1 CHAPTER

Fluid Properties

Q.1 Match List-I (Fluid) with List-II (Classification of fluid) and select the correct answer using the codes given below the lists:

List-I
A. Gasoline
B. Suspended starch solution
C. Tooth paste
D. Blood

List-II
1. Shear thickening fluid
2. Shear thinning fluid
3. Bingham plastic fluid
4. Newtonian fluid
5. Thixotropic fluid

Codes:

	A	B	C	D
(a)	4	2	5	1
(b)	4	1	3	2
(c)	4	3	1	2
(d)	3	4	1	5

Q.2 Work done in blowing a soap bubble of diameter 12 cm will be [Assume surface tension of soap solution as 0.04 N/m]
(a) 18.09×10^{-4} N-m
(b) 9.05×10^{-4} N-m
(c) 7.24×10^{-3} N-m
(d) 36.2×10^{-4} N-m

Q.3 The dimensions of dynamic viscosity (μ) are
(a) $ML^{-1}T^{-2}$
(b) $ML^{-1}T^{-1}$
(c) MLT^{-2}
(d) $M^{-1}L^{-1}T^{0}$

Q.4 The liquid used in manometers should have
(a) low density
(b) high density
(c) low surface tension
(d) high surface tension

Q.5 A circular disc of diameter 'd' is slowly rotated in a liquid of large viscosity μ at a small distance h from a fixed surface. The minimum torque required to maintain an angular velocity ω will be

(a) $\dfrac{\mu \pi d^{4} \omega}{32h}$
(b) $\dfrac{\mu \pi d^{4} \omega}{8h}$

(c) $\dfrac{\mu \pi d^{3} \omega}{32h}$
(d) $\dfrac{\mu \pi d^{3} \omega}{8h}$

Q.6 What is the capillary rise in a narrow two-dimensional slit of width 'w'?
(a) Half of that in a capillary tube of diameter 'w'
(b) Two-third of that in a capillary tube of diameter 'w'
(c) One-third of that in a capillary tube of diameter 'w'
(d) One-fourth of that in a capillary tube of diameter 'w'

Q.7 Consider the following statements:
1. A small bubble of one fluid immersed in another fluid has a spherical shape.
2. The droplets of a fluid move upward or downward in another fluid due to unbalance between gravitational and buoyant forces.
3. Droplets of bubbles attached to a solid surface can remain stationary in a gravitational fluid if the surface tension exceeds buoyant forces.
4. Surface tension of a bubble is proportional to its radius while buoyant force is proportional to the cube of its radius

Which of these statements are correct?
(a) 1, 2, 3 and 4
(b) 1, 2 and 4
(c) 1 and 3 only
(d) 2, 3 and 4

Q.8 A fluid (sp. gr. = 0.9, μ = 1.2 Pas) flows in a laminar state between two stationary parallel plates set 3 cm apart. If the steady discharge is 600 cm³/s per cm width of plates, the shear stress at a distance 1 cm from either boundary is
(a) 160 Pa
(b) 320 Pa
(c) 480 Pa
(d) 640 Pa

Q.9 An increase in pressure of 2 bars decreases the volume of a liquid by 0.01%. The bulk modulus of elasticity of liquid is
(a) 2×10^{5} N/m²
(b) 2×10^{7} N/m²
(c) 2×10^{9} N/m²
(d) 2×10^{11} N/m²

Q.10 Which of the following statement is correct?
(a) Dynamic viscosity of water is nearly 50 times to that of air
(b) Kinematic viscosity of water is 30 times more that of air
(c) Water is soil is able to rise a considerable distance above the groundwater table due to viscosity
(d) Vapour pressure of a liquid is inversely proportional to the temperature.

Q.11 Which one of the following pressure unit represents the least pressure?
(a) millibar
(b) mm of Hg
(c) N/mm²
(d) kgf/cm²

Q.12 Assertion (A): At the standard temperature, the kinematic viscosity of air is greater than that of water at the same temperature.
Reason (R): The dynamic viscosity of air at standard temperature is lower than that of water at the same temperature.
(a) both A and R are true and R is the correct explanation of A
(b) both A and R are true but R is not a correct explanation of A
(c) A is true but R is false
(d) A is false but R is true

Q.13 Match List-I with List-II and select the correct answer using the codes given below the lists:

List-I
A. Lubrication
B. Rise of sap in trees
C. Formation of droplets
D. Cavitation

List-II
1. Capillary
2. Vapour pressure
3. Viscosity
4. Surface tension

Codes:

	A	B	C	D
(a)	2	4	1	3
(b)	3	4	1	2
(c)	2	1	4	3
(d)	3	1	4	2

Q.14 Force necessary to lift a thin platinum wire ring of 3 cm diameter from a water surface will be [neglect the weight of wire]
(a) 0.0137 N
(b) 0.0275 N
(c) 0.0069 N
(d) 0.0034 N

Q.15 Assertion (A): Cavitation occurs when the velocity is high and pressure is low.
Reason (R): Vapour cavitation is less damaging than air cavitation.
(a) both A and R are true and R is the correct explanation of A
(b) both A and R are true but R is not a correct explanation of A
(c) A is true but R is false
(d) A is false but R is true

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Explanations   **Fluid Properties**

2.   (d)

The soap bubble has two interfaces

$\therefore$ Workdone $= 0.04 \times 4\pi \times (6 \times 10^{-2})^2 \times 2$
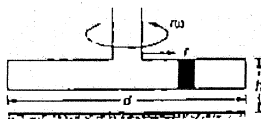
$= 36.2 \times 10^{-4}$ N-m

4.   (a)

The liquid used in manometer should be of light density so as to measure even small variation in pressure.

5.   (a)

Consider an element of disc at a distance r and having width dr linear velocity at this radius $r\omega$

Shear stress $= \mu \dfrac{dv}{dy}$

Torque = Shear stress × area × r

$= \tau \times 2\pi r dr \times r = \mu \dfrac{du}{dy} 2\pi r^2 dr$

Assuming that gap h is small so that velocity distribution may be assumed linear

$\therefore \quad \dfrac{du}{dy} = \dfrac{r\omega}{h}$

$dT = \mu \dfrac{r\omega}{h} 2\pi r^2 dr$

$\therefore \quad T = \int^{d/2} \dfrac{2\pi\mu\omega}{h} r^2 dr = \dfrac{\mu\pi d^4 \omega}{32h}$

8.   (a)

For small gap, τ is assumed to be constant

$v_{avg} = \dfrac{Q}{y} = \dfrac{600}{3} = 200$ cm/sec

$\therefore \quad \dfrac{dv}{dy} = \dfrac{200}{1.5}$

$\therefore \quad \tau = \mu \dfrac{dv}{dy} = 1.2 \times \dfrac{200}{1.5} = 160$ Pa

9.   (c)

dp = Increase in pressure = 2 bars

dV = Decreases in volume = 0.01%

$\therefore \quad -\dfrac{dV}{V} = \dfrac{0.01}{100}$

Bulk modulus, K is given by

$K = \dfrac{dp}{-\dfrac{dV}{V}} = \dfrac{2}{\dfrac{0.01}{100}} = 2 \times 10^4$ bars

Now,   1 bar = 10^5 N/m²

$\therefore \qquad K = 2 \times 10^4 \times 10^5$ N/m²

$= 2 \times 10^9$ N/m²

10.   (a)

Water is about 50 times viscous than air. Kinematic viscosity of air is more than that of water.

11.   (a)

1 millibar < 1 mm Hg < 1 kgf/cm² < 1 N/mm²

14.   (a)

$\sigma = 0.073$ N/m

Considering length

$= 2 \times$ Circumference of ring

$\therefore$ Force $= \sigma \times l$

$= 0.073 \times 2 \times \pi \times d$

$= 0.073 \times 2 \times 3.14 \times 0.03$

$= 0.0137$ N

15.   (c)

A is true but R is false.

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