tension
(c) Capillary pore pressure
(d) None of these
[MP SUB Eng. - 2016]
43. Rheology is the study of
(a) Newtonian fluids (b) Ideal fluids
(c) Non-Newtonian fluids (d) None of these
[H.P. SSC - 2015]
44. If the mass density of a fluid is 789 kg/m^3 Taking $g = 9.806 \text{ m/sec}^2$. Specific volume will be
(a) $0.126 \text{ m}^3/\text{kN}$ (b) $0.122 \text{ m}^3/\text{kN}$
(c) $0.129 \text{ m}^3/\text{kN}$ (d) $0.132 \text{ m}^3/\text{kN}$
[UK Combined AE - 2012]
45. With an increase in the radius of the tube, the rise of liquid in the tube due to surface tension will ____
(a) Decrease (b) Increase
(c) Remains unchanged (d) Cannot be said
[UK Combined AE - 2012]
46. If pipes of too small diameter are used, the power required may _____.
(a) Considerably increased
(b) Considerably decreased
(c) Be constant
(d) Be null
[MP Draftman JE - 2017]
47. What shall be the pressure intensity inside a soap bubble of radius 4 cm? (Surface tension of water is 0.0736 N/m) :
(a) 7.36 N/m^2 (b) 1.84 N/m^2
(c) 3.68 N/m^2 (d) None of these
[UPSSSC JE - 2016]
48. Which of the following is not the unit of pressure?
(a) Kg/cm^2 (b) Psi
(c) Atmosphere (d) Newton
[UP Jal Nigam JE - 2016]
49. The expression for kinematic viscosity of a fluid is-
(a) Dynamic viscosity $\times$ density
(b) Dynamic viscosity / density
(c) Dynamic viscosity $\times$ pressure
(d) None of the above
[Uttarakhand AE - 2013]
50. Which of the following is dimensionless?
(a) Specific volume (b) Specific weight
(c) Specific gravity (d) Specific speed
[DMRC JE - 2017]
51. The region within which the effect of viscosity is confined, is known as
(a) Cavitation (b) Stagnation layer
(c) Boundary layer (d) Free layer
[UPRVUNL JE - 2015]
52. A fluid whose viscosity changes with the rate of deformation is known as :
(a) Newtonian fluid (b) Laminar flow
(c) Turbulent flow (d) Non-newtonian fluid
[MP SUB. Eng. - 2016]

- 110.** Newton's Law of Viscosity is a relationship between
 (a) Shear stress and velocity
 (b) Rate of shear strain and velocity
 (c) Pressure, velocity and temperature
 (d) Shear stress and rate of shear strain
[RSMSSB-JE - 2020]
- 111.** With rise in pressure, the bulk modulus of liquid
 (a) Remains constant (b) Increases
 (c) Decreases (d) None of the above
[UPPSC-AE - 2020]
- 112.** Calculate the kinematic viscosity (stoke) of the fluid, if the dynamic viscosity of fluid is 0.5 poise and specific gravity is 0.4 ?
 (a) 0.95 (b) 1 (c) 1.25 (d) 1.5
[NCL - 2020]
- 113.** The dimensional constant for discharge is :
 (a) T^{-1} (b) L^2T^{-1}
 (c) L^3T^{-1} (d) ML^{-3} (e) ML^{-4}
[CE : 25.02.2018 (Shift-2)]
- 114.** What is the specific gravity of one litre of a liquid that weighs 5 N?
 (a) 0.71 (b) 0.41 (c) 0.61 (d) 0.51
- 115.** What is the specific weight of one litre of oil whose specific gravity is 0.7?
 (a) 6.867 N (b) 6867 N/m³
 (c) 700 kg/m³ (d) 13.868 kg
- 116.** A fluid in which the shear stress is more than the yield value and the shear stress is proportional to the rate of shear strain is called a/an:
 (a) real fluid (b) non-Newtonian fluid
 (c) Newtonian fluid (d) ideal plastic fluid
- 117.** What is the viscosity of water having the kinematic viscosity of 6 stokes and specific gravity of 1.9?
 (a) 13.04 poise (b) 14.8 poise
 (c) 12.40 poise (d) 11.40 poise
- 118.** $ML^{-2}T^{-2}$ is the dimension for which physical Quantity ?
 (a) Dynamic Viscosity (b) Surface Tension
 (c) Energy (d) Specific Weight
- 119.** A Newtonian fluid is one which
 (a) Obeys Newton's law of viscosity
 (b) Is highly viscous
 (c) Is compressible and non-viscous
 (d) Is incompressible and Non-viscous
- 120.** Which of the following is the unit of Poise?
 (a) Mass density (b) Dynamic Viscosity
 (c) Velocity gradient (d) Kinematic viscosity
- 121.** A real fluid in which the shear stress is directly proportional to the rate of shear strain is known as:
 (a) Newtonian fluid. (b) Ideal plastic fluid
 (c) Ideal fluid (d) Non Newtonian fluid
- 122.** Calculate the density of one litre of petrol of specific gravity = 0.7
 (a) 7000 kg/m³ (b) 70 kg/m³
 (c) 7 kg/m³ (d) 700 kg/m³
- 123.** Which below expression satisfies 'surface tension on hollow bubble'?
 (a) $p = \frac{4\sigma}{d}$ (b) $p = \frac{\sigma}{d}$
 (c) $p = \frac{2\sigma}{d}$ (d) $p = \frac{8\sigma}{d}$
- 124.** If 900 kg liquid occupies volume of one cubic meter, then 0.90 represents it's
 (a) Specific gravity (b) Specific volume
 (c) Density (d) Unit weight
- 125.** Centi poise is the unit of
 (a) Unit weight (b) Dynamic viscosity
 (c) Kinematic viscosity (d) Velocity
- 126.** Shear stress develops on a fluid element, if
 (a) The fluid container is subject to uniform linear acceleration
 (b) The fluid is in- viscous
 (c) The fluid is at rest
 (d) The fluid is viscous and the flow is non-uniform
- 127.** The ratio of specific weight of a liquid to specific weight of pure water at standard temperature is called:
 (a) density of a liquid
 (b) surface tension of a liquid
 (c) specific gravity of a liquid
 (d) compressibility of a liquid
- 128.** The variation in the volume of a liquid with the variation of pressure is called:
 (a) capillarity (b) compressibility
 (c) surface tension (d) viscosity

163. The kinematic viscosity of oil of specific gravity 0.8 and dynamic viscosity 2 poise is -
 (a) 2.5 centistoke (b) 2500 cm²/sec
 (c) 2.5×10^{-4} cm²/sec (d) 2.5 stokes

[TNPSC - 1998, APPSC - 2013]

164. In MLT system, the dimensions of angular momentum would be
 (a) MLT⁻¹ (b) ML²T (c) ML²T⁻¹ (d) ML²T⁻²
165. If the surface tension of a soap air interface is 0.09 N/m, the difference between the internal and external pressure in the soap bubble of 3 cm diameter is-
 (a) 22 (b) 20 (c) 24 (d) 30

[CGSES - 2015]

166. Capillarity is due to
 i. Surface tension
 ii. Cohesion
 iii. Viscosity
 iv. Weight density of fluid
 (a) (ii),(iii) (b) (iii)
 (c) (i) (d) (ii),(iii),(v)

[SSC-JE - 2014]

167. The bulk modulus of elasticity of a compressible fluid for isothermal process is equal to
 (a) p (b) kp
 (c) k (d) none of these

[APPSC - 1984]

168. If the diameter of a capillary tube is doubled, the capillary rise will be—
 (a) Unaffected (b) Doubled
 (c) Halved (d) None of the above.
169. The region within which the effect of viscosity is confined, is known as—
 (a) Cavitation (b) Stagnation layer
 (c) Boundary layer (d) Free layer

[UP RVUNL JE - 2015]

170. A fluid whose viscosity changes with the rate of deformation is known as—
 (a) Newtonian fluid (b) Laminar flow
 (c) Turbulent flow (d) Non-Newtonian fluid

[MP SUB. ENG. 2016 Morning]

171. It is the product of elastic stress and the area of a flowing liquid—
 (a) Pressure force (b) Elastic force
 (c) Gravity force (d) Viscous force

[UP Jal Nigam JE 2013, MP SUB ENG.
 (Morning) 2016]

172. Match list-I with List-II and choose the correct answer from the options given below

List-I	List-II
Physical Quantity	Dimension
(A) Angular velocity	(i) L ² T ⁻¹
(B) Angular acceleration	(ii) T ⁻¹
(C) Discharge	(iii) T ⁻²
(D) Kinematic viscosity	(iv) L ³ T ⁻¹
(a) (A)–(i), (B)–(ii), (C)–(iii), (D)–(iv)	
(b) (A)–(ii), (B)–(iii), (C)–(iv), (D)–(i)	
(c) (A)–(iii), (B)–(iv), (C)–(i), (D)–(ii)	
(d) (A)–(ii), (B)–(iv), (C)–(i), (D)–(iii)	

[LMRC JE - 2015]

173. Match list-I with List-II and choose the correct answer from the options given below—

List-I (Fluid property)

- (A) Compressibility
 (B) Gravity
 (C) Viscosity
 (D) Vapour pressure

List-II (Flow Phenomenon)

- (i) Flow of real fluid past a tiny sphere
 (ii) Cavitation
 (iii) Hydraulic Jump
 (iv) Flight of supersonic aircraft
 (a) (A)–(iii), (B)–(iv), (C)–(ii), (D)–(i)
 (b) (A)–(iii), (B)–(iv), (C)–(i), (D)–(ii)
 (c) (A)–(iv), (B)–(iii), (C)–(i), (D)–(ii)
 (d) (A)–(iv), (B)–(iii), (C)–(ii), (D)–(i)

[UP PCL JE - 2015]

174. With increase in temperature the viscosity of air and water varies as

- (a) Viscosity of air increases and viscosity of water increases
 (b) Viscosity of air decreases and viscosity of water decreases
 (c) Viscosity of air decreases and viscosity of water increases
 (d) Viscosity of air increases and viscosity of water decreases

[SSC JE - 2016]

175. The ratio of specific weight of a liquid to the specific weight of pure water at a standard temperature is called

- (a) Density of liquid
 (b) Specific gravity of liquid
 (c) Compressibility of liquid
 (d) Surface tension of liquid

ANSWERS SHEET

1. **Ans. (d)**

Ideal fluid is non viscous, frictionless and incompressible.

2. **Ans. (a)**3. **Ans. (a)**

Viscosity is a function of temperature.

4. **Ans. (b)**

Fluid has zero or very less shear strength and always moves when subjected to shearing stress.

5. **Ans. (d)**

With increase in temperature viscosity of liquid decreases while for gases it increases.

6. **Ans. (a)**

$$v = \frac{\mu}{\rho} = \frac{3.4 \times 10^{-3}}{1300} = 2.6 \times 10^{-6} \text{ m}^2/\text{s}$$

7. **Ans. (d)**8. **Ans. (c)**

$$\rho = 1000 \text{ kg/m}^3$$

$$\mu = 1 \frac{\text{N-s}}{\text{m}^2} \text{ then}$$

$$v = \frac{1}{10^3} = 10^{-3} \text{ m}^2/\text{s}$$

9. **Ans. (d)**

For newtonian fluid,

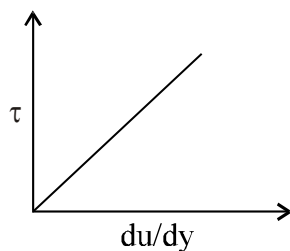
$$\tau = \frac{\mu du}{dy}$$

10. **Ans. (d)**Kinematic viscosity is not a dimensionless quantity its unit is m^2/sec .11. **Ans. (d)**12. **Ans. (d)**

Total energy consist of inertial energy, pressure energy and kinetic energy.

13. **Ans. (c)**

Rheogram for Newtonian fluid is a straight line passing through origin

14. **Ans. (c)**

$$K = \frac{\partial P}{\partial V} = \frac{500 \times 2}{4 \times 10^{-3}} = 250 \times 10^3 \text{ KPa} = 250 \text{ MPa}$$

15. **Ans. (b)**

$$v = \frac{\mu}{\rho} = \frac{\text{kg}}{\frac{\text{m-sec}}{\text{kg/m}^3}} = \frac{\text{m}^2}{\text{sec}}$$

16. **Ans. (a)**

For newtonian fluid, stress is directly proportional to velocity gradient.

$$\tau = \frac{\mu du}{dy}$$

17. **Ans. (b)**Human blood $\rightarrow$ Pseudo plastic fluidToothpaste $\rightarrow$ Bingham plastic fluidAir, water, petrol, Diesel, Kerosene, mercury $\rightarrow$ Newtonian fluids18. **Ans. (c)**

Ideal fluid is the fluid which is incompressible and have no viscosity.

19. **Ans. (b)**

Poise is the unit of dynamic viscosity or viscosity

$$1 \text{ poise} = 0.1 \text{ N-s/m}^2$$

20. **Ans. (a)**

Specific gravity is also called as relative density.

21. **Ans. (d)**

Stoke's is the unit of kinematic viscosity in CGS

$$1 \text{ stoke} = 10^{-4} \text{ m}^2/\text{sec}$$

22. **Ans. (a)**

$$\rho = \frac{M}{V}$$

23. **Ans. (b)**

$$\text{Dimension of viscosity} = \frac{\text{N-s}}{\text{m}^2}$$

$$= \frac{(\text{MLT}^{-2})\text{T}}{\text{L}^2} = \text{ML}^{-1}\text{T}^{-1}$$

24. *Ans. (d)*

$$\text{Drag force} = \frac{1}{2} C_D \rho A V^2$$

Clearly drag force is directly proportional to square of velocity.

25. *Ans. (a)*

Fluid has zero or very less shear resistance that's why can't sustain shear stress.

26. *Ans. (b)*

$$1 \text{ KPa} = 1 \times 10^3 \text{ Pa} = 10^3 \frac{\text{N}}{\text{m}^2}$$

27. *Ans. (d)*

Compressibility is property by virtue of which fluid undergo volume change under external pressure.

28. *Ans. (b)*

$$1 \text{ centipoise} = 10^{-2} \text{ poise}$$

29. *Ans. (c)*

Viscosity of water at 20°C is 10^{-2} poise.

30. *Ans. (c)*

$$\text{Volume} = 4 \text{ m}^3$$

$$\text{Total weight} = 30 \text{ kN}$$

$$\text{Weight} = mg = (V\rho)g = 30 \times 10^3 \text{ N}$$

$$(\rho g = \text{weight density})$$

$$4\rho g = 30$$

$$(\rho g) = 7.5 \text{ kN/m}^3$$

$$\text{Specific weight} = 7.5 = 7.5 \text{ kN/m}^3$$

31. *Ans. (b)*

The property by virtue of which fluid undergo volume under pressure is compressibility

32. *Ans. (b)*

Newton's law of viscosity

$$\tau = \frac{\mu du}{dy}$$

here τ = shear stress

μ = dynamic viscosity

$$\frac{du}{dy} = \text{rate of shear strain}$$

33. *Ans. (c)*

Pascal-second = N-s/m^2 = unit of dynamic viscosity.

34. *Ans. (c)*

$$\text{Mass} = \text{Volume} \times \text{density}$$

$$3000 = 4 \times \rho$$

$$\text{Density } (\rho) = 750$$

$$\text{Specific gravity} = \frac{750}{\text{density of water}} = \frac{750}{1000}$$

$$= 0.75$$

35. *Ans. (a)*

Viscosity is the resistance to flow offered by one layer of fluid on another.

36. *Ans. (d)*

Eddy viscosity is due to turbulent flow.

37. *Ans. (d)*

Solid resist applied shear stress by static deformation neither liquid nor gases.

38. *Ans. (a)*

$$F = (\sigma)L$$

$$\sigma = \frac{F}{L} = FL^{-1} \quad \left[\begin{array}{l} \sigma = \text{surface tension} \\ F = \text{Force} \\ L = \text{Length} \end{array} \right]$$

39. *Ans. (a)*

With increase in turbidity in water such as salt, surface tension of water will increase.

40. *Ans. (a)*

The weight per unit volume of a liquid at standard temperature and pressure is called specific weight.

41. *Ans. (a)*

Surface tension of water is inversely proportional to temperature.

42. *Ans. (b)*

Rise of capillary is due to surface tension and cohesion combinedly known as capillary tension.

43. *Ans. (c)*

Rheology is the study of non-newtonian fluid

44. *Ans. (c)*

For the given fluid

$$1 \text{ m}^3 \rightarrow 789 \text{ kg}$$

$$1 \text{ m}^3 \rightarrow 789 \times 9.81 \text{ N}$$

$$1 \text{ m}^3 \rightarrow 789 \times 9.81 \text{ kN} = 7.74 \text{ kN}$$

$$\text{So specific volume} = \frac{1}{7.74} \text{ m}^3/\text{kN}$$

$$= 0.129 \text{ m}^3/\text{kN}$$

45. *Ans. (a)*

$$\text{Height of rise in capillary} = \frac{2\sigma \cos \theta}{\rho g r} = h$$

so with increase in radius of tube, the rise of liquid decreases.

46. *Ans. (a)*

47. *Ans. (a)*

$$P \text{ for soap bubble} = \frac{8\sigma}{d} = \frac{4\sigma}{r}$$

$$= \frac{4 \times 0.0736}{4 \times 10^{-2}} = 7.36 \text{ N/m}$$

48. *Ans. (d)*

Unit of pressure $\rightarrow$ Pa, Psi, kg/cm^2 , N/m^2 , atmosphere
while newton is the unit of force.

49. *Ans. (b)*

$$\nu = \frac{\mu}{\rho}$$

50. *Ans. (c)*

Specific gravity is the ratio of density of a fluid and density of standard fluid at 27°C so it is dimensionless.

51. *Ans. (c)*

Flow inside boundary layer is viscous flow and outside is not viscous and thus irrotational.

52. *Ans. (d)*

For newtonian fluid viscosity remains constant with rate of deformation while for non-newtonian fluid viscosity changes with rate of deformation.

53. *Ans. (b)*

Physical quantity Dimension

- | | |
|--------------------------|---------------------------|
| (a) Angular velocity | T^{-1} |
| (b) Angular acceleration | T^{-2} |
| (c) Discharge | L^3T^{-1} |
| (d) Kinematic viscosity | L^2T^{-1} |

54. *Ans. (c)*

Fluid property	Flow phenomenon
Compressibility	Flight of supersonic aircraft
Gravity	Hydraulic jump
Viscosity	Flow of real fluid past a tiny sphere
Vapour pressure	Cavitation

55. *Ans. (d)*

Line A in rheograph is for Bingham plastic fluid, Ex – Tooth paste.

56. *Ans. (a)*

Surface energy is caused by force of cohesion between liquid molecules and for water at 100°C at sea level vapour pressure is equal to atmospheric pressure and that is why water start boiling at 100°C .

57. *Ans. (b)*58. *Ans. (b)*

Density of sea water is greater than density of river water, so when ship enters in river, its submerged volume has to increase to stay stable.

59. *Ans. (d)*

We know that,

$$\tau = \mu \frac{du}{dy}$$

$$\text{Force} = \mu A = \frac{du}{dy} \times \mu A$$

Here 1N is required for 1mm^2 area

$$\mu \times 1 \times \frac{100}{10^{-2}} = 1$$

$$\mu = 10^{-4} \text{ N-s/mm}^2$$

$$= \frac{10^{-4}}{10^{-6}} \text{ N-s/m}^2$$

$$= 100 \text{ N-s/m}^2$$

$$\mu = 10^3 \text{ poise}$$

60. *Ans. (b)*

Molecules of milk and water are different and bond between two different molecules is due to adhesion.

61. *Ans. (a)*

The surface energy per unit area of the interface of a liquid with another liquid or gas is surface tension.

62. *Ans. (b)*

Spherical shape of droplets of mercury is due to high surface tension.

63. *Ans. (b)*

Falling drops of water becomes spheres due to the property of surface tension of water.

64. *Ans. (d)*

Surface tension of water at 20°C is 0.076 N/m

$$h = \frac{4\sigma \cos \theta}{\rho g d} = \frac{4 \times 0.076}{1000 \times 9.81 \times 10^{-3}} = 0.030 \text{ m}$$

65. *Ans. (d)*

Cavitation is primarily associated with the vapour pressure of fluid.

66. *Ans. (c)*

$$\text{For a water droplet, } P = \frac{4\sigma}{d}$$

$$P = \frac{4 \times 0.075}{0.0075 \times 100}$$

$$\Rightarrow \frac{4 \times 75 \times 10^{-3}}{75 \times 10^{-2}} = 0.4 \text{ N/cm}^2$$

67. *Ans. (b)*

Density of mercury is very high as compare to water i.e. 13.6 and so the weight of mercury column is also high so the rise of capillary in mercury is below free surface that is capillary depression.

68. *Ans. (d)*

Density of water = 1000 kg/m^3 .

69. *Ans. (d)*

Water has its maximum density at 4°C .

70. *Ans. (c)*

71. *Ans. (c)*

Because with increasing temperatures cohesive forces decreases which reduces the resistance between the layers .

72. *Ans. (c)*

Attraction between same type molecules is cohesion.

73. *Ans. (c)*

Mercury is more viscous than water.

74. *Ans. (c)*

75. *Ans. (b)*

$$\sigma(\pi d) = w \left(\frac{\pi d^2}{4} \right) h$$

$$h = \frac{4\sigma}{wd}$$

76. *Ans. (b)*

77. *Ans. (d)*

For soap bubble

$$2\sigma(\pi d) = P \times \pi d^2/4$$

$$P = \frac{8\sigma}{d}$$

78. *Ans. (d)*

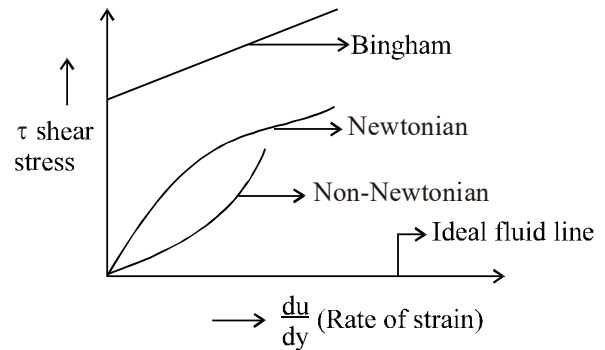
Because in mercury cohesion force is more, compare to adhesion force.

79. *Ans. (b)*

Water is 55 times more viscous than air.

80. *Ans. (b)*

- Ideal fluid** : Shear stress is zero.
- Newtonian fluid** : Shear stress vary linearly with the rate of strain.
- Non-newtonian fluid** : Shear stress vary non linearly with the rate of strain.
- Bingham plastic** : Fluid behaves like a solid until a minimum yield stress beyond which it exhibits a linear relation between shear stress and rate of strain.



81. *Ans. (c)*

$$K = \frac{dP}{\frac{dV}{V}}$$

$$K = \frac{(120 - 60)}{-\left(\frac{0.20}{100}\right)}$$

$$K = 30,000 \text{ N/cm}^2$$

82. *Ans. (c)*

Surface tension of water at 40°C is $6.96 \times 10^{-2} \text{ N/m}$

$$h = \frac{4\sigma}{\rho g d}$$

$$h = 0.01488$$

$$h \approx 15 \text{ mm}$$

83. *Ans. (c)*

Thixotropic fluid do not show shear thinning behaviour

84. *Ans. (d)*

$$1000 \times 0.6 = 600 \text{ kg/m}^3.$$

85. *Ans. (b)*

$$P_i - P_o = \frac{2T}{R}$$

$$\Delta P = \frac{2 \times 0.01}{0.001} = 20$$

86. *Ans. (a)*

Surface tension is due to attractive forces between same type of molecule i.e. cohesion.

87. *Ans. (b)*

Newton's law of viscosity says shear stress is proportional to rate of strain.

$$\tau \propto \frac{du}{dy}$$

$$\tau = \mu \frac{du}{dy} \text{ [here } \mu \text{ is viscosity]}$$

88. **Ans. (a)**

Compressibility is reciprocal of bulk modulus of elasticity.

$$\beta = \frac{1}{K}$$

89. **Ans. (a)**90. **Ans. (b)**

For a fluid at rest the relative velocity between its layers is zero and thus shear stress is zero.

91. **Ans. (d)**

Capillarity : Surface tension

Vapour pressure : Cavitation

Viscosity : Shear forces

Specific gravity : Density of water

92. **Ans. (c)**

$$K = -\frac{\partial p}{\partial V} = \frac{50-100}{-\left(\frac{20}{20}\right)} = \frac{-50}{-1} = 50 \text{ pa}$$

93. **Ans. (b)**

Diameter = 3mm.

Surface tension = 0.0736 N/m

$$\theta = 0^\circ$$

$$h = \frac{4\sigma \cos \theta}{\rho g d}$$

$$= \frac{4 \times 0.0736 \times \cos 0^\circ}{1000 \times 9.81 \times 3 \times 10^{-3}} \times 1000 \text{ mm}$$

 $\Rightarrow$

$$10 \text{ mm}$$

94. **Ans. (d)**

Coefficient of viscosity can be determined by

- (a) Capillary tube method
- (b) Orifice type viscometer
- (c) Rotating cylinder method

95. **Ans. (d)**

Free surface of a liquid tends to contract to the smallest possible area due to force of surface tension as in case of spherical droplets in rainfall.

96. **Ans. (a)**

Compressibility is inverse of bulk modulus

$$\beta = \frac{1}{K} = \left(-\frac{\partial V}{\partial P} \right)$$

97. **Ans. (b)**

Specific volume is define as volume per unit mass.

98. **Ans. (c)**Unit of surface tension is N/m it can also be written as J/m².99. **Ans. (b)**

$$\mu = 0.7 \text{ poise} = 7 \times 10^{-2} \text{ N-s/m}^2$$

$$G = 0.8$$

$$v = \frac{\mu}{\rho} = \frac{7 \times 10^{-2}}{.8 \times 1000}$$

$$= .875 \times 10^{-4} \text{ m}^2/\text{sec}$$

$$= 0.875 \text{ stokes}$$

100. **Ans. (b)**

Specific gravity is define as the ratio of specific weight of a liquid to the specific weight of pure water at standard temperature.

101. **Ans. (b)**

Mass per unit volume of a liquid at a standard temperature and pressure is called mass density.

$$\rho = \frac{M}{V}$$

102. **Ans. (c)**

Viscosity is consider as dynamic property in model analysis.

103. **Ans. (b)**

Height of capillary rise is inversely proportional to density of fluid and diameter of capillary

$$h = \frac{4\sigma \cos \theta}{\rho g d}$$

104. **Ans. (c)**

Mercury has very low vapour pressure and high density.

105. **Ans. (b)**

The increase in pressure of a liquid, raises the boiling point of a liquid and vice-versa.

106. **Ans. (b)**

$$1 \text{ lt} = 10^{-3} \text{ m}^3 = 10^{-3} \times 10^6 \text{ cm}^3 = 1000 \text{ cm}^3$$

107. **Ans. (d)**

Practical fluids are real fluids and they posses

1. Viscosity
2. Surface tension
3. Compressibility

108. **Ans. (c)**109. **Ans. (d)**110. **Ans. (d)**111. **Ans. (b)**

130. *Ans. (c)*

Ideal fluid is only an imaginary fluid as all the fluids, which exist, have some viscosity.

131. *Ans. (c)*

Specific Gravity of Mercury = 13.6

132. *Ans. (c)*

The density of water is 1 gm/cm³.

133. *Ans. (c)*

SI unit of dynamic viscosity = $\frac{\text{N} \cdot \text{sec}}{\text{m}^2}$

$$1 \text{ Poise} = \frac{\text{Dyne} \cdot \text{sec}}{\text{cm}^2}$$

134. *Ans. (c)*

Surface tension is defined as the tensile force acting on the surface of a liquid in contact with a gas or on the surface between two immiscible liquids.

135. *Ans. (a)*

Specific Volume :

It is defined as the volume of the fluid occupied by a unit mass or volume per unit mass of a fluid is called a specific volume.

$$\text{Specific Volume} = \frac{1}{\text{density}}$$

136. *Ans. (b)*

C.G.S unit of kinematic viscosity = cm²/sec

137. *Ans. (d)*

$$\tau = \mu \frac{du}{dy}$$

$$\tau \propto \frac{du}{dy}$$

138. *Ans. (c)*

$$\text{Bulk modulus} = \frac{\text{direct stress}}{\text{volumetric strain}}$$

$$= -\frac{dP}{\frac{dV}{V}}$$

139. *Ans. (d)*

Specific Weight = ρg

$$= \frac{W}{V}$$

$$= 6 \times 10^3 \text{ N/m}^3$$

140. *Ans. (c)*141. *Ans. (a)*

$W = 100\text{N}$, Weight in water 75N

$$W - F_B = 75\text{N}$$

$$100 - F_B = 75\text{N}$$

$$F_B = 25\text{N}$$

$$\rho_w \times g \times V = 25$$

$$V = \frac{25}{\rho_w \times g}$$

$$\rho g V = 100$$

$$\rho g \left(\frac{25}{\rho_w g} \right) = 100$$

$$\rho = 4\rho_w$$

$$\text{Specific gravity} = \left(\frac{\rho}{\rho_w} \right) = 4$$

142. *Ans. (c)*

Fluid type
(Non Newtonian)

Dilatants fluid

Pseudoplastic fluids

Thixotropic

Rheopectic

Bingham plastic fluid

Examples

Butter, quick sand, sugar in water

Paints, lipstick, blood, milk

Printer ink, enamels

Gypsum, solution in water, bentonite solution

Sewage sludge, toothpaste, drilling mud gel

143. *Ans. (b)*144. *Ans. (c)*

$$\tau = A \left(\frac{du}{dy} \right)^n + B$$

By seeing second value

$$\frac{du}{dy} = 0$$

But τ has some value.

145. *Ans. (b)*

Unit of dynamic viscosity

SI unit: Pa-s or Kg m⁻¹ s⁻¹

CGS unit: Poise

Unit of kinematic viscosity

$$\text{SI unit: } \frac{\text{m}^2}{\text{s}}$$

CGS unit: Stokes

FLUID STATICS

OBJECTIVE QUESTIONS

CHAPTER

2

1. The line of action of force exerted by a liquid on a plane area passes through the
 - (a) Centre of pressure
 - (b) Centre of buoyancy
 - (c) Centre of gravity
 - (d) Centre of inertia
2. The depth of centre of pressure in rectangular lamina of height h with one side in the liquid surface is at
 - (a) h
 - (b) $\frac{h}{3}$
 - (c) $\frac{2h}{3}$
 - (d) $\frac{h}{2}$
3. A closed cubical box 0.8 m on each side, is half filled with water and the other half being filled with oil of specific gravity 0.75. Then the pressure difference at the bottom and top layers in pascal.
 - (a) 7678
 - (b) 5800
 - (c) 8628
 - (d) 6867
4. 1 N/m² pressure is equivalent to
 - (a) 1 pascal
 - (b) 10⁻⁵ bar
 - (c) Both (a) and (b)
 - (d) None of these
5. The total force on the surface of a vertical sluice gate 2 m × 1 m with its top 2 m, surface being 0.5 m below the water level will be
 - (a) 500 kN
 - (b) 1000 kN
 - (c) 1500 kN
 - (d) 2000 kN
6. The point in the immerse body through which the resultant pressure of the liquid may be taken to act is known as
 - (a) Metacentre
 - (b) Centre of pressure
 - (c) Centre of buoyancy
 - (d) Centre of gravity
7. A piezometer cannot be used for pressure measurement in pipes when
 - (a) Pressure difference is low
 - (b) Velocity is high
 - (c) Fluid in the pipe is a gas
 - (d) Fluid is highly viscous
8. The location of resultant force acting on a body submerged in water (i.e. depth of centre of pressure) will be
 - (a) $h_G + \frac{I_G}{h_G A}$
 - (b) $h_G + \frac{h_G A}{I_G}$
 - (c) $h_G - \frac{I_G}{h_G A}$
 - (d) $h_G + \frac{h_G}{I_G A}$

where h_G = depth of centroid of the surface,
 A = area
 I_G = M.I. of the surface about an axis lying in the surface, passing through its centroid and parallel to the free surface.
9. If a surface is inclined at angle θ with the liquid surface, then total pressure on the immersed surface will be
 - (a) $wA\bar{x}$
 - (b) $wA\bar{x}\cos\theta$
 - (c) $wA\bar{x}\sin\theta$
 - (d) $wA\bar{x}\tan\theta$
10. A barometer is used to measure
 - (a) Very low pressures
 - (b) Very high pressures
 - (c) Pressure of fluid in a pipe line
 - (d) Atmospheric pressure
11. Vertical component of pressure force on a sub-merged curved surface is equal to
 - (a) Its horizontal component
 - (b) The force on a vertical projection of the curved surface
 - (c) The product of pressure at centroid and surface area
 - (d) The weight of liquid vertically above the curved area
12. 1 atm. pressure is equivalent to
 - (a) 1.01325×10^5 N/m²
 - (b) 760 mm Hg
 - (c) 1.01325 bar
 - (d) All the above
13. If a barometer carries water instead of mercury, the height of column for a pressure equivalent to 75 cm of mercury will be
 - (a) 1020 cm
 - (b) 1000 cm
 - (c) 1034 cm
 - (d) 1040 cm

[Punjab Draftman - 2013]

14. A vertical wall is subjected to liquid (of specific weight 'w') pressure on one side. If h be the height of liquid surface, then total pressure on wall per unit length is
- (a) wh (b) $\frac{wh}{2}$
- (c) $\frac{wh^2}{2}$ (d) $\frac{2}{3}wh$
15. The horizontal component of force on a curved surface is equal to the
- (a) Weight of liquid vertically above the curved surface
- (b) Weight of liquid retained by the curved surface
- (c) Product of pressure at its centroid and area
- (d) Force on a projection of the curved surface into a vertical plane
16. What shall be pressure head of a liquid of specific gravity 0.8 for a pressure head of 100 m of water: –
- (a) 80 m (b) 125 m
- (c) 160 m (d) 64 m
- [RPSC-VPITI]
17. Which one of the following pressure units represents the least pressure?
- (a) Millibar (b) mm of Mercury
- (c) N/mm² (d) kgf/cm²
18. Atmospheric pressure is measured by ____.
- (a) Altimeter (b) Piezometer
- (c) Barometer (d) Spectrometer
- [PEB-SUB ER. - 2017]
19. Differential manometers are used to measure
- (a) Pressure in water channels
- (b) Pressure in water pipes
- (c) Difference of pressure between any two points
- (d) Atmospheric pressure
- [OPSC - AE]
20. The position of centre of pressure on a plane surface immersed vertically in a static mass of fluid is
- (a) At the centre of submerged area
- (b) Always above the centre of gravity
- (c) Always below the centre of gravity
- (d) Has no relation with centre of gravity
- [TSPSC-AE - 2015]
21. The pressure in metres of oil (specific gravity 0.8) equivalent to 80 m of water is
- (a) 64 (b) 80 (c) 100 (d) 88
- [LBS-ASST.PROF. - 2017]
22. The atmospheric pressure head is ____ mm of mercury.
- (a) 9.81 (b) 760 (c) 10.33 (d) 9810
- [Haryana JE - 2018]
23. The rise of liquid in manometers gives the
- (a) Mercury level at that point.
- (b) Discharge capacity at that point.
- (c) Pressure head at that point.
- (d) Density of water at that point.
- [Haryana JE - 2018]
24. The distance of centre of pressure from the surface of liquid is _____ of the density of the liquid.
- (a) Dependent (b) Independent
- (c) Inversely proportional (d) Directly proportional
- [Haryana JE - 2018]
25. A vertical triangular area with vertex downward and altitude 'h' has its base lying on the free surface of a liquid. The centre of pressure below the free surface is at a distance
- (a) h/4 (b) h/3 (c) h/2 (d) 2h/3
- [TSPSC-AE - 2015, Chandigarh JE - 2016, Punjab-Phed - 2015]
26. 1 bar = _____ N/m²
- (a) 10² (b) 10³ (c) 10⁴ (d) 10⁵
- [Haryana JE - 2018]
27. The pressure or intensity of pressure at a point in a static fluid is equal in all directions states by
- (a) Pascal's Law (b) Newton's Law
- (c) Euler's Law (d) Reynold's Law
- [Haryana JE - 2018]
28. The pressure which is measured with reference to absolute zero pressure is
- (a) Gauge pressure (b) Absolute pressure
- (c) Atmospheric pressure (d) None of the above
- [Haryana JE - 2018]
29. The pressure of a liquid measured with the help of piezometer tube is
- (a) Vacuum pressure (b) Atmospheric pressure
- (c) Absolute pressure (d) Gauge pressure
- [ISRO - 2017, PMB-SD-2021, OPSC - AE]
30. Which is the simplest form of manometer used for measuring gauge pressures?
- (a) U-tube Manometer (b) Simple Manometer
- (c) Differential Manometer (d) Piezometer
- [Haryana JE - 2017]
31. Select the correct statement
- (a) Absolute pressure = (Gauge pressure – Atmospheric pressure)
- (b) Gauge pressure = (Absolute pressure – Atmospheric pressure)
- (c) Absolute pressure = (Atmospheric pressure + Vacuum pressure)
- (d) Gauge pressure = (Atmospheric pressure + Vacuum pressure)
- [PMB JE - 2018]

32. Centre of pressure of a vertically immersed surface is always below the centre of gravity of the area by the distance of
- (a) $\frac{I_G}{A\bar{x}}$ (b) $\frac{I_G}{\bar{x}}$
- (c) $\frac{\bar{x}}{2}$ (d) $\bar{x}$
- [DMRC - 2018]
33. What is the direction of total liquid pressure on submerged surface?
- (a) Inclined 45° to the surface
- (b) Inclined 30° to the surface
- (c) Normal to the surface
- (d) Parallel to the surface
- [AEC - 2017]
34. The atmospheric pressure head of water is :
- (a) 8.31 m (b) 25.51 m
- (c) 12.32 m (d) 10.33 m
- [DMRC - 2018]
35. Why is mercury a preferred material over water in barometers?
- (a) Because of its heat conductivity
- (b) Because it has higher density and lower vapour pressure
- (c) Because of better bulk modulus
- (d) Because of its colour
- [PHED-Raj., DDA JE - 2018]
36. The location of centre of pressure for a circular plate 2m diameter immersed vertically in water with its top edge 1.0m below the water surface is
- (a) 1.125 m (b) 2.000m
- (c) 1.215m (d) 2.125m
- [UK Combined AE - 2012]
37. Centre of pressure of an inclined plane surface is :
- (a) $\frac{I_G \cdot \sin^2 \theta}{A\bar{x}} + \bar{x}$ (b) $\frac{I_G \cdot \sin \theta}{A\bar{x}} + \bar{x}$
- (c) $\frac{I_G \cdot \sin^2 \theta}{A\bar{x}} - \bar{x}$ (d) $\frac{I_G \cdot \sin^2 \theta}{A^2 \bar{x}} + \bar{x}$
- [UKPSC AE - 2007]
38. The maximum compressive force in a gravity dam exists _____ when the reservoir is full-
- (a) At the heel
- (b) At the centre of base
- (c) Within middle third of base
- (d) At the toe
- [Uttarakhand AE - 2013]
39. Hydrostatic pressure on a dam depends upon its:
- (a) Length (b) Breadth
- (c) Depth (d) All of these
- [BCCL JE - 2017]
40. If a vertical circular plate of diameter 'd' is submerged in water, what is the depth of centre of pressure from the water surface?
- (a) $d/2$ (b) $3d/5$ (c) $5d/8$ (d) $4d/7$
- [UPPCL JE - 2016]
41. The equivalent value of a pressure of a kg/cm^2 in terms of the height of water column is :
- (a) 10.3 metres of water (b) 10 metres of water
- (c) 1 metre of water (d) 1.3 metres of water
42. The total pressure force on a plan area is equal to the area multiplied by the intensity of pressure at its centroid, if
- (a) Area is horizontal (b) Area is vertical
- (c) Area is inclined (d) All the above
- [HPSSC JE - 2015]
43. Pascal's law states that pressure at a point is equal in all directions, in a
- (a) Static solid (b) Static fluid
- (c) Static gas (d) Moving fluid
- [Uttarakhand JE - 2015]
44. The ratio of pressure between the points A and B located at depths 0.5m and 2.0m respectively below a constant level of water in tank is
- (a) $1:\sqrt{2}$ (b) 1 : 2 (c) 1 : 4 (d) 1 : 16
- [Uttarakhand JE - 2015, RPSC AEn - 2013]
45. The total pressure on a plane surface submerged in a liquid and inclined at an angle θ with the horizontal will be
- (a) $\rho \cdot A \cdot g\bar{x}$ (b) $\rho \cdot A \sin \theta$
- (c) $\rho \cdot A \cdot \cos \theta$ (d) $\rho \cdot A \cdot \tan \theta$
- [Uttarakhand JE - 2015]
46. The centre of pressure of a submerged plainular region is?
- (a) Free from orientation of region
- (b) In the centroid of Region
- (c) Always below the centroid
- (d) Point where the resultant force act on the region due to pressure
- [LMRC JE - 2016]

47. In order to avoid sliding of masonry dam, the force of friction between the dam and soil should be at least _____ the total water pressure per meter length.
(a) Equal to (b) 1.5 times
(c) Double (d) 2.5 times
[UPSSSC JE - 2015]
48. Which one of the following pressure unit represents the least pressure?
(a) millibar (b) mm of mercury
(c) N/mm² (d) kgf/cm²
[UK Combined AE - 2012, RJC Exam - 2016]
49. The pressure less than the atmospheric pressure is known as
(a) Suction pressure (b) Vacuum pressure
(c) Negative pressure (d) All the above
[UK Combined AE - 2012]
50. Piezometer is suitable for fluid related measurements which are _____.
(a) Small and positive (b) Small and negative
(c) Large and positive (d) Large and negative
[UPPCL JE - 2016]
51. A piezometer tube in pipes measures :
(a) Velocity head (b) Total pressure
(c) Static pressure (d) Negative static pressure
[NMRC JE - 2017]
52. Atmospheric pressure at a location is recorded as 74.8 cm of mercury (sp. gr. = 13.6) column. This pressure is equal to :
(a) 99795 N/m² (b) 1 MPa
(c) 10.34 m of Water Column (d) 1 Kg/cm²
[MP SUB Eng. - 2015]
53. For measuring the static pressure in a pipe, a pressure gauge is usually connected to :
(a) Orifice meter (b) Venturimeter
(c) Barometer (d) Piezometric
[CGPSC - 2018]
54. Gauge pressure has _____ value.
(a) Zero (b) Positive
(c) Negative (d) Zero, positive or negative
[UPPCL JE - 2016]
55. Manometer is used for measuring
(a) Velocity at a point in a fluid
(b) Pressure at a point in a fluid
(c) Difference of pressure between two points
(d) Both (b) and (c)
[UP Jal Nigam JE - 2013, Uttarakhand JE - 2015]
56. The pressure measured with the help of a piezometer tube is in :
(a) N/mm² (b) N/m²
(c) Head of liquid (d) N/cm²
[DMRC JE - 2015]
57. Absolute pressure in flow system-
(a) Is always above the atmospheric pressure
(b) Is equal to a vacuum pressure
(c) May be above, below or equal to the local atmospheric pressure
(d) Is also called negative pressure
[RRB JE - 2015]
58. In order to increase sensitivity of U-tube manometer, one leg is usually inclined by angle θ . Sensitivity of inclined tube to sensitivity of U-tube is equal to
(a) $\sin \theta$ (b) $\sin \theta$ (c) $\tan \theta$ (d) $\frac{1}{\sin \theta}$
59. A square surface 6 m $\times$ 6 m lies in a vertical line in water with its upper edge at water surface. The hydrostatic force on square surface is
(a) 30,000 kg (b) 108,000 kg
(c) 27,000 kg (d) 13,500 kg
60. If P_H and P_V are horizontal and vertical components of force then total force impressed on a curved surface is
(a) $P = \sqrt{P_H^2 + P_V^2}$ (b) $P = (P_H^2 - P_V^2)^{7/2}$
(c) $P = P_H - P_V$ (d) $P = (P_H^2 + P_V^2)^{5/2}$
61. A vertical rectangular plane surface is submerged in water such that its top and bottom surfaces are 1.5 m and 6.0 m respectively below the free surface. The position of centre of pressure below the free surface will be at a distance of
(a) 3.8 m (b) 4.0 m (c) 4.2 m (d) 4.5 m
[CGPSC]
62. Match List I with List II and select the correct answer :
- | List I | | List II | |
|--------|-----------------------|---------|-------------------|
| A | Centroid | 1 | Always positive |
| B | Centre of pressure | 2 | Area moment zero |
| C | Free surface | 3 | Constant area |
| D | Second moment of area | 4 | Constant pressure |
| | | 5 | Resultant force |
- (a) A-2, B-4, C-5, D-3 (b) A-4, B-2, C-3, D-1
(c) A-2, B-5, C-4, D-1 (d) A-5, B-3, C-2, D-4
[CGPSC]

ANSWERS SHEET

1. **Ans. (a)**

The line of action of force exerted by a liquid on a plane area passes through the centre of pressure.

2. **Ans. (c)**

$$h_{cp} = \bar{h} + \frac{I_{xx} \sin^2 \theta}{Ah}$$

$$\bar{h} = \frac{h}{2}, I_{xx} = \frac{bh^3}{12}, \theta = 90^\circ, \sin^2$$

$$\theta = 1^\circ = 1, A = bh, \bar{h} = \frac{h}{2}$$

$$h_{cp} = \frac{h}{2} + \frac{bh^3}{12} \times 1 \times \frac{2}{bh \times h}$$

$$= \frac{h}{2} + \frac{h}{6} = \frac{4h}{6} = \frac{2h}{3}$$

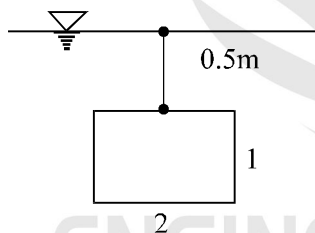
3. **Ans. (d)**

Side of cube = 0.8m

$$\begin{aligned} \text{Pressure at bottom} - \text{pressure at top} &= \rho_1 g h_1 + \rho_2 g h_2 \\ &= 1000 \times 9.81 \times 0.4 + 750 \times \\ &9.81 \times 0.4 \\ &= 6867 \text{ Pa} \end{aligned}$$

4. **Ans. (c)**

$$1 \frac{\text{N}}{\text{m}^2} = 1 \text{ Pa} = 10^{-5} \text{ Bar}$$

5. **Ans. (d)**

$$F = \rho g A \bar{h}$$

$$\begin{aligned} &= 1000 \times 10 \times (2 \times 1) (0.5 + 0.5) \\ &= 2000 \text{ kN} \end{aligned}$$

6. **Ans. (b)**

The point in the immersed body through which the resultant pressure of the liquid may be taken to act is known as centre of pressure.

7. **Ans. (c)**

Piezometer cannot be used for pressure measurement in pipes when fluid in the pipe is a gas, it works for fluid.

8. **Ans. (a)**

$$h_{cp} = \bar{h}_G + \frac{I_{xx} \sin^2 \theta}{Ah_G}$$

9. **Ans. (a)**

If a surface is inclined at angle θ with the liquid surface, then total pressure on the immersed surface will be =

$$w A \bar{x}$$

10. **Ans. (d)**

Barometer is used to measure atmospheric pressure.

11. **Ans. (d)**

Vertical component of pressure force on a sub-merged curved surface is equal to the weight of liquid vertically above the curved area.

12. **Ans. (d)**

$$\begin{aligned} 1 \text{ atm} &= 1.01325 \times 10^5 \text{ N/m}^2 \\ &= 760 \text{ mm Hg} = 1.01325 \text{ bar} \end{aligned}$$

13. **Ans. (a)**

$$\begin{aligned} \rho g h &= \rho g h \\ \Rightarrow \rho_w g h_w &= \rho_{Hg} g h_{Hg} \\ 1000 h_w &= 13.6 \times 1000 \times 75 \\ h_w &= 1020 \text{ cm} \end{aligned}$$

14. **Ans. (c)**

Specific weight of liquid = $w = \rho g$

$$\text{Pressure at depth } h = \frac{\rho g h^2}{2} = \frac{w h^2}{2}$$

15. **Ans. (d)**

Horizontal component of force on a curved surface is equal to force on a projection of the curved surface into a vertical plane.

16. **Ans. (b)**

$$\begin{aligned} P &= \rho g h \\ \Rightarrow \rho_1 g h_1 &= \rho_2 g h_2 \\ 0.8 \times h_1 &= 100 \\ h_1 &= \frac{100}{0.8} = 125 \text{ m} \end{aligned}$$

17. **Ans. (a)**18. **Ans. (c)**

Atmospheric pressure is measured by barometer.

19. **Ans. (c)**

Differential manometers are used to measure difference of pressure between any two points.

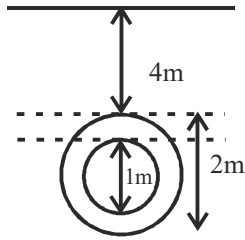
20. **Ans. (c)**

Centre of pressure is always below the centre of gravity.

21. **Ans. (c)**

$$\begin{aligned} P &= \rho g h \\ \Rightarrow \rho_1 g h_1 &= \rho_2 g h_2 \\ 0.8 \times h_1 &= 80 \\ h_1 &= \frac{80}{0.8} = 100 \text{ m} \end{aligned}$$

145. Ans. (c)



$$F_R = \rho g h A$$

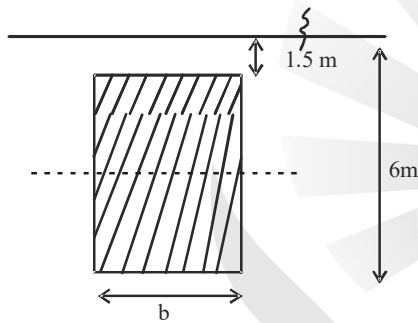
$$= 10^3 \times 10 \times (4) \times \frac{\pi}{8} (2^2 - 1^2)$$

$$= 12,000 \pi$$

Where concentric circles given it means 2D shape is given
then $\bar{h} = h = 4\text{m}$ (only surface)

146. Ans. (d)

147. Ans. (d)



$$h_p = \bar{h} + \frac{I_{Gxx} \sin^2 \theta}{\bar{h} A}$$

Where

A = area of rectangular plane surface
= $(6 - 1.5) \times b$

$$I_{Gxx} = \frac{bd^3}{12}$$

$\theta = 90^\circ$ (Vertical plane)

$$= \left(1.5 + \frac{4.5}{2} \right) + \frac{\frac{b \times (4.5)^3}{12}}{\left(\frac{4.5}{2} + 1.5 \right) \times b \times 4.5}$$

$$h_p = \left(1.5 + \frac{4.5}{2} \right) + \frac{\frac{b(6-1.5)^3}{12} \times \sin^2 90^\circ}{\left(\frac{4.5}{2} + 1.5 \right) \times (6-1.5) \times b}$$

$$= 3.75 + \frac{4.5^2}{3.75 \times 12} = 4.2 \text{ m}$$

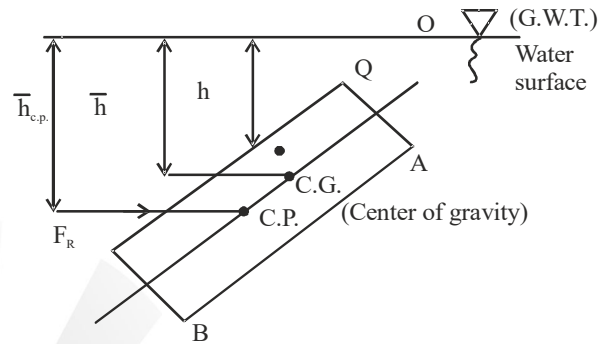
148. Ans. (b)

Where

F_R = Reaction force at centre of pressure

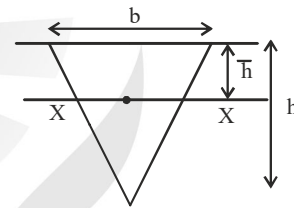
$\bar{h}$ = height of centre of gravity

$\bar{h}_{c.p.}$ = height of centre of pressure from water surface



149. Ans. (b)

1.

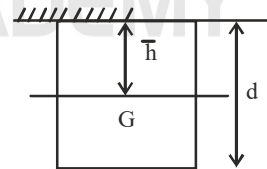


Then

$$\bar{h} = \frac{h}{3}$$

$$\text{area} = \frac{bh}{2}, \quad I_{Gxx} = \frac{bh^3}{36}$$

2.



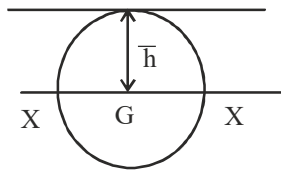
Rectangular section

$$\bar{h} = \frac{d}{2}$$

$$A = bd$$

$$I_{Gxx} = \frac{bd^3}{12}$$

3.

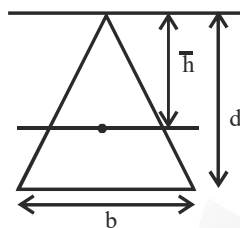


$$\bar{h} = R$$

$$A = \pi R^2$$

$$I_{Gxx} = \frac{\pi R^4}{4}$$

4.

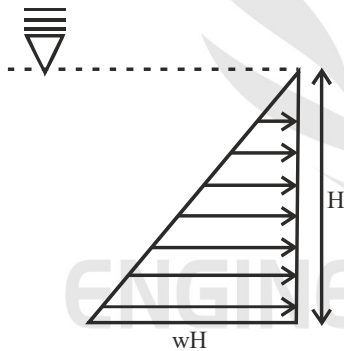


$$\bar{h} = \frac{2d}{3}$$

$$A = bd/2$$

$$I_{Gxx} = \frac{bd^3}{36}$$

150. Ans. (b)



The total pressure per unit length is

$$= \frac{1}{2} wH \times H = \frac{1}{2} wH^2$$

151. Ans. (b)

$$\text{Total pressure} = \frac{1}{2} wH^2 \times b$$

$$= \frac{1}{2} \times 196.2 \times 5 \times 3 = 1.4715 \text{ mN}$$

152. Ans. (c)

Archimedes principle

The height of water increased due to melted ice is exactly the same as the height increase due to buoyancy force of the block of ice had melted. Thus the level of water is the contained remains same.

153. Ans. (a)

Metacentre : The point of intersection between an imaginary line drawn vertically through the centre of buoyancy of a floating vessel and a corresponding line through the new centre of buoyancy when the vessel is tilted.

Centre of buoyancy : The centroid of the immersed part of floating body.

Centre of pressure : A point on a surface through which the resultant force due to pressure passes.

154. Ans. (b)

Total pressure force on top

$$F_T = \frac{\rho}{4} \omega^2 \pi R^4$$

Where

ω = angular velocity

ρ = density of water

155. Ans. (d)

156. Ans. (d)

157. Ans. (c)

158. Ans. (c)

159. Ans. (b)

160. Ans. (b)

161. Ans. (a)

□□□

Fluid Statics
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