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**Website :** www.engineersacademy.org  
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# PROPERTIES OF FLUIDS

**CHAPTER****1****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/m<sup>2</sup>. Its kinematic viscosity, in m<sup>2</sup>/s, is
- (a)  $2.6 \times 10^{-6}$
  - (b)  $4.4 \times 10^{-6}$
  - (c)  $5.8 \times 10^{-6}$
  - (d)  $7.2 \times 10^{-6}$
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

[RPSC]

[DDA JE - 2018]

[UKPSC-JE - 2020]

[CGPSC - 2018]

11. One poise is equivalent to  
 (a) 3600 kg/m-hr (b) 1 dyne sec/cm<sup>2</sup>  
 (c) 10<sup>-1</sup> 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 2m<sup>3</sup> of liquid results in a volume change of 0.004 m<sup>3</sup>. 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/m<sup>2</sup> (b) m<sup>2</sup>/s  
 (c) N/m (d) N.s/m  
**[RPSC-VPITI, Haryana JE, ISRO - 2018]**
16. A fluid, which satisfies the relations ' $\tau$ ' =  $\mu$  (du/dy), where ' $\tau$ ' is shear stress,  $\mu$  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-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<sup>6</sup>cm<sup>3</sup>/s (b) 10<sup>-2</sup>m<sup>2</sup>  
 (c) 10<sup>4</sup>cm<sup>3</sup>/s (d) 10<sup>-4</sup>m<sup>2</sup>/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 ( $\mu$ ) has the dimension as :  
 (a) MLT<sup>-2</sup> (b) ML<sup>-1</sup>T<sup>-1</sup>  
 (c) ML<sup>-1</sup>T<sup>-2</sup> (d) M<sup>-1</sup>L<sup>-1</sup>T<sup>-1</sup>  
**[MPSC - 2012, AEC - 2017, MPSC - 2018, RSB 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<sup>2</sup> (b) 1000 N/m<sup>2</sup>  
 (c) 100 N/mm<sup>2</sup> (d) 1000 N/cm<sup>2</sup>  
**[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<sup>3</sup> contains oil which weight 30 kN. The specific weight of the oil is  
 (a) 4.5 kN/m<sup>3</sup> (b) 6 kN/m<sup>3</sup>  
 (c) 7.5 kN/m<sup>3</sup> (d) 10 kN/m<sup>3</sup>  
**[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<sup>-1</sup> (b) F  
 (c) FL<sup>-2</sup> (d) FL<sup>-3</sup>  
**[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  $789 \text{ kg/m}^3$  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  $0.0736 \text{ N/m}$ ) :  
 (a)  $7.36 \text{ N/m}^2$   
 (b)  $1.84 \text{ N/m}^2$   
 (c)  $3.68 \text{ N/m}^2$   
 (d) None of these  
**[UPSSSC JE - 2016]**
48. Which of the following is not the unit of pressure?  
 (a)  $\text{Kg/cm}^2$  (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  
**[Utrakhand 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]**

53. Match List I with List II and choose the correct answer from the options given below :

**List-I****(Physical quantity)**

- A. Angular velocity
- B. Angular acceleration
- C. Discharge
- D. Kinematic viscosity

**List-II****(Dimension)**

- a.  $L^2T^{-1}$
  - b.  $T^{-1}$
  - c.  $T^{-2}$
  - d.  $L^3T^{-1}$
- (a) A-a, B-b, C-d, D-a
  - (b) A-b, B-c, C-d, D-a
  - (c) A-c, B-d, C-a, D-b
  - (d) A-b, B-d, C-a, D-c

[LMRC JE - 2015]

54. Match List-I with List-II and the correct answer from the options below.

**List-I (Fluid property)**

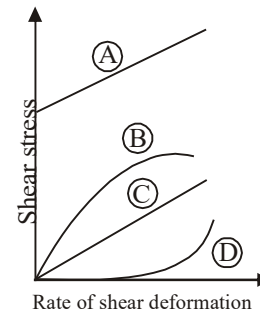
- A. Compressibility
- B. Gravity
- C. Viscosity
- D. Vapour pressure

**List-II (Flow Phenomenon)**

- a. Flow of real fluid past a tiny sphere
  - b. Cavitation
  - c. Hydraulic jump
  - d. Flight of supersonic aircraft
- (a) A-c, B-d, C-b, D-a
  - (b) A-c, B-d, C-b, D-a
  - (c) A-d, B-c, C-a, D-b
  - (d) A-d, B-c, C-b, D-a

[UPPCL JE - 2015]

55. In the given figure which nature of fluid is represented by curve A?



- (a) Newtonian
- (b) Pseudo-plastic
- (c) Dilatant
- (d) Ideal Bingham plastic

[UPPCL JE - 2015]

56. Which of the following statements is correct?

- (a) For water at  $100^\circ\text{C}$  at sea level, the vapour pressure is equal to the atmospheric pressure
- (b) Air is 50,000 times more compressible than water
- (c) Viscosity of the molecules is the property exhibited by them in both static and dynamic conditions
- (d) Surface energy is caused by the force of adhesion between liquid molecules

[UPPCL JE - 2015]

57. From the options given below, in which situations, the viscous force is unimportant?

- (a) Incompressible fluids in closed pipes
- (b) Motion of aeroplanes
- (c) Capillary waves in channels
- (d) Resistance to motion of ship

[MP SUB Eng. - 2016]

58. When a ship moving on sea water enters river and moves inland, it is expected to

- (a) Rise a little
- (b) Sink a little
- (c) Maintain the same level of draft
- (d) Rise or fall depending on whether it is made of wood or steel

[MP SUB ENG - 2016]

59. A plate of thickness 0.010 mm, distant from a fixed plate, moves at 10 cm/s and requires a force of 1 N per unit area i.e. 1 N/mm<sup>2</sup> to maintain this speed. What would be the fluid viscosity between the plates?  
 (a) 10<sup>-3</sup> poise (b) 10<sup>-4</sup> poise  
 (c) 2 × 10<sup>-3</sup> poise (d) None of these  
**[HPSSSB JE - 2017]**
60. Milk mixes with water due to  
 (a) Very good cohesion  
 (b) Very good adhesion  
 (c) Very good surface tension  
 (d) Very good vapour pressure  
**[RRB JE - 2015]**
61. A liquid forms an interface with another liquid or gas; the surface energy per unit area of the interface is known as :  
 (a) Surface tension (b) Specific energy  
 (c) Specific heat (d) Suction energy  
**[RRB SSE - 2015]**
62. Spherical shape of droplets of mercury is due to-  
 (a) High density (b) High surface tension  
 (c) High adhesion (d) Water  
**[RRB JE - 2015]**
63. Falling drops of water become spheres due to the property of :  
 (a) Compressibility of water  
 (b) Surface tension of water  
 (c) Capillarity of water  
 (d) Viscosity of water  
**[RRB JE - 2014]**
64. The capillary rise at 20°C in clean glass tube of 1 mm diameter, containing water is :  
 (a) 15 mm (b) 50 mm  
 (c) 20 mm (d) 30 mm  
**[RRB JE - 2015]**
65. Cavitation is primarily associated with of the following fluid properties  
 (a) Specific gravity (b) Surface tension  
 (c) Viscosity (d) Vapour pressure  
**[RRB SSE - 2015]**
66. The intensity of pressure developed by surface tension of 0.075 N/m in a droplet of water of 0.075 mm diameter is-  
 (a) 0.8 N/cm<sup>2</sup> (b) 0.6 N/cm<sup>2</sup>  
 (c) 0.4 N/cm<sup>2</sup> (d) 400 N/cm<sup>2</sup>  
**[RRB JE - 2015, Punjab Phed - 2015]**
67. Capillarity of liquid in small-diameter tubes is due to molecular attraction. In case of Mercury, the following occurs in terms of capillarity  
 (a) Capillary rise (b) Capillary depression  
 (c) Capillary flattening (d) Compressibility  
**[RRB SSE - 2015]**
68. The density of water is :  
 (a) 10<sup>-3</sup> kg/m<sup>3</sup> (b) 1 kg/m<sup>3</sup>  
 (c) 10<sup>2</sup> kg/m<sup>3</sup> (d) 10<sup>3</sup> kg/m<sup>3</sup>  
**[RRB JE - 2014]**
69. Water has its maximum density at :  
 (a) 0°C (b) 100°C  
 (c) 50°C (d) 4°C  
**[RRB JE - 2014]**
70. If cohesion between molecules of fluid is greater than adhesion between fluid and glass, then the free level of fluid in a dipped glass tube will be  
 (a) Higher than the surface of liquid  
 (b) The same as the surface of liquid  
 (c) Lower than the surface of liquid  
 (d) Unpredictable
71. Dynamic viscosity of the liquids with rise in temperature  
 (a) Does not show any change  
 (b) Increases  
 (c) Decreases  
 (d) None of these

72. Property of a fluid because of which its own molecules attract each other is  
 (a) Adhesion (b) Compressibility  
 (c) Cohesion (d) Capillarity
- [UKPSC JE - 2020 (II)]
73. Viscosity of water in comparison to mercury is  
 (a) Variable and unstable  
 (b) Higher  
 (c) Lower  
 (d) Same
74. Angle of contact in case of a liquid depends upon  
 (a) The material existing above the free surface of the liquid  
 (b) The nature of the liquid and solid  
 (c) Both of the above  
 (d) Depends upon temperature
75. The rise or fall of head 'h' in a capillary tube of diameter 'd' and liquid surface tension ' $\sigma$ ' and specific weight 'w' is equal to  
 (a)  $\frac{2d}{w\sigma}$  (b)  $\frac{4\sigma}{wd}$   
 (c)  $\frac{3w\sigma}{d}$  (d)  $\frac{4wd}{\sigma}$
76. The bulk modulus of elasticity of a  
 (a) Fluid decreases with the increase in pressure  
 (b) Liquid decreases with increase of temperature  
 (c) Liquid increases with increase in temperature  
 (d) None of the above
77. For a soap bubble, the surface tension  $\sigma$  and difference of pressure ( $\Delta P$ ) are related as  
 (a)  $\Delta P = \frac{4\sigma}{d}$  (b)  $\Delta P = \frac{\sigma}{4d}$   
 (c)  $\Delta P = \frac{\sigma}{2d}$  (d)  $\Delta P = \frac{8\sigma}{d}$   
 where d is diameter of bubble
78. Mercury doesn't wet glass. This is due to property known as  
 (a) Surface tension (b) Adhesion  
 (c) Viscosity (d) Cohesion
79. The viscosity of water with respect to air is about  
 (a) 50 times (b) 55 times  
 (c) 60 times (d) 65 times
80. Match List I with List II and select the correct answer :
- | List I |                     | List II |  |
|--------|---------------------|---------|--|
| A      | Ideal fluid         | 1       | Shear stress does not vary linearly with the rate of strain  |
| B      | Newtonian fluid     | 2       | Tensile stress varies linearly with the rate of strain   |
| C      | Non-Newtonian fluid | 3       | Shear stress is zero   |
| D      | Bingham plastic     | 4       | Viscosity decreases with increase in temperature   |
|        |                     | 5       | Shear stress varies linearly with the rate of strain   |
|        |                     | 6       | Fluid behaves like a solid until a minimum yield stress beyond which it exhibits a linear relationship between shear stress and the rate of strain |
- (a) A-3, B-5, C-6, D-1  
 (b) A-3, B-5, C-1, D-6  
 (c) A-5, B-3, C-4, D-2,  
 (d) A-5, B-4, C-3, D-2
- [CGPSC]
81. Determine the bulk modulus of elasticity of liquid, if the pressure of liquid is increased from 60 N/cm<sup>2</sup> to 120 N/cm<sup>2</sup>. The volume of liquid was found to decrease by 0.20%.  
 (a)  $1 \times 10^4$  N/cm<sup>2</sup>  
 (b)  $2 \times 10^4$  N/cm<sup>2</sup>  
 (c)  $3 \times 10^4$  N/cm<sup>2</sup>  
 (d)  $4 \times 10^4$  N/cm<sup>2</sup>
- [CGPSC]
82. A clean glass tube of 2 mm diameter contains water at 40°C. The capillary rise is approximately  
 (a) 5 mm (b) 10 mm  
 (c) 15 mm (d) 20 mm
- [CGPSC]

83. Which of the following statements is INCORRECT about thixotropic fluids?  
 (a) Apparent viscosity depends on the time of shearing  
 (b) Thixotropy is an irreversible process  
 (c) Thixotropic fluid shows shear thinning behavior  
 (d) Thixotropic fluids are in general non-Newtonian fluids  
**[CEPTM - 2009]**
84. The mass density of one litre of diesel of relative density 0.6 is :  
 (a) 1000 kg/m<sup>3</sup> (b) 6000 kg/m<sup>3</sup>  
 (c) 60 kg/m<sup>3</sup> (d) 600 kg/m<sup>3</sup>  
**[WRD B. Tech - 2013]**
85. The excess pressure in a droplet of 0.002 m diameter a fluid with surface tension of 0.01 N/m is  
 (a) 10 (b) 20  
 (c) 4  $\pi$  (d) 0.00004  $\pi$   
**[AEM - 2017]**
86. Surface tension is a phenomenon due to  
 (a) Cohesion only  
 (b) Viscous force only  
 (c) Adhesion between liquid and solid molecules  
 (d) Difference in magnitude between the forces due to adhesion and cohesion  
**[MPSC - 2018]**
87. Newton's law of viscosity is given by the relation  
 (a)  $\tau = \mu^2 \frac{du}{dy}$  (b)  $\tau = \mu \frac{du}{dy}$   
 (c)  $\tau = \mu \frac{dy}{du}$  (d)  $\tau = \mu^2 \frac{dy}{du}$   
**[CEMPM - 2018]**
88. Compressibility is the reciprocal of  
 (a) Bulk modulus of elasticity  
 (b) Shear modulus of elasticity  
 (c) Young's modulus of elasticity  
 (d) Viscosity  
**[CEMPM - 2018]**
89. Which one of the following is defined as force per unit length –  
 (a) Surface tension (b) Compressibility  
 (c) Capillarity (d) Viscosity  
**[RRB JE - 2015]**
90. For a fluid at rest–  
 (a) The shear stress is zero only on the horizontal plane  
 (b) The shear stress is zero  
 (c) The shear stress is maximum on a plane inclined at 45° to the horizontal  
 (d) The shear stress depends upon the co-efficient of viscosity  
**[UPSSC JE - 2015]**
91. Match List-I (fluid properties) with List-II (related terms) and select the correct answer using the given lists:  
**List-I** **List-II**  
 A. Capillarity a. Cavitation  
 B. Vapour pressure b. Density of water  
 C. Viscosity c. Shear forces  
 D. Specific gravity d. Surface tension  
 (a) A-a, B-d, C-b, D-c  
 (b) A-a, B-d, C-c, D-b  
 (c) A-d, B-a, C-b, D-c  
 (d) A-d, B-a, C-c, D-b  
**[UPRVUNL JE - 2015]**
92. A liquid compressed in a cylinder has initially a volume of 20 m<sup>3</sup> at a pressure of 100 pa. If the new volume is 40 m<sup>3</sup> at a pressure of 50 Pa, the bulk modulus of elasticity would be :  
 (a) 20 Pa (b) -20 Pa  
 (c) 50 Pa (d) -50 Pa  
**[UPRVUNL AE - 2014]**
93. A glass tube of 3 mm diameter is immersed in water which is at 20°C. The surface tension for water is 0.0736 N/m. The contact angle for water is 0°C. How much will be the capillary rise or depression ?  
 (a) 20 mm (b) 10 mm  
 (c) 0.492 cm (d) 0.56 cm  
**[MP SE - 2016]**

## 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)*

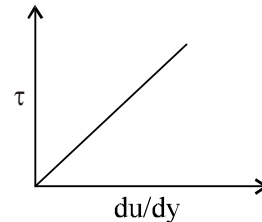
Kinematic viscosity is not a dimensionless quantity its unit is  $\text{m}^2/\text{sec}$ .

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 fluid

Toothpaste  $\rightarrow$  Bingham plastic fluid

Air, water, petrol, Diesel, Kerosene, mercury  $\rightarrow$  Newtonian fluids

18. *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

$$\tau = \text{shear stress}$$

$$\mu = \text{dynamic viscosity}$$

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

33. *Ans. (c)*

Pascal-second =  $\text{N-s/m}^2$  = 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)*

$$F = (\sigma)L$$

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

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

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

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

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

$$\begin{aligned} \text{So specific volume} &= \frac{1}{7.74} \text{ m}^3/\text{kN} \\ &= 0.129 \text{ m}^3/\text{kN} \end{aligned}$$

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)*

$$\begin{aligned} P \text{ for soap bubble} &= \frac{8\sigma}{d} = \frac{4\sigma}{r} \\ &= \frac{4 \times 0.0736}{4 \times 10^{-2}} = 7.36 \text{ N/m} \end{aligned}$$

48. *Ans. (d)*

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

49. *Ans. (b)*

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

50. *Ans. (c)*

Specific gravity is the ratio of density of a fluid and density of standard fluid at  $27^\circ\text{C}$  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	$\text{T}^{-1}$
(b) Angular acceleration	$\text{T}^{-2}$
(c) Discharge	$\text{L}^3\text{T}^{-1}$
(d) Kinematic viscosity	$\text{L}^2\text{T}^{-1}$

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  $100^\circ\text{C}$  at sea level vapour pressure is equal to atmospheric pressure and that is why water start boiling at  $100^\circ\text{C}$ .

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<sup>2</sup> 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<sup>3</sup>.

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

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

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

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

$$h = 0.01488$$

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

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.

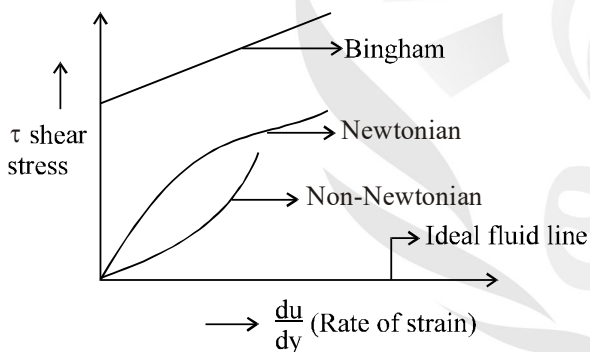
80. *Ans. (b)*

1. **Ideal fluid** : Shear stress is zero.

2. **Newtonian fluid** : Shear stress vary linearly with the rate of strain.

3. **Non-newtonian fluid** : Shear stress vary non linearly with the rate of strain.

4. **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  $6.96 \times 10^{-2} \text{ N/m}$

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)*

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

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

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

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  $J/m^2$ .

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)*

112. *Ans. (c)*

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

$$= \frac{0.5 \times 0.1}{0.4 \times 1000} \frac{\text{m}^2}{\text{sec}}$$

$$= 0.125 \times 10^{-3} \text{ m}^2/\text{sec}$$

$$= 1.25 \text{ stoke}$$