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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

[RPSC]

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

[UKPSC-JE - 2020]

5. With decrease in temperature, the viscosity in gases generally

(a) Increases linearly

(b) Increases exponentially

(c) Remain unaffected

(d) Decreases

[CGPSC - 2018]

6. Viscosity of a fluid with specific gravity 1.3 is measured to be 0.0034 Ns/m^2. Its kinematic viscosity, in m^2/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

[DDA JE - 2018]

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/cm^2

(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 2m^3 of liquid results in a volume change of 0.004 m^3. 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^2 (b) m^2/s

(c) N/m (d) N.s/m

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

16. A fluid, which satisfies the relations 'τ' = μ (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-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) 10^6cm^3/s (b) 10^{-2}m^2

(c) 10^4cm^3/s (d) 10^{-4}m^2/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) $ML^{-1}T^{-1}$

(c) $ML^{-1}T^{-2}$ (d) $M^{-1}L^{-1}T^{-1}$

[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 m/sec^2. Specific volume will be

(a) 0.126 m^3/kN (b) 0.122 m^3/kN

(c) 0.129 m^3/kN (d) 0.132 m^3/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) Considerbly 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 × density

(b) Dynamic viscosity / density

(c) Dynamic viscosity × 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

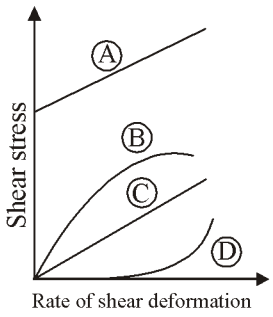
(b) A-c, B-d, C-b, D-a

(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°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^2 to maintain this speed. What would be the fluid viscosity between the plates?

(a) 10^{-3} poise (b) 10^{-4} poise

(c) 2×10^{-3} 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^2 (b) 0.6 N/cm^2

(c) 0.4 N/cm^2 (d) 400 N/cm^2

[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 ocurs 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^{-3} kg/m^3 (b) 1 kg/m^3

(c) 10^2 kg/m^3 (d) 10^3 kg/m^3

[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 'σ' 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 σ and difference of pressure (ΔP) 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^2 to 120 N/cm^2. The volume of liquid was found to decrease by 0.20%.

(a) 1×10^4 N/cm^2

(b) 2×10^4 N/cm^2

(c) 3×10^4 N/cm^2

(d) 4×10^4 N/cm^2

[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^3 (b) 6000 kg/m^3

(c) 60 kg/m^3 (d) 600 kg/m^3

[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 π (d) 0.00004 π

[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 in maximum on a place inclined at 45° to the horizontal

(d) The shear stress depends upon the co-efficient of viscosity

[UPSSC JE - 2015]

91. Match List-I (fluild 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 intially a volume of 20 m^3 at a pressure of 100 pa. If the new volume is 40 m^3 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]

94. The coefficient of viscosity may be observed by
(a) Capillary tube method
(b) Orifice type viscometer
(c) Rotating cylinder method
(d) All of these

[MP SE - 2016]

95. Free surface of a liquid tends to contract to the smallest possible area due to force of
(a) Adhesion (b) Viscosity
(c) Gravity (d) Surface tension

[MP SE - 2016]

96. Compressibility is equal to
(a) $\frac{-(dV / V)}{dp}$ (b) $\frac{dp}{-(dV/V)}$
(c) $\frac{dp}{dp}$ (d) $\sqrt{\frac{dp}{dp}}$

[Uttrakhand JE - 2008]

97. Specific volume is ratio of
(a) Mass and volume
(b) Volume and mass
(c) Weight and volume
(d) Volume and weight

[RWRD JE - 2014, DSSSB - 2021 Shift]

98. Which one of the following is correct dimension of surface tension
(a) N/m^2 (b) J/m
(c) J/m^2 (d) W/m

[UPRVNL JE - 2016]

99. The dynamic viscosity of fluid is 0.7 poise and specific gravity is 0.8, then the kinematic viscosity of fluid in stokes is :
(a) 1.14 (b) 0.87
(c) 0.22 (d) 0.34

[UPRVNL JE - 2016]

100. What is the ratio of specific weight of a liquid of the specific weight of pure water at a standard temperature called as?
(a) Density of liquid
(b) Specific gravity of liquid
(c) Compressibility of liquid
(d) Surface tension of liquid

[Vizag Steel M.T. - 2011]

101. The mass per unit volume of a liquid at a standard temperature and pressure is called
(a) Specific weight
(b) Mass density
(c) Specific gravity
(d) None of these

[Vizag Steel (J.T.) - 2017]

102. Viscosity is considered as ..... property in model analysis.
(a) Geometric
(b) Dimensionless
(c) Dynamic
(d) Kinematic

[M.P. Vyapam - 2017]

103. The height to which a liquid will rise in an open capillary tube is inversely proportional to :
(a) Temperature of liquid
(b) Density of liquid
(c) Air pressure
(d) Surface tension

[ISRO Vikram Sarabhai - 2017]

104. Which property of mercury is the main reason for use in barometers?
(a) Low density
(b) Negligible capillary effect
(c) Very low vapour pressure
(d) Low compressibility

[UPPSC AE - 2016]

105. The increase in pressure of a liquid

(a) Lowers the boiling point of a liquid

(b) Raises the boiling point of a liquid

(c) Does not effect the boiling point of a liquid

(d) Reduces its volume

[MP SE - 2016]

106. One liter of water occupies a volume of :

(a) 100 m^3 (b) 1000 cm^3

(c) 10000 cm^3 (d) 100000 m^3

[MP SE - 2016]

107. The desirable properties for an practical fluids :

(a) Should be viscous

(b) Should posses surface tension

(c) Should be compressible

(d) All of the above

[MP SE - 2016]

108. Find the surface tension in soap bubble of 40 mm diameter when the inside pressure is 2.5 N/m^2 above atmospheric pressure.

(a) 0.860 N/m (b) 1.265 N/m

(c) 0.0125 N/m (d) 0.0064 N/m

[RSMSSB-JE - 2020]

109. Pressure inside a water droplet is given by relation

(a) $P = \frac{3\sigma}{d}$ (b) $P = \frac{8\sigma}{d}$

(c) $P = \frac{16\sigma}{d}$ (d) $P = \frac{4\sigma}{d}$

[RSMSSB-JE - 2020]

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/m^3

(c) 700 kg/m^3 (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/m^3 (b) 70 kg/m^3

(c) 7 kg/m^3 (d) 700 kg/m^3

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

129. What is the specific gravity of a liquid having the viscosity 0.006 Ns/m^2 and kinematic viscosity 0.025×10^{-4} m^2/s.

(a) 2.4 (b) 0.5

(c) 2 (d) 1.2

130. All imaginary fluids are _____.

(a) ideal plastic fluid (b) real fluids

(c) ideal fluids (d) plastic fluids

131. Specific Gravity of Mercury is _____.

(a) 1.6 (b) 10.6

(c) 13.6 (d) 15.6

132. The Value of Density of water is _____.

(a) 5gm/cm^3 (b) 0.5gm/cm^3

(c) 1gm/cm^3 (d) 10gm/cm^3

133. CGS unit of Viscosity is _____.

(a) (Dyne-sec)/(cm^3)

(b) (Dyne-sec)/(cm)

(c) (Dyne-sec)/(cm^2)

(d) (Dyne-sec3)/(cm^2)

134. Surface tension can be defined as _____.

(a) The force acting on the surface of a liquid in contact with ground

(b) The compressive force acting on the surface of a liquid in contact with a gas

(c) The tensile force acting on the surface of a liquid in contact with a gas

(d) The shear force acting on the surface of a liquid in contact with a gas

135. The volume of a fluid occupied by a unit mass is called as _____.

(a) Specific Volume

(b) Specific Weight

(c) Viscosity

(d) Specific Gravity

136. CGS unit of Kinematic Viscosity is _____.

(a) Cm^3/s (b) Cm^2/s

(c) Cm^2/s^2 (d) Cm^2/s^3

137. As per Newton's Law of viscosity the shear stress acting between two layers of fluid is :

(a) Directly proportional to the distance between them.

(b) Inversely proportional to the square of the distance between them

(c) Directly proportional to the square of the distance between them.

(d) Inversely proportional to the distance between them.

138. Bulk modulus is defined as :

(a) Sum of direct stress and volumetric strain

(b) Product of direct stress and volumetric strain

(c) Ratio of direct stress and volumetric strain

(d) Difference of direct stress and volumetric strain

139. A tank is filled with 1L liquid & weight of the same was found to be 6 N. What is the specific weight of the liquid ?

(a) 0.6 * 10^{-3} N/m^3

(b) 6 * 10^{-3} N/m^3

(c) 0.6*10^3 N/m^3

(d) 6*10^3 N/m^3

140. 1 Newton (N) is equal to _____.

(a) 10 kg m/s^2 (b) 0.1 kg m/s^2

(c) 1 kg m/s^2 (d) 100 kg m/s^2

141. An object weight 100 N in air and 75 N in water when fully submerged unit. The specific gravity of the object is

(a) 4.0 (b) 4.5

(c) 2.5 (d) 1.25

[JPSC]

142. Printer's ink is an example of

(a) Newtonian fluid

(b) Non-Newtonian fluid

(c) Thixotropic substance

(d) Elastic solid

143. Dynamic Viscosity of a gas

(a) Increases s temperature decreases

(b) Increases as temperature increases

(c) Is independent of temperature

(d) May increase or decrease with increase in temperature, depending on the nature of gas

144. The following results are obtained on shear stress (τ) and rate of deformation at constant temperature for a fluid.

(du/dy) (radians/sec)	0	0	1	2	3
τ(kPa)	0	10	20	30	40

The above fluid is classified as

(a) Newtonian (b) Non-Newtonian

(c) Ideal plastic (d) Thixotropic

[MPSC - 2018]

145. The units of kinematic viscosity are

(a) kg/m^2.sec (b) kg/sec/m^2

(c) m/kg.sec (d) m^2/sec

[UKPSC]

146. The flow in a pipe is laminar if the Reynolds number is

(a) Less than 2000

(b) Between 2000 and 4000

(c) Between 4000 and 6000

(d) Equal to 6300

147. The unit of kinematic viscosity is :

(a) gm/cm-sec^2 (b) dyne-sec/cm^2

(c) gm/cm^2-sec (d) cm^2/sec

148. Two horizontal plates are placed in parallel keeping 2.0 cm apart. If the space between the plates is filled with an oil of viscosity 10 poise, then what would be the shear stress in oil if upper plate is moved with velocity of 3.0 m/s

(a) 50 N/m^2 (b) 100 N/m^2

(c) 150 N/m^2 (d) 200 N/m^2

[Punjab - SSSB]

149. At room temperature, the dynamic and kinematic viscosity of water are

(a) Both greater than that of air.

(b) Both lesser than that of air

(c) Respectively greater than and lesser than that of air.

(d) Respectively less er than and greater than that of air.

[Punjab SDO - 2021]

150. Which of the following is the least incompressible fluid ?

(a) Gasoline (b) Kerosene oil

(c) Helium (d) Water

[OPSC AE - 2015]

151. What is the specific weight of water in S.I. units ?

(a) 9.81 gm (b) 981 gm

(c) 9.81 kN/m^3 (d) 9.81 $\times$ 10^3 kN/m^2

[OPSC AE - 2015]

152. An ideal flow of a liquid obeys :

(a) Continuity equation

(b) Newton's law of viscosity

(c) Newton's second law of motion

(d) Dynamic viscosity law

[JPSC - AE]

153. Which one of the following pressure units represents the maximum pressure ?

(a) Millibar (b) mm of Hg

(c) N/mm^2 (d) kg(f) cm^2

[JPSC - AE]

154. Which of the following statements is correct ?

(a) Dynamic viscosity of water is nearly 50 times that of air

(b) Kinematic viscosity of water is 30 times that of air

(c) Water in soil is able to rise a considerable distance above the ground water table due to viscosity

(d) Vapor pressure of a liquid is inversely proportional to the temperature

[JPSC - AE]

155. Which one of the following expresses the height of rise or fall of a liquid in a capillary tube ?

Where , w = Specific weight of the liquid, α = Angle of contact of the liquid surface, s = Surface tension, d = diameter of capillary tube.

(a) $\frac{4wd}{\sigma\cos\alpha}$ (b) $\frac{\sigma\cos\alpha}{4wd}$

(c) $\frac{4\sigma\cos\alpha}{wd}$ (d) $\frac{wd}{4\sigma\cos\alpha}$

[JPSC - AE]

156. Poise is the unit of :

(a) Dyne-cm/s^2 (b) Dyne-cm/s

(c) Dyne-s/cm (d) Dyne-s/cm^2

[JPSC - AE]

157. The surface tensional a soap bubble of 50 mm diameter with its inside pressure being 2.5 N/m^2 above the atmospheric pressure is :

(a) 0.0125 N/m (b) 0.0156 N/m

(c) 0.2000 N/m (d) 0.0312 N/m

[JPSC - AE]

158. If the kinematic viscosity of a fluid is 6 stokes and specific gravity is 1.9, then dynamic viscosity of the liquid in poise is :

(a) 11.40 (b) 1.40

(c) 10.80 (d) 3.16

[DFCCIL - 2016]

159. The atmospheric pressure at sea level is called

(a) Normal pressure

(b) Standard atmospheric pressure

(c) Barometric pressure

(d) Absolute pressure

[MPSC]

160. The property of a fluid which determines its resistance to shearing stress, is called_____.

(a) Permeability (b) Viscosity

(c) Capillarity (d) Density

[MPSC - 2019]

161. At what standard temperature, the specific gravity of water is equal to 1

(a) 2 °C (b) 4 °C

(c) 10 °C (d) 20 °C

[MPSC - 2017]

162. The pressure at a point 4 m below the free surface of water is :

(a) 19.24 kPa (b) 29.24 kPa

(c) 39.24 kPa (d) 49.24 kPa

[MPSC - 2016]

163. The kinematic viscosity of oil of specific gravity 0.8 and dynamic viscosity 2 poise is -

(a) 2.5 centistoke (b) 2500 cm^2/sec

(c) 2.5×10^{-4}cm^2/sec (d) 2.5 stokes

[TNPSC - 1998, APPSC - 2013]

164. In MLT system, the dimensions of angular momentum would be

(a) MLT^{-1} (b) ML^{2}T

(c) ML^{2}T^{-1} (d) ML^{2}T^{-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 capiltary rise will be—

(a) Unaftected

(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 corect answer from the options given below

List–I

Physical Quantity

(A) Angular velocity

(B) Angular acceleration

(C) Discharge

(D) Kinematic viscosity

List–II

Dimension

(i) L^2T^{-1} (ii) T^{-1}

(iii) T^{-2} (iv) L^3T^{-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 corect 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 water increases

(d) Viscosity of air increases and viscosity 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)***

$$\nu = \frac{\mu}{\rho} = \frac{3.4\times10^{-3}}{1300} = 2.6 \times 10^{-6}\ m^2/s$$

7. ***Ans. (d)***

8. ***Ans. (c)***

$$\rho = 1000\ kg/m^3$$

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

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

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.

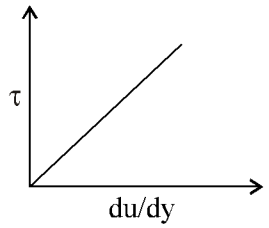
11. ***Ans. (d)***

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)***

$$K = \frac{\frac{\partial P}{\partial V}}{V} = \frac{500\times2}{4\times10^{-3}} = 250 \times 10^3\ KPa = 250\ MPa$$

15. ***Ans. (b)***

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

16. ***Ans. (a)***

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

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

17. ***Ans. (b)***

Human blood → Pseudo plastic fluid

Toothpaste → Bingham plastic fluid

Air, water, petrol, Diesel, Kerosene, mercury → 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 poise = 0.1 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 stoke = 10^{-4} m^2/sec

22. ***Ans. (a)***

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

23. ***Ans. (b)***

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

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

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)***

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

27. ***Ans. (d)***

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

28. ***Ans. (b)***

1 centipoise = 10^{-2} poise

29. ***Ans. (c)***

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

30. ***Ans. (c)***

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

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

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

$(\rho g$ = weight density)

$$4\rho g = 30$$

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

Specific weight= 7.5 = 7.5 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

$\frac{du}{dy}$ = 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)***

$$F = (\sigma)L$$

$$\sigma = \frac{F}{L} = FL^{-1}$$

σ = surface tension
F = Force
L = Length

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 combindely known as capillary tension.

43. *Ans. (c)*

Rheology is the study of non-newtonian fluid

44. *Ans. (c)*

For the given fluid

$$1m^3 \rightarrow 789kg$$

$$1m^3 \rightarrow 789 \times 9.81N$$

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

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

$$= 0.129\ m^3/kN$$

45. *Ans. (a)*

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

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

46. *Ans. (a)*

47. *Ans. (a)*

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

$$= \frac{4\times0.0736}{4\times10^{-2}} = 7.36\ N/m$$

48. *Ans. (d)*

Unit of pressure → 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 phesomenon**
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)***

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)***

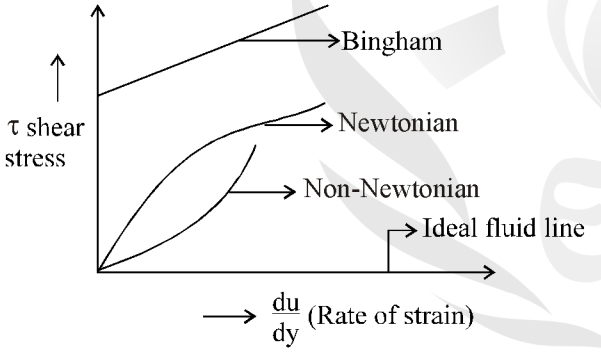
Because in mercury cohesion force is more, compare to adhesion force.

79. ***Ans. (b)***

Water is 55 times more viscous than air.

80. ***Ans. (b)***

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 6.96×10^{-2} N/m

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

$$h = 0.01488$$

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

83. ***Ans. (c)***

Thixotropic fluid do not show shear thinning behaviour

84. ***Ans. (d)***

$1000 \times 0.6 = 600$ 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)***

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

93. ***Ans. (b)***

Diameter = 3mm.

Surface tension = 0.0736 N/m

$$\theta = 0^oC$$

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

$$= \frac{4\times0.0736\times\cos0^o}{1000\times9.81\times3\times10^{-3}}\times1000mm$$

$$\Rightarrow \quad 10mm$$

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)***

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

$$G = 0.8$$

$$\nu = \frac{\mu}{\rho} = \frac{7\times10^{-2}}{.8\times1000}$$

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

$$= 0.875 \text{ stokes}$$

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)***

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

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)***

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

$$= \frac{0.5\times0.1}{0.4\times1000} \ \frac{m^2}{sec}$$

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

$$= 1.25 \text{ stoke}$$

113. ***Ans. (c)***

$$\text{Discharge (Q)} = \frac{V}{T}\left(\frac{m^3}{sec}\right)$$

$$= L^3T^{-1}$$

114. ***Ans. (d)***

Specific Weight of liquid

$$= \frac{5N}{1\times10^{-3}\,m^3}$$

$$= 5 \times 10^3\ N/m^3$$

$$S.G. = \frac{5\times10^3}{9810} = 0.51$$

115. ***Ans. (b)***

$$S.G. = \frac{\text{Specific Weight of Oil}}{\text{Specific Weight of Water}}$$

$$0.7 \times 9810 = S.W.\ of\ oil$$

$$6867\ W/m^3 = S.W.\ of\ oil$$

116. ***Ans. (d)***

Ideal Plastic Fluid : When the shear stress is proportional to the velocity gradient and shear stress is more than the yield value, it is known as ideal plastic fluid.

117. ***Ans. (d)***

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

$$6 \times 10^{-4} = \frac{\mu}{1.9\times1000}$$

$$\mu = 1.14\ NS/m^2$$

$$1\ poise = 0.1\ N.S/m^2$$

$$\mu = 11.40\ poise$$

118. ***Ans. (d)***

$$\text{Specific Weight} = \gamma = \rho g$$

$$= \frac{kg}{m^3}\times\frac{m}{sec^2}$$

$$= ML^{-2}T^{-2}$$

119. ***Ans. (a)***

A newtonian fluid is one which obeys newton's law of viscosity.

120. ***Ans. (b)***

Poise is the unit of dynamic viscosity.

121. ***Ans. (a)***

Newtonian fluids are defined as fluids for which the shear stress is linearly proportional to the shear strain rate.

122. ***Ans. (d)***

$$\text{Density of Petrol} = 0.7 \times 1000$$

$$= 700\ kg/m^3$$

123. ***Ans. (d)***

For hollow bubble

$$P_i - P_o = \frac{4T}{r} = \frac{8\sigma}{d}$$

124. ***Ans. (a)***

$$\text{Specific Gravity} = \frac{\text{Density of Fluid}}{\text{Density of Standard Fluid}}$$

125. ***Ans. (b)***

Poise is the unit of dynamic viscosity.

126. ***Ans. (d)***

Shear stress develops on a fluid element when a fluid is viscous and if it is in motion.

127. ***Ans. (c)***

Specific Gravity of Liquid

$$= \frac{\text{Specific Weight of a Liquid}}{\text{Specific Weight of Water}}$$

128. ***Ans. (b)***

Compressibility is defined as the ratio of volumetric strain to compressive stress.

$$\beta = -\frac{\partial V}{V \times \partial P}$$

129. ***Ans. (a)***

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

$$\rho = \frac{0.006}{0.025\times10^{-4}}$$

$$= 2400 \text{ kg/m}^3$$

$$\text{S.G.} = \frac{2400}{1000} = 2.4$$

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/cm^3.

133. ***Ans. (c)***

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

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

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 = cm^2/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)***

$$\text{Specific Weight} = \rho g$$

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

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

140. ***Ans. (c)***

141. ***Ans. (a)***

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

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

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

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

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

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

$$\rho g V = 100$$

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

$$\boxed{\rho = 4\rho_w}$$

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

142. *Ans. (c)*

Fluid type (Non Newtonian)	Examples
Dilatants fluid	Butter, quick sand, sugar in water
Pseudoplastic fluids	Paints, lipstic, blood, milk
Thixotropic	Printer ink, enamels
Rheopectic	Gypsum, solution in water, bentonite solution
Bingham plastic fluid	Sewage sludge, toothpaste, drilling mud gel

143. *Ans. (b)*

144. *Ans. (c)*

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

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 $Kgm^{-1}\ s^{-1}$

CGS unit: Poise

Unit of kinematic viscosity

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

CGS unit: Stokes

146. *Ans. (a)*

$$\text{Reynolds number} = \frac{\text{Inertial force}}{\text{Viscous force}}$$

$$R_e = \frac{\rho VD}{\mu}$$

V is the mean velocity of flow.

ρ is the mass density.

μ is the dynomic viscosity.

D is the knonw dia of the pipe.

The type of flow is based on the value of R_e

If $R_e < 2000$, the flow is called laminar

$R_e < 4000$, the flow is called turbulent

If $2000 < R_e < 4000$, the flow is called transition

147. *Ans. (d)*

Kinematic viscosity: The ratio of dynamic viscosity to density appears frequently and this ratio is given by the name of kinematic vescosity. Its unit is stoke or $\left(\frac{m^2}{s}\right)$.

148. *Ans. (c)*

$$\tau = \mu \cdot \frac{dv}{dy}$$

$$= \left(1 \times \frac{3}{0.02}\right) = 150\,N/m^2$$

149. *Ans. (c)*

150. *Ans. (d)*

151. *Ans. (c)*

152. *Ans. (a)*

153. *Ans. (c)*

$N/mm^2 = 10^6$ Pa

$kgf/cm^2 = 9.81/10^{-4}$ Pa

milibar $= 10^2$ Pa

mm of mercury $= 10^{-3} \times 13600 \times 9.81$

$= 133.416$ Pa

154. *Ans. (a)*

1. Water is about 50 times more viscous than air.
2. Castor oil is about 1000time more viscous than water.
3. Crude oil about 10 times more viscous than water.
4. Gasoline is about 1/3 time viscous than water.

Kinematic viscousity of air is more than that of water.

155. *Ans. (c)*

156. *Ans. (d)*

157. ***Ans. (b)***

$$P = \left(\frac{8\sigma}{d}\right)$$

$$\Rightarrow \quad \sigma = \frac{\Delta P \times d}{8}$$

$$= \frac{2.5 \times 0.050}{8}$$

$$= 0.0156 \text{ N/m}$$

158. ***Ans. (a)***

$$\nu = 6 \times 10^{-4} \frac{m^2}{sec}$$

Density of fluid = s. gravity × 1000

$$= 1.9 \times 1000 = 1900 \text{ kg/m}^3$$

$$\nu = \frac{\text{Dynamic viscosity}}{\text{Density of fluid}}$$

$$6 \times 10^{-4} = \frac{\mu}{1900}$$

$$\boxed{1.14 \frac{NS}{m^2} = \mu}$$

$$\boxed{11.40 \text{ Poise} = \mu}$$

159. ***Ans. (b)***

160. ***Ans. (b)***

161. ***Ans. (b)***

Water has a density of 1 at 4°C. When the s gravity is defined based on water at 4°C, then the specific gravity is equal to the density of liquid.

162. ***Ans. (c)***

$$P = \rho g H$$

$1000 \times 9.81 \times 4 = 39240$ Pa, 39.24 kPa

163. ***Ans. (d)***

Kinematic viscosity (ν) = $\frac{\mu}{\rho}$ (Dynamic viscosity, and density)

$$= \frac{2}{0.8}$$

$\nu = 2.5$ stokes

Its SI unit is m^2/sec CGS unit is cm^2/sec or stoke

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

164. ***Ans. (c)***

165. ***Ans. (c)***

$$\Delta P = 8\sigma/d$$

$$\Delta P = 8 \times 0.09/0.03$$

$$= 24 \text{ N/m}^2$$

166. ***Ans. (c)***

Capillarity is due to the adhesion of the liquid to the sides of the tube and due to the surface tension of the liquid.

167. ***Ans. (a)***

$$PV = \text{constant}$$

$$PdV + VdP = 0$$

$$P = \frac{dP}{\left(-\frac{dV}{V}\right)} \quad \boxed{K_{\text{is otherwal}} = P}$$

168. ***Ans. (c)***

169. ***Ans. (c)***

170. ***Ans. (d)***

171. ***Ans. (b)***

172. ***Ans. (b)***

173. ***Ans. (c)***

174. ***Ans. (d)***

175. ***Ans. (b)***

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Properties of the Fluids
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CHAPTER 1

PRECIPITATION AND FREQUENCY OF RAINFALL DATA

OBJECTIVE QUESTIONS

1. Which of the following types of raingauge is used for measuring rain in remote hilly inaccessible areas?

(a) Tipping bucket type

(b) Weighing type

(c) Floating type

(d) Symon's raingauge

2. Precipitation caused by lifting of an air mass due to the pressure difference is called

(a) Cyclonic precipitation

(b) Convective precipitation

(c) Orographic precipitation

(d) None of these

3. A recording type rain gauge

(a) Produces a mass curve of rain fall

(b) Records the cumulative rain

(c) Is sometimes called as integrating rain gauge or continuous rain gauge

(d) All of the above

4. Isohyets are the imaginary lines joining the points of equal

(a) Pressure (b) Height

(c) Humidity (d) Rainfall

5. For determination of average annual precipitation in a catchment basin, the best method is

(a) Arithmetic mean method

(b) Thiessen's polygon method

(c) Isohyetal method

(d) None of these

6. Precipitation caused due to upward movement of warmer air as compared to surrounding air is called

(a) Cyclonic precipitation

(b) Convective precipitation

(c) Orographic precipitation

(d) None of these

7. Symon's rain gauge is

(a) Tipping-bucket gauge

(b) Weighing type gauge

(c) Float type gauge

(d) Non-recording gauge

8. The rainfall on five successive days were measured as 10 cm, 8 cm, 6 cm, 4 cm and 2 cm respectively. If the infiltration index or the storm loss rate for the catchment area is earlier estimated as 5 cm/day, the total surface run off will be

(a) 5 cm (b) 6 cm

(c) 9 cm (d) 14 cm

[RPSC AEn - 2013]

9. Cyclonic precipitation results from

(a) Lifting of air masses covering into low pressure area

(b) Natural rising of warmer, lighter air in colder and denser surroundings

(c) Lifting of warm moisture-laden air masses due to topographic barriers

(d) All of the above

10. If 'p' is the precipitation, 'a' is the area represented by a raingauge, and 'n' is the number of raingauges in a catchment area, then the weighted mean rainfall is : –

(a) $\Sigma ap/n$ (b) $\Sigma ap^2/\Sigma a$

(c) $\Sigma ap/\Sigma a$ (d) $\Sigma ap^3/\Sigma a^2$

[RPSC-VPITI-2016]

11. The hydrology is a science which deals with the

(a) Occurrence of water on the earth

(b) Distribution of water on the earth

(c) Movement of water on the earth

(d) All of the above

12. Humidity refers to the ___.

(a) Volume of the air

(b) Water vapour in the air

(c) Pressure of the moisture

(d) Mass of the air

[PEB-SUB ER.-2017]

13. Which of the following instruments is not connected with stream flow measurement?

(a) Hygrometer

(b) Echo-depth recorder

(c) Electro-magnetic flow meter

(d) Sounding weight

[MPSC-2012]

14. The length of all streams per unit area of a watershed is called

(a) Stream density

(b) Drainage density

(c) Stream coefficient

(d) Drainage coefficient

15. The flow mass curve is an integral curve of

(a) Hydrograph

(b) Hyetograph

(c) Flow duration curve

(d) S-curve

[LBS-ASST.PROF.2017]

16. The water from the ocean to the atmosphere, atmosphere to the ground and back to the ocean again is called

(a) Hydrological cycle (b) Climate effect change

(c) Low pressure (d) High pressure

[Haryana JE-2018]

17. What is the diameter of receiver tipping bucket rain gauge?

(a) 400 mm (b) 500 mm

(c) 300 mm (d) 100 mm

[Haryana JE-2018]

18. When raindrops evaporate before reaching the earth while passing through dry air is called as:

(a) Drizzle (b) Virga

(c) Snowfall (d) Sleet

[DMRC-2018]

19. Which of the following represents a tropical cyclone?

(a) Zone of low pressure with clockwise winds in northern hemisphere

(b) Zone of low pressure with anticlockwise winds in northern hemisphere

(c) Zone of high pressure with anticlockwise winds in northern hemisphere

(d) Low pressure zone that occurs in northern hemisphere

[AEC-2017]

20. Percentage of water available on earth that is saline is

(a) 33% (b) 67%

(c) 97% (d) 0%

[U.K. AE-2012]

21. Standard recording rain gauge adopted in india is:

(a) Natural syphon type

(b) Tipping bucket type

(c) Weighing bucket type

(d) None of the above

[MP VYAPM Sub Engineer - 2017/ RRB JE - 2014]

22. If allowable percentage error in the estimate of basic rain fall is 'E' and co-efficient of variation of rainfall is 'C_v', then optimum number of rain guages is given by

(a) $\sqrt{\frac{C_v}{R}}$ (b) C_v/E

(c) $\left(\frac{C_v}{E}\right)^{3/2}$ (d) $\left(\frac{C_v}{E}\right)^{2}$

[U.K. AE-2012]

23. The areal characteristics of a rain storm are represented by a

(a) DAD curve (b) Hyetograph

(c) Mass curve (d) Double mass curve

24. Hydrological cycle is denoted by equation

(a) P = E + R (b) P = E – R

(c) P = ER (d) P = E/R

[UPSSC JE-2015]

25. Which term is appropriate for the branch of physical geography which deals with the origin, distribution of water on the earth surface?

(a) Hydrolysis (b) Oxidation

(c) Hydropethia (d) Hydrology

[DFCCIL-2016]

26. The rain gauge must be set as near the ground as possible?

(a) To reduce elvation effect

(b) To reduce wind effect

(c) To reduce slope effect

(d) To avoid visibility

[Uttarakhand AE-2007]

27. A 60% index of wetness means

(a) Rain excess of 40%

(b) Rain deficiency of 40%

(c) Rain deficiency of 60%

(d) None of the above

[U.K. AE-2012]

28. The hydrological equation states that

(a) Σinflow = Σoutflow

(b) Σinflow = Σoutflow = constant

(c) sub surface inflow = sub surface outflow

(d) Σinflow – Σoutflow = Change in storage

[U.K. AE-2012]

29. Which of the following is not a form of precipitation?

(a) Snow (b) Rain

(c) Hail (d) Smog

[U.K. AE-2012]

30. Double mass cruve technique is followed to

(a) Check the consistency of rain gauge record

(b) Find the average rainfall over a number of year

(c) Find the number of rain gauge required

(d) Estimate the missing precipitation values

[U.K. AE-2012]

31. What is the unit of runoff in M.K.S system?

(a) Cubic metre/sec (b) Square metre

(c) Cubic metre (d) Metre/sec

[NMRC JE-2017]

32. The precipitation is measured in terms of

(a) Intensity of pressure

(b) Depth of water

(c) Quantity of water

(d) Volume of water

[U.K. AE-2012]

33. A rain gauge should preferable be fixed

(a) Near the building

(b) Under the tree

(c) In an open space

(d) In a closed space

[U.K. J.E.-2015, H.P.S.S.C-2015]

34. Hydrology is necessary for civil engineers for

(a) Designing and construction of irrigation structure

(b) Designing and construction of ridges and culverts

(c) Flood control works

(d) All of these

[I.O.F. JE-2015]

35. Precipitation includes

(a) Rain (b) Snow

(c) Hail (d) All of these

[I.O.F. JE-2015]

36. Which one of the following pairs is NOT correctly matched?

(a) Water losses Evaporation

(b) Run off Stream flow

(c) Percolation Soil Erosion

(d) Storm Precipitation

[F.C.I. JE-2016]

37. Which method gives accurate estimate of average rainfall in a hilly area catchement?

(a) Isohyetal method

(b) Normal ratio method

(c) Arithmetic mean method

(d) Theissen polygon method

[UKPSC AE-2013]

38. A rainfall with a intensity of 5 mm/hr is classified as

(a) Trace (b) Light rain

(c) Moderate rain (d) Heavy rain

[Jharkhand SSC JE-2016]

39. Rainfall hyetograph shows the variation of .....

(a) Cumulative rainfall with time

(b) Rainfall intensity with time

(c) Rainfall depth over an area

(d) Rainfall intensity with the cumulative rainfall

40. A fine sprinkle of numerous water droplets of size less than 0.5mm and intensity less than 1 mm/h is known as :

(a) Hail (b) Drizzle

(c) Glaze (d) Fog

[PEB-SUB ER.-2017]

41. The observed annual runoff from a basin of area 500 km^2 is 150 Mm^3 and the corresponding annual rainfall over the basin during the same years is 750 mm. What is the runoff coefficient?

(a) 0.2 (b) 0.67

(c) 0.4 (d) 0.5

[UPPSC-AE-2020]

42. The Theissen weights of 4 rain gauges A, B, C and D covering a river basin are 0.15, 0.25, 0.30 and 0.30 respectively. If the average depth of rainfall for the basin is 5 cm and rainfall recorded at B, C and D are 5 cm, 4 cm and 5 cm respectively, what is the rainfall at A?

(a) 5 cm (b) 6 cm

(c) 7 cm (d) 8 cm

[UPPSC-AE-2020]

43. As per Indian Standards, in predominantly hilly areas with heavy rainfall, there should be 1 rain gauge station per____km^2.

(a) 520 (b) 330

(c) 130 (d) 30

[GPSC-2019]

44. Which of the following statement(s) is/are correct?

(i) Normal ratio method is used for estimating missing annual precipitation value at a station when the annual precipitation and normal annual precipitation at neighbouring stations are known

(ii) Arithmetic average method of calculating the average precipitation is superior to Thiessen-Polygon method

(iii) Isohyetal method of calculating average rainfall is superior to arithmetic average method and Thiessen-Polygon method

(a) (i) and (ii) (b) (i) and (iii)

(c) (ii) and (iii) (d) (i), (ii) and (iii)

[GPSC-2019]

45. For a 10% error in the estimation of mean rainfall and for a coefficient of variation of the rainfall (Cv) is equal to 30, Find the number of optimal stations, N?

(a) 3 (b) 12

(c) 6 (d) 9

46. Natural syphon type rain guage is also known as _____.

(a) Float type gauge

(b) Weighing bucket type

(c) Tipping bucket type

(d) Syphon rain gauge

47. When the size of water droplets is under 0.5 mm and it intensity is < 1 mm per hour, what is it called as ?

(a) Snow (b) Sleet

(c) Rain (d) Drizzle

48. In a town, the monthly precipitation is recorded as 28 cm and the mean temperature is recorded as 25°C over a period of one month. Calculate the monthly runoff.

(a) 31 cm (b) 5 cm

(c) 10 cm (d) 16 cm

49. Out of the following which one is non-automatic type rain gauge?

(a) Weighing bucket rain gauge

(b) Symon's rain gauge

(c) Float type rain gauge

(d) Tipping bucket rain gauge

50. Frontal precipitation comes under which type of precipitation?

(a) Convective precipitation

(b) Precipitation due to turbulent ascent

(c) Cyclonic precipitation

(d) Orographic precipitation

51. A rain gauge which is non-automatic type which is used by Meteorological department of government of India.

(a) Float type rain gauge.

(b) Weighing bucket rain gauge.

(c) Symon's Rain gauge

(d) Tipping bucket type rain gauge.

52. a.) The effective rainfall is uniformly distributed within its duration of specified period of time.

b.) The effective rainfall is distributed throughout the whole area of the drainage basin. Pick the correct statement.

(a) Statement (a) is true and (b) is false

(b) Both statements (a) and (b) are true

(c) Statement (b) alone is true

(d) Statement (a) alone is true

53. In plain area, the rain gauge density prescribed by IS 4987-1994 (Reaffirmed 2004) is-

(a) 250 m^2 (b) 500 km^2

(c) 400 km^2 (d) 150 km^2

54. Which of the following non-automatic rain gauges is being used by Indian Meteorological Department?

(a) Tipping bucket type rain gauge.

(b) Float type rain gauge.

(c) Symon's Rain gauge

(d) Weighing bucket rain gauge.

55. Four rain-gauge stations A, B, C and D in a catchment area have recorded 20, 25, 22 and 15 cm respectively. If their Thiessen weights are 0.3, 0.4, 0.1 and 0.2, then what is the average depth of rainfall on the catchment?

(a) 19.2 cm (b) 22.2 cm

(c) 21.2 cm (d) 20.2 cm

56. The precipitation caused due to the upward movement of air that is warmer than its surroundings is called _____.

(a) Convective precipitation

(b) Frontal cyclonic precipitation

(c) Non frontal cyclonic precipitation

(d) Orographic precipitation

57. Time of concentration is the

(a) Time of maximum possible precipitation that may concentrate and fall over a given basin

(b) Time taken by the rain water to flow to an existing defined drain in a basin

(c) Time for which the rain water remains concentrated on the basin

(d) Maximum time taken by the rain water to reach the outlet of the basin

[GPSC-2019]

58. What is the normal range of moderate intensity rainfall?

(a) 2.5 mm/hr – 7.5 mm/hr

(b) 7.5 mm/hr – 10.5 mm/hr

(c) 1.0 mm/hr – 1.5 mm/hr

(d) 8 mm/hr – 10 mm/hr

59. If it rains between 2 p.m. and 3 p.m. and the entire basin area just starts contributing water at 3 p.m. to the outlet, then the time of concentration will be

(a) 15 minutes (b) 20 minutes

(c) 30 minutes (d) 60 minutes

[JPSC AE 2013]

60. A 4-hour rainfall in catchment of 250 km^2 produces rainfall depths of 6.2 cm and 5.0 cm in successive 2-hour unit periods. Assuming the ϕ index of the soil to be 1.2 cm/hours, the runoff volume in ha-m will be

(a) 16 (b) 22

(c) 1600 (d) 2200

[JPSC AE 2013]

61. The Thiessen polygonal areas of the four rain gauge stations A, B, C and D in a catchment are 75, 125, 150 and 150 km^2 respectively. If the average depth of rainfall for the catchment is given as 5 cm and the rainfall recorded at B,C and D are 5 cm, 4 cm and 5 cm. What is the rainfall at A ?

(a) 8 cm (b) 7 cm

(c) 6 cm (d) 5 cm

[Chandigarh JE]

62. Which of the following pairs of terms used in ground water hydrology are not synonymous ?

(a) Permeability and hydraulic conductivity

(b) Storage coefficient and storativity

(c) Actual velocity of flow and discharge velocity

(d) Water table aquifer and unconfined aquifer

[MPSC 2020]

63. Raingauge station 'X' did not function for a part of month during which a storm occurred. The storm produced rainfall of 84, 70 and 96 mm at three surrounding stations A, B and C respectively. The normal annual rainfall at the stations X, A, B and C are respectively 770, 770, 770 and 770 mm. Estimate the missing storm rainfall at station 'X'.

(a) 83.33 mm (b) 82.33 mm

(c) 84.33 mm (d) 81.33 mm

[MPSC 2020]

64. If the total runoff is 1600 m^3/sec, drainage basin area is 104 km^2, time interval is 2 hours, then the depth of direct runoff is : (d = direct run off depth)

(a) 12.07 cm (b) 11.07 cm

(c) 13.07 cm (d) 14.07 cm

[MPSC 2020]

65. The coefficient of variation of the rainfall for six rain gauge stations in catchments was found to be 29.54%. The optimum number of stations in the catchments for an admissible 10% error in the estimation of the mean rainfall will be :

(a) 3 (b) 6

(c) 9 (d) 12

[UKPSC]

66. A 3-hour storm on a small drainage basin produced rainfall intensities of 3.5 cm/hr, 4.2 cm/hr and 2.9 cm/hr in successive hours. If the surface runoff due to storm is 3 cm, then the value of ϕ-index will be :

(a) 2.212 cm/hr (b) 2.331 cm/hr

(c) 2.412 cm/hr (d) 2.533 cm/hr

[MPSC 2020]

67. Which one of the following methods is NOT used to measure the velocity of flow of a river ?

(a) The surface float method

(b) The Pitot tube method

(c) The current meter method

(d) The sounding cable method

68. The probable maximum precipitation is defined as

(a) The lowest or minimum rainfall for a given duration that is physically possible over a station or basin

(b) the greatest or extreme rainfall for a given duration that is physically possible over a station or basin

(c) The rain fall over a basin which would produce a flood flow with high risk of being exceeded

(d) the recognition that there is a physical lower limit to the amount of precipitation

[UPPSC AE]

69. Isopluvial map is

(a) a line joining the equal intensities of rainfall

(b) a line joining the equal duration of rainfall

(c) a line joining the equal frequency of rainfall

(d) a line joining the equal depths of rainfall

[UPPSC AE]

70. Which one of the following methods/techniques is used in the indirect determination of stream - flow ?

(a) Dilution techniques

(b) Electromagnetic method

(c) Slope-area method

(d) Area-velocity method

[UPPSC AE]

71. An area is declared drought affected it its mean rainfall is less than :

(a) 50% (b) 60%

(c) 75% (d) 85%

72. The normal annual rainfall at stations A, B and C situated in meteorologically homogeneous region are 175 cm, 180 cm and 150 cm respectively. In the year 2000. Station B was inoperative an stations A and C recorded annual precipitations of 150 cm and 135 cm respectively. The annual rainfall at station B in that year could be estimated to be nearly.

(a) 150 cm (b) 143 cm

(c) 158 cm (d) 168 cm

[JPSC AE]

73. The surface velocity at any vertical section of a steam is

(a) not of any use in stream flow measurement

(b) smaller than the mean velocity in that vertical

(c) larger than the mean velocity in that vertical section

(d) equal to the velocity in that vertical at 0.6 times the depth.

[JPSC AE]

74. According to recommendations of IS : 4987-1968, how many raingauges would be required for 1170 square kilometer hilly area ?

(a) 6 (b) 7

(c) 9 (d) None of above

[GPSC AE]

75. The Thiessen Polygon is :

(a) a polygon obtained by joining adjoining raingauge station.

(b) a representative area used for weighting the observed station precipitation.

(c) an area used in the construction of depth-area curve.

(d) The descriptive term of or the shape of hydrograph

[MPSC 2019]

76. In a flow-mass curve study, the demand line drawn from a ridge in the curve did not intersect the mass curve again. This represents that :

(a) The reservoir was not full at the beginning.

(b) The storage was not adequate.

(c) The demand cannot be met by the inflow as the reservoir will not refill.

(d) The reservoir is wasting water by spill

[MPSC 2019]

77. Direct run-off is made up of :

(a) Surface run-off, prompt inter flow and channel precipitation.

(b) Surface run-off, infiltration and evapotranspiration.

(c) Overladen flow only.

(d) Rainfall and Evaporation.

[MPSC 2019]

78. The rainfall Intensity of Light Rain is :

(a) Up to 2.5 mm/hr

(b) Up to 3.0 mm/hr

(c) Up to 5.00 mm/hz

(d) Up to 7.5 mm/hz

[MPSC 2019]

79. In a DAD analysis the maximum average depth of rainfall for an 18 hr storm was 28 cm in an area of size 10 km^2. From the same duration the maximum average depth in an area of 1000 km^2 can be expected to be :

(a) = 28 cm

(b) < 28 cm

(c) > 28

(d) depends upon the type of rainfall

[MPSC 2018]

80. In a hydrological cycle, the average residence time of water in the global

(a) atmospheric moisture is larger than that in the global rivers

(b) oceans is smaller than that of the global groundwater

(c) rivers is larger than that of the global groundwater

(d) oceans is larger than that of the global groundwater

[MPSC 2012]

81. If the maximum depth of a 50 years –15h rainfall depth at Bhubaneswar is 260 mm, the 50 year -h-maximum rainfall depth at the same place is

(a) < 260 mm (b) > 260 mm

(c) = 260 mm (d) None of the above

[MPSC 2012]

82. Match the following lists :

List-I (Plot of)

A. Accumulated precipitation vs time in chronological order

B. Rainfall intensity vs time

C. Stream flow vs time in chronological order

D. Steam discharge vs percent time the flow is equalled or exceeded

List-II (Name)

I. Hydrograph

II. Hyetograph

III. Flow-duration curve

IV. Mass curve of rainfall

Codes :

	A	B	C	D
(a)	IV	II	I	III
(b)	IV	II	III	I
(c)	II	IV	I	III
(d)	II	IV	III	I

[MPSC 2012]

83. The earth's water circulatory system is known as

(a) Earth cycle

(b) Water cycle

(c) Hydrological cycle

(d) Irrigation cycle

[UKPSC JE 2015]

84. A portion of precipitation that is not evaporated contributes to

(a) Run off (b) Evaporation

(c) Settlement (d) Transpiration

[UKPSC JE 2015]

85. Permeable spur's are best suited for rivers which
(a) Carry heavy suspended load
(b) Carry large bed load, but right suspend load
(c) Need permanent protection of dikes
(d) Need attracting the river current
[CGSES - 2015]

86. In India, Average annual rainfall is the mean of the annual rainfalls measured over a period of how many years-
(a) 14 (b) 10
(c) 20 (d) 35
[CGHB - 2015]

87. If actual rainfall in a particular year is 50 cm and the average annual rainfall in that area is 75 cm, then the index of wetness is-
(a) 150.0% (b) 66.67%
(c) 33.33% (d) 100.00%
[CGHB - 2015]

88. Hydrology is a science which deals with the
(a) Occurrence of water on the earth
(b) Distribution of water on the earth
(c) Movement of water on the earth
(d) All
[TNPSC - AE - 2013]

89. The amount of precipitation is measured by
(a) rain gauge (b) osmoscope
(c) turbditimeter (d) All
[TNPSC - AE - 2013]

90. In India rainfall is generally recorded at
(a) 8 A.M. (b) 12 Noon
(c) 4 P.M. (d) 8 P.M.
[TNPSC - 2008]

91. The hydrologic cycle is expressed by the equation
(a) $P = E - R$ (b) $P = E + R$
(c) $R = R \times R$ (d) $P = E/R$
[TNPSC - 2008]

92. Cyclonic precipitation is caused by lifting of an air mass due to
(a) Pressure difference
(b) Temperature difference
(c) Natural topographical barriers
(d) None **[APPSC - 2012]**

93. If it rains between 2 pm and 3 pm and the entire basin area just starts contributing water at 3 pm to the outlet then the time of concentration will be
(a) 15 minutes (b) 20 minutes
(c) 30 minutes (d) 60 minutes
[APPSC - (AE) 2012]

94. If 'P' is the precipitation 'Q' is the area represented by a rain gauge and "n" is the number of rain gauge in a catchment area, then the weighted mean rainfall is
(a) $\frac{\Sigma ap^3}{\Sigma a^2}$ (b) $\frac{\Sigma ap}{n}$
(c) $\frac{\Sigma ap}{\Sigma a}$ (d) $\frac{\Sigma ap^2}{\Sigma a^3}$
[APPSC AE - 2012]

95. According to Indian standard, the number of rain gauge stations for an area of 5200 km^2 in plains should be
(a) 10 (b) 15
(c) 20 (d) 30
[APPSC - 2012]

96. The most accurate method of finding the average depth of rainfall over an area is
(a) Thiessen polygon
(b) Isohyetal method
(c) Arithmetic mean method
(d) Any of the above
[APPSC - 2012]

97. A rain gauge should preferable be fixed–
(a) Near the building
(b) Underthe tree
(c) In an open space
(d) In a closed space
[Uttrarakhand JE Paper II 2015, HP SSC 2015]

98. Hydrology is the science which deals with–

(a) Rain water

(b) River water

(c) Sea water

(d) Surface and under ground water

[IOF JE 2015]

99. Precipitation includes:

(a) Rain (b) Snow

(c) Hail (d) All of these

[IOF JE 2015]

100. The standard Symon type raingauge has a collecting diameter equal to–

(a) 5.08 cm (b) 10.0 cm

(c) 12.7 cm (d) 25.1 cm

[Uttrakhand Paper II JE 2015]

101. Humidity is measured by:

(a) Hydrometer (b) Hygrometer

(c) Hyctometer (d) Aneomometer

[MP SUB ENG. 3 April, Morning 2016]

102. ..... is the result from lifting of warm moisture laden air masses due to topographic barriers

(a) Convective precipitation

(b) Orographic precipitation

(c) Cyclonic precipitation

(d) Hydrography precipitatior

[MP Sab-Engg. 2016]

❑❑❑

ANSWERS SHEET

1. *Ans. (a)*

Type's of rain-gauge :

1. **Non-recording rain-gauge :** Non-recording rain-gauge measure total rain-fall in total observation duration.

   Types of non-recording rain-gauge :

   (a) Symon rain-gauge

   (b) Standard rain-gauge

2. **Recording rain-gauge :** Recording rain gauge measure total rain-fall and rain-fall intensity. It's also measured accumulative rain-fall.

   Types of recording rain gauge :

   (a) Weighing bucket type rain-gauge : Self recording gauges are used to determine rate of rainfall over short period's of time. The weighing bucket rain-gauge essentially of a receiver bucket supported by spring or lever balance or any other weighing mechanism. The movement of the bucket due to it's increasing weight it transmitted to a pen which traces the record on a clock driven chart. It's mostly used in hilly area.

   (b) Tipping bucket type rain-gauge : Tipping bucket type rain-gauge consists of 300mm diameter sharp edge receiver. At the end of the receiver is provided a funnel. A pair of bucket are pivoted under the funnel in such a way that when one bucket receives 0.25mm of PPT it tips, discharging it's contents into a container bringing the other bucket under the funnel. Tipping of bucket completes an electric circuit causing the movement of pen to mark on clock driven revolving drum which carries a record sheet. The electric pluses generated due to the tipping of bucket is recording at the control room far away from the rain gauge station.

   (c) Float (Anti-syphon) type rain-gauge : Working type rain-gauge is similar to the weight bucket type rain-gauge. A funnel receives the rain water which is collected in a rectangular container. A float is provided at the bottom of the container. The float is raises as the water level raise the container. It's recorded by pen moving on a recording drum actuated by a clock work. When the water level in the container rises so that the float touches the top, the syphon comes into operation and releases the water; thus all the water in the box drained out.

2. *Ans. (a)*

Precipitation caused by lifting of an air mass due to the pressure difference is called cyclonic ppt.

3. *Ans. (d)*

4. *Ans. (d)*

Isohyetal method is superior method compare to other method to calculate average rainfall.

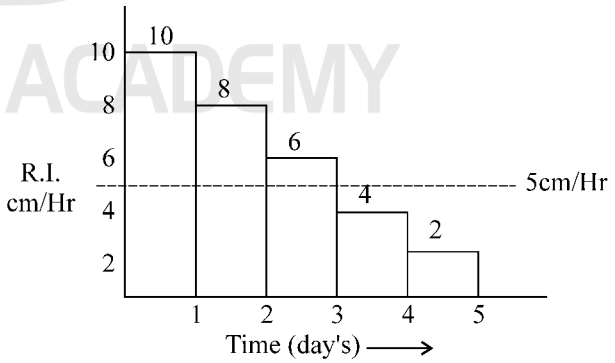
5. *Ans. (c)*

6. *Ans. (b)*

Precipitation caused due to upward movement of warmer air mass compared to surrounding air is called convective precipitation.

7. *Ans. (d)*

8. *Ans. (c)*



Run-off = (Rain-fall) – (Losses)

$$\phi\text{–index} = \frac{P_e - R}{te}$$

$$\text{Run-off} = (10-5)+(8-5)+(6-5)$$

$$= 9 \text{ cm}$$

$$5 = \frac{(10+8+6)-R}{3}$$

$$R = 9 \text{ cm}$$

9. ***Ans. (a)***

Cyclonic percipitation results from lifting of air mass covering into low pressure area.

10. ***Ans. (c)***

$$\text{Weighted mean rainfall} = \frac{\Sigma ap}{\Sigma a}$$

11. ***Ans. (d)***

12. ***Ans. (b)***

Humidity refers water vapour in the air-mass.

13. ***Ans. (a)***

Hygrometer not uses to measured stream flow measurement.

14. ***Ans. (b)***

The length of all stream per unit area of a watershed is called drainage density.

15. ***Ans. (c)***

The flow mass curve is an integral curve of. Flow duration curve.

16. ***Ans. (a)***

The water from the ocean to the atmosphere, atmosphere to the ground and back to the ocean again is called hydrological cycle.

17. ***Ans. (c)***

The diameter of receiver tipping bucket rain-gauge is 300 mm.

18. ***Ans. (b)***

When raindrops evaporate before reaching the earth while passing through dry air is called as virga.

19. ***Ans. (b)***

Tropical cyclone zone of low pressure with anticlockwise winds in northern hemisphere.

20. ***Ans. (c)***

On the earth 97% water is saline water.

21. ***Ans. (a)***

In India adopted recording type rain-gauge is natural syphon type rain-gauge.

22. ***Ans. (d)***

$$N = \left[\frac{C_V}{E}\right]^2$$

where, N = Optimum number of rain-gauge

C_V = Coefficient of variation.

E = Given error in %

23. ***Ans. (a)***

The areal characteristics of a rain storm are represented by a DAD curve.

24. ***Ans. (a)***

The Hydrological cycle denoted by

$$P = E + R$$

25. ***Ans. (d)***

Hydrology is the science of water which deal with

- Accurence
- Circulation
- Distribution of water of the earth and earth's atmosphere.

Hydrology concerned with :

- Water in stream and lakes
- Rainfall and snow fall
- Show and ice on the land and occurring below earth's surface in the pores of the soil and rock's.

26. ***Ans. (b)***

The rain-gauge must be set as near the ground to reduce wind effect.

27. ***Ans. (b)***

Rain-deficiency = 100% – index of wetness

Rain-deficiency = 100% – 60% = 40%

28. ***Ans. (d)***

Hydrological equation –

Change in storage = Σinflow – Σoutflow

29. ***Ans. (d)***

Mode of PPT :

1. Rain
2. Snow
3. Drizzle
4. Hail
5. Slate

30. ***Ans. (a)***

Double mass curve technique to determine the consistency of rain-gauge record.

31. ***Ans. (a)***

Run-off measured in cubic meter per sec.

32. ***Ans. (b)***

The precipitation is measured in terms of depth of water in mm or cm.

33. ***Ans. (c)***

A rain-gauge should preferable an open space.

34. ***Ans. (d)***

35. ***Ans. (d)***

36. ***Ans. (c)***

Percolation is not soil erosion.

37. ***Ans. (a)***

38. ***Ans. (c)***

S.No.	Rainfall intensity	Rain type
1	0 to 2.5 cm/hr.	Light rain
2	2.5 to 7.5 cm/hr.	Moderate rain
3	> 7.5 cm/Hr	Heavy rain

39. ***Ans. (b)***

40. ***Ans. (b)***

Drizzle - Drizzle is a rain in which size of water drop upto 0.5 mm and rain density is less than 1 mm/Hr.

41. ***Ans. (c)***

42. ***Ans. (c)***

43. ***Ans. (c)***

Explanation

Evaporation Station Density: The WMO recommends the minimum number of evaporimeter in a particular region.

(i) Arid zones - one station for every 30,000 km^2

(ii) Humid temperate estimates - one station for every 50,000 km^2

(iii) Cold region - one station for every 10,000 km^2

According to Indian Standard

In plain, there should be at least one rain gauge station for an area of 750 km^2.

In hilly regions, one rain gauge station normally represents an area between 100 km^2 - 250 km^2.

In arid areas, one rain gauge station should normally represent an area between 1500 km^2 - 10,000 km^2

$\therefore$ The appropriate answer is **1 rain gauge per 130 km^2** as (it is in the range 100 km^2 - 250 km^2).

44. ***Ans. (b)***

In calculating average rainfall in a catchment area arithmetic mean method is very crude method at it is rarely used.

Thiessen polygon method of calculating the average precipitation is superior to stations on a rational basis.

The isohyetal method is superior to other methods (arithmetic mean and thieseen) when stations are large in number.

45. ***Ans. (d)***

Calculation:

Given,

Number of Rain gauge = X, error = 10%, $C_V = 30$

The optimum number of rain gauge – n = $(30/10)^2 = 9$

$\therefore$ The number of Optimum Gauges = 9

Concept

The optimum number of rain gauges is given by

$$N = \left(\frac{C_v}{\in}\right)^2$$

Where,

C_v is the coefficient of variation

$\in$ is error

The coefficient of variation is given by

$$C_v = \frac{\sigma_{n-1}}{\bar{P}}$$

Where,

$\bar{P}$ is average rainfall

σ is the standard deviation

46. *Ans (c)*

The working of this type of rain gauge is **similar to weighing bucket rain gauge.** A funnel receives the water which is collected in a rectangular container. A float is provided at the bottom of container, and this float raises as the water level rises in the container.

47. *Ans (d)*

The different types of precipitation are:

- Rain. Most commonly observed, drops larger than drizzle (0.02 inch / 0.5 mm or more) are considered rain. ...
- Drizzle. Fairly uniform precipitation composed exclusively of fine drops very close together. ...
- Ice Pellets (Sleet) ...
- Hail. ...
- Small Hail (Snow Pellets) ...
- Snow. ...
- Snow Grains. ...
- Ice Crystals.

48. *Ans (d)*

As per Khosla's formula, monthly runoff is given as

$$\mathbf{R_M = P_m - L_m}$$

where R_M = Monthly runoff

L_m = Monthly losses in cm = 0.48 × temperature

Claculation:

Given data,

P_m = 28 cm

L_m = 0.48 × temperature = 0.48 × 25°C = 12 cm

As per Khosla's formula, monthly runoff is given as

$$\mathbf{R_m = P_m - L_m}$$

$$\mathbf{R_m = 28 - 12 = 16\ cm}$$

49. *Ans (b)*

50. *Ans (c)*

Cyclonic precipitation: Cyclonic Precipitation. Cyclonic precipitation **results from the lifting of air converging into a low pressure area, or cyclone** A cyclone is defined as an area of low pressure with a counter-clockwise (Northern Hemisphere) circulation of the air around it, usually inward, towards the center.

51. *Ans (c)*

Symon's rain gauge: Symon's gauge is a non-recording gauge used by the meteorological department of India. In the Symon's rain gauge, rain water is collected in a cylindrical bottle which is measured manually on daily basis.

52. *Ans (b)*

Concept:

The following assumptions are made while using the unit hydrograph principle:

1. **Effective rainfall should be uniformly distributed over the basin**, that is, if there are 'N' rain gauges spread uniformly over the basin, then all the gauges should record almost the same amount of rainfall during the specified time.
2. Effective rainfall is constant over the catchment during the unit time.
3. The direct runoff hydrograph for a given effective rainfall for a catchment is always the same irrespective of when it occurs. Hence, any previous rainfall event is not considered.

This antecedent precipitation is otherwise important because of its effect on soil-infiltration rate, depressional and detention storage, and hence, on the resultant hydrograph.

4. The ordinates of the unit hydrograph are directly proportional to the effective rainfall hyetograph ordinate.

53. *Ans (b)*

As per IS a recommendation, the rain gauge density depending on the terrain of the area and it is given below:

Location	Rain Gauge Density
Plain region	1 station per 520 km^2
Average elevation of 1000m	1 station per 260-390 km^2
Hilly and heavy rainfall areas	1 station per 130 km^2

54. *Ans (c)*

Symon's Rain gauge

This bottle is fixed in the ground slightly below the ground level. The rain water enters the bottle through the funnel and gets collected in the bottle. The bottle can collect about 10 cm to 12 cm of rain. Rainfall is recorded daily at 8 A.M. by a man deputed for this purpose.

55. **Ans (c)**

Thiessen polygon method:

In this method, the rainfall recorded at each station is giver a weightage basis of the area closest to the station. The average precipitation over catchment area is given as,

$$P_{avg} = \frac{P_1A_1 + P_2A_2 + P_3A_3 + ...P_nA_n}{A_1 + A_2 + A_3 + ...A_n}$$

$$= \frac{P_1A_1 + P_2A_2 + P_3A_3 + ...P_nA_n}{A}$$

Where is called the weightage factor

$$\frac{A_1}{A}, \frac{A_2}{A} ..... \frac{A_n}{A}$$

Calculation:

Given,

$P_A = 20$, $P_B = 25$ cm, $P_C = 2$cm, $P_D = 15$ cm

$P_{avg} = ?$

Weightage factor for station A, B, C and D is given, 0.3, 0.4, 01 and 0.2

$\because$ We know, the average rainfall

$$P_{avg} = \frac{P_AA_A + P_BA_B + P_CA_C + P_DA_D}{A_A + A_B + A_C + A_D}$$

$$= \frac{P_AA_A + P_BA_B + P_CA_C + P_DA_D}{A}$$

$$P_{avg} = \frac{20\times0.3 + 25\times0.4 + 22\times0.1 + 15\times0.2}{1}$$

$$P_{avg} = 21.2 \text{ cm}$$

56. *Ans (a)*

57. *Ans (d)*

Time of Concentration is the time required by the entire drainage area to contribute to the runoff is called the time of concentration or time require by the most extreme point in the drainage to reach the point of interest.

In other words, it is the maximum time taken by the rainwater to reach the outlet of the basin.

- Time of concentration = overland flow time + channel flow time
- Overland flow is also called sheet flow. It is the phase of runoff when water flows as a sheet on plain land.
- Channel flow time is the time during which runoff flows in open channel up to the gauging site.
- Time of concentration depends upon the slope, the catchment characteristics and the flow path.
- For a hydrograph analysis, time of concentration is defined as the time duration from the end of excess rainfall to the point of inflection.

58. ***Ans (a)***

Precipitation comes to earth's surface in different forms

(1) Rain : It is the most common form of precipitation. In this the water droplet size are larger than 0.5 mm and smaller than 6 mm.

On the basis of intensity, rainfall is classified into as:

Type	Intensity (mm/hr)
Light rain	< 2.5
Moderate rain	2.5 – 7.5
Heavy rain	> 7.5

59. ***Ans. (d)***

The time after which the whole catchment area starts contributing to the flow is called time of concentration.

60. ***Ans. (d)***

Effective rainfall which produces rainfall

$= (6.2 + 5) - 1.2 \times 2$

$= 8.8$ cm

Runoff = Area × Effective rainfall

$= 250 \times 10^6 \times 8.8 \times 10^{-2}$

$= 2200$ Ha-m

61. ***Ans. (b)***

By Thiessen polygen method

$$P_{avg} = \frac{P_A A_A + P_B A_B + P_C A_C + P_D A_D}{A_A + A_B + A_C + A_D}$$

$$5 \text{ cm} = \frac{75 \times P_A + 125 \times 5 + 150 \times 4 + 150 \times 5}{75 + 125 + 150 + 150}$$

$$P_A = 7 \text{ cm}$$

62. ***Ans. (c)***

63. ***Ans. (c)***

P_X = ? N_X = 770

P_A = 84 mm N_A = 770

P_B = 70 mm N_B = 770

P_C = 96 mm N_C = 770

$N_X \pm 10\%$ of N_X = (693, 847)

All values are lies inside the range so we can adopt airthmatic avg. method to find missing rainfall value

$$P_X = \frac{P_A + P_B + P_C}{3}$$

$$= \frac{84 + 70 + 96}{3}$$

$= 84.33$ mm

64. ***Ans. (b)***

$$\text{Total runoff} = 1600 \frac{m^3}{sec} \times 2 \times 60 \times 60$$

$= 11.52 \times 10^6 \text{ m}^3$

Depth of direct runoff

$$\frac{11.52 \times 10^6 \text{ m}^3}{104 \times 10^6 \text{ m}^2} = 11.07 \text{ cm}$$

65. ***Ans. (c)***

No. of raingauge is given by

$$N = \left(\frac{C_v}{e}\right)^2 = \left(\frac{29.54}{10}\right)^2$$

$= 8.72$

$\simeq 9$

66. ***Ans. (d)***

$$\phi\text{-Index} = \frac{\text{Total Infiltration}}{\text{Total time of the storm}}$$

$$= \frac{P_{total} - R}{t}$$

$$= \frac{(3.5 + 4.5 + 2.9) - 3}{3}$$

$= 2.533$ (mm/hr)

67. ***Ans. (d)***

Sounding cable method is used for measuring for depth inside water.

68. *Ans. (b)*

Probable Maximum Precipitation (PMP) is termed as "theoretically the greatest depth of precipitation for a given duration that is physically possible over a given size storm area at a particular geographic location at a given time of the year.

69. *Ans. (d)*

A line on a map connecting places registering the same amount of precipitation or rainfall.

70. *Ans. (c)*

Direct method of Discharge Measurement:

There are following method

- Area velocity method
- Moving boat method
- Dilution technique
- Electromagnetic method
- Ultrasonic method

Indirect Method of Discharge Measurement:

(i) In this method, we include such technique which find the discharge with the help of relationship between discharge and depth

(ii) The broad classification of this method are:

- Flow measurement structure
- Slope area method

71. *Ans. (c)*

72. *Ans. (b)*

73. *Ans. (c)*

74. *Ans. (c)*

As per IS a recommendation, the rain gauge density depending on the terrain of the area and it is given below:

Location	Rain Gauge Density
Plain region	1 station per 520 km^2
Average elevation of 1000m.	1 station per 260-390 km^2
Hilly and heavy rainfall areas	1 station per 130 km^2

From the above table

No. of rain gauge required = 1170/130 = 9

75. *Ans. (b)*

In this method the rainfall recorded at each station is given a weightage on the basis of an area closest to the station.

76. *Ans. (c)*

Mass diagram:

It is the plot of accumulated inflow (i.e. supply) or outflow (i.e. demand) versus time.

Now, whenever the demand line drawn from a ridge does not intersect the mass curve again, it means the rate of inflow is less than or equal to rate of demand.

So, the reservoir will not be refilled and the demand cannot be met by the inflow.

77. *Ans. (a)*

Based on the time delay between the precipitation and the runoff, the runoff is classified as

(a) Direct Runoff : It is that part of runoff which enters the stream immediately after rainfall. It includes surface runoff, prompt interflow and rainfall on the surface of system. In case of snow melt, the resulting flow entering the stream is also a direct runoff.

(b) Base flow : The delayed flow that reaches a stream essentially as groundwater is called base flow. Many times delayed interflow is included in this category.

78. *Ans. (a)*

Intensity (mm/hr)	Type
0 – 2.5	Light
2.5 – 7.5	Medium
>7.5	Heavy

79. *Ans. (b)*

The depth area curve for a particular storm can be calculated with the help of the equation as,

$$\bar{P} = P_o \, e^{-(K/A^n)}$$

from the above equation we can say that the by increasing the area rainfall depth will decrease.

80. *Ans. (d)*

81. *Ans. (c)*

82. ***Ans. (a)***

83. ***Ans. (c)***

84. ***Ans. (a)***

85. ***Ans. (a)***

Permeable spurs

- All passage of stream passes through them
- Best suited when the river carries huge/heavy sediments in suspension

86. ***Ans. (d)***

- The normal annual rainfall at a station is measured over a period of 30 years
- The annual average rainfall is the mean of annual rain falls measured over a period of 35 years

87. ***Ans. (b)***

$$\text{Index of wetness} = \frac{\text{Actual rainfall in a particular year}}{\text{Average annual rainfall}}$$

$$= \frac{50}{75} \times 100 = 66.67\%$$

Index of dryness

= 100 - index of wetness

= 100 - 66.67

= 33.33%

88. ***Ans. (ds)***

89. ***Ans. (a)***

90. ***Ans. (a)***

91. ***Ans. (b)***

92. ***Ans. (a)***

93. ***Ans. (d)***

Time of concentration for a given storm water drain generally consists of two parts.

(i) The inlet time or overland flow time or time of equilibrium

(ii) The channel flow time or gutter flow time

94. ***Ans. (c)***

$$\text{Weighted rainfall} = \frac{\Sigma ap}{\Sigma a}$$

95. ***Ans. (a)***

96. ***Ans. (b)***

97. ***Ans. (c)***

98. ***Ans. (d)***

99. ***Ans. (d)***

100. ***Ans. (c)***

101. ***Ans. (b)***

102. ***Ans. (b)***

❑❑❑

Precipitation, Frequency of Rainfall Data

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