GOVT.OF KARNATAKA

DEPT. OF PRE-UNIVERSITY EDUCATION

CET- 2012

FLUID MECHANICS

- SUBSTANCES WHICH FLOWS ARE CALLED FLUIDS
- LIQUIDS and GASES TOGETHER ARE CALLED FLUIDS
- FLUIDS DO NOT HAVE A MODULUS OF RIGIDITY.
- DENSITY= MASS/VOLUME

- **Specific Gravity= Density of the sub/ density of the water = Wt in air/ Loss of wt in water**

Fluid pressure= normal thrust/Area

$p=\rho gh$

up thrust= wt of fluid displaced = mg = $v\rho g$

viscous force, $F= -\eta adv/dx$

SI unit of coefficient of viscosity is Nsm^{-2} or $kgm^{-1}s^{-1}$

- Equation of continuity ,

av= constant

surface tension = force / length

SI unit of S.T. is Nm^{-1}

Capillary rise, $h = 2T\cos\theta/r\rho g$

Excess pressure , $p= 2T/r$

1. The density of a block which floats in water with 10% of its volume above the water is

1. **1000 kgm^{-3}**
2. **900 kgm^{-3}**
3. **800 kgm^{-3}**
4. **700 kgm^{-3}**

Ans: 2. 900 kgm^{-3}

Wt of floating body = Wt of water displaced

$mg = m'g$

i.e. $V\rho = 0.9\ V \times 1000$

$\rho = 900\ kgm^{-3}$

2. Density of sea water is 1000 kgm^{-3}. If g=10 ms^{-2}, the force acting on a boat of 100 m^3 sunk in a sea is

1. 16 N
2. 61 N
3. 10^6 N
4. 601 N

Ans: 3. 10^6 N

Force= ρVg = 1000 × 100 × 10
= 10^6 N

3. Hydraulic brake works on the basis of ____

1. Pascal's law
2. Bernoulli's principle
3. Poiseuille's law
4. Archimedes principle

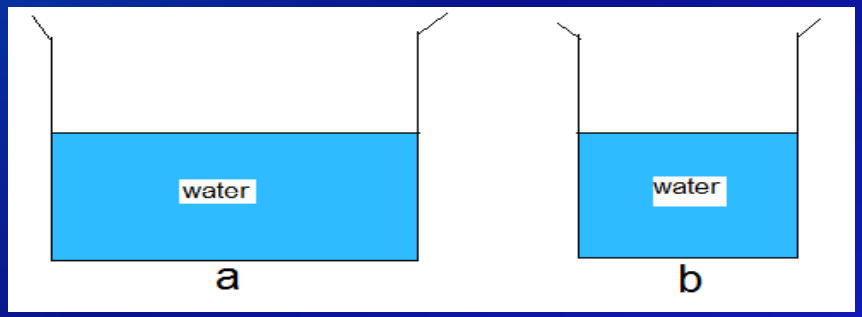
Ans: 1. Pascal's law

4. The unit of thrust is

1. Nm^{-1}
2. Nm
3. N
4. Nm^{-2}

Ans: 3, N

5. From the adjacent figure, the correct observation is ……..



1. The pressure on the bottom of tank ‘a’ is smaller than at the bottom of ‘b’.
2. The pressure on the bottom of tank ‘a’ is greater than at the bottom of ‘b’
3. The pressure on the bottom of ‘a’ and ‘b’ is same
4. The pressure depend on the shape of the container

Ans: 3

6. Two substances of equal volumes with the densities ρ_1 and ρ_2 are mixed together . The density of the mixture would be

1. $\rho_1 + \rho_2$
2. $(\rho_1 + \rho_2)/2$
3. $\sqrt{\rho_1 \rho_2}$
4. $\dfrac{\rho_1 \rho_2}{\rho_1 + \rho_2}$

Ans: 2

$$\rho_{mix} = m_1 + m_2 / v_1 + v_2$$
$$= v(\rho_1 + \rho_2) / 2v$$
$$= (\rho_1 + \rho_2) / 2$$

7. A solid floats in a liquid with a portion of it being submerged. Then

a) The liquid exerts an up thrust equal to the weight of the solid

b) The weight of the displaced liquid is equal to the weight of the solid

c) The solid exerts a force equal to its weight on the liquid

The correct statement (s) from above

1. a and b
2. b and c
3. b
4. a, b and c

Ans: 4

8. The mass of a liquid contained in a cylindrical vessel of cross sectional area A is 800 kg. If the pressure at the bottom of the vessel is 4×10^4 pascal, then A is

1. $1m^2$
2. $2m^2$
3. $0.1m^2$
4. $0.2m^2$

Ans: 4

$p = \rho gh$

but $\rho = m/V = m/Ah$

$p = (m/Ah)gh$

$p = mg/A$

$A = mg/p$

$= 800 \times 10 / 4 \times 10^4$

$= 0.2 m^2$

9. A solid sphere of radius 0.1m just floats in a liquid of density $3x10^3$ kg m^{-3}. The mass of the body is

1. $1.39x10^{-6}$ kg
2. 12.56 kg
3. 1.39 kg
4. 12.56×10^3 kg

Ans : 2

density of body = density of liquid

= mass / volume

mass of body = density x volume

$=3x10^3x4/3x3.14x(0.1)^3$

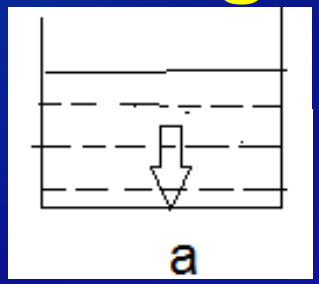
= 12.56 kg

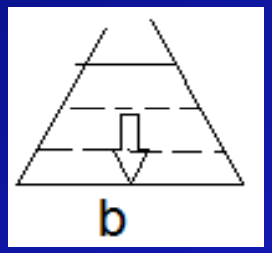
10. An ideal fluid is one which___

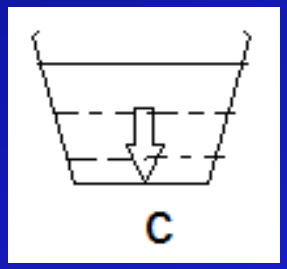
1. is incompressible
2. offers no force of friction
3. is compressible
4. is incompressible and offers no force of friction.

Ans : 4

11. Three vessels of different shape are filled with water to same height. Rank the situation according to the pressure exerted on the bottom of the vessel from least to greatest.







1. a,b,c 2. b, a, c
3. c,a,b 4. all the pressures are same

Ans: 4

12. A cube of ice is floating in water contained in vessel. When the ice melts, the level of water in the vessel

1. remains unchanged
2. rises
3. falls
4. none of these

Ans : 1

13. A cylindrical vessel containing a liquid is fitted with a piston of mass m. If p_0 is the atmospheric pressure and A is the area of cross section of the piston, then the pressure of the liquid just below the piston is given by

1. $p = p_0 + mg$

2. $p_0 = p + mg$

3. $p = p_0 + \frac{mg}{A}$

4. $p_0 = p + \frac{mg}{A}$

Ans: 3

upward trust = net downward force

$$pA = p_0A + mg$$

$$p = p_0 + mg/A$$

14. A cubical block of steel of side ‘a’ and density ‘ρ’ floats on mercury of density ‘σ’ with a part of it being submerged. The height of the block above the mercury level is given by

1.a $\left[1-\frac{\rho}{\sigma}\right]$

2.a $\left[1+\frac{\rho}{\sigma}\right]$

3.a $\left[1-\frac{\sigma}{\rho}\right]$

4.a $\left[1+\frac{\sigma}{\rho}\right]$

Ans : 1

weight of cube = up thrust

mg =wt of the mercury displaced

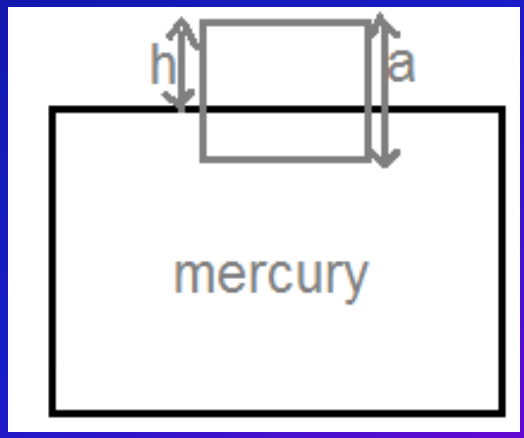
$$mg = v\sigma g$$

$$v\rho g = v\sigma g$$

$$a^3\rho g = a^2(a-h)\sigma g$$

$$(a-h) = a\rho/\sigma$$

$$h = a(1-\rho/\sigma)$$



15. The pressure in the water pipe at the ground level in a building is 19. 6x 10^4 Nm^{-2} and at the fourth floor is 4.9 x10^4 Nm^{-2}. The height of the fourth floor is (density of water is 1000kgm^{-3})

1. 10m
2. 15m
3. 9.8m
4. 15.9m

Ans: 2

total energy at ground level = total energy at the fourth floor

$$p_g+\tfrac{1}{2}\rho v_g^2=p_f+\rho gh+\tfrac{1}{2}\rho v_f^2$$

but $v_g = v_f$

$$p_g=p_f+\rho gh$$

$$h=(p_g-p_f)/\rho g$$

$$= (19.6- 4.9)\ 10^4/\ 1000x\ 9.8$$

$$= 15m$$

16. A fluid is undergoing streamline flow. Then____

1. the velocity of any molecule is same
2. the pressure is same at all the points
3. the velocity at a given point is same
4. the velocity at all the points is same

Ans: 3

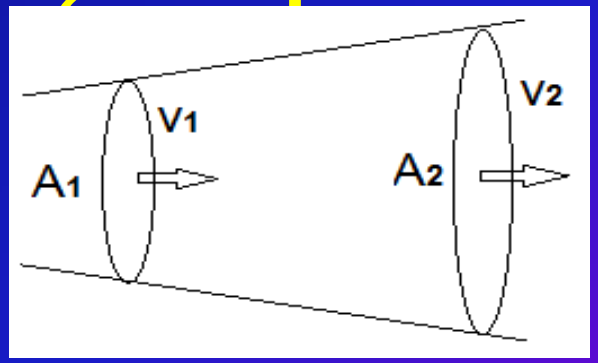
17. An incompressible fluid flows through a pipe of non uniform cross-sectional area as shown in the figure. If A_1 and A_2 are the area of cross-sections at A and B, v_1 and v_2 are the velocities at A and B , then the ratio v_1/v_2 is equal to

1. $\frac{A_1}{A_2}$

2. $\sqrt{\frac{A_1}{A_2}}$

3. $\frac{A_2}{A_1}$

4. $\sqrt{\frac{A_2}{A_1}}$



Ans : 3

18. Bernoulli's principle is derived on the basis of law of conservation of____

1. energy
2. momentum
3. mass
4. angular momentum

Ans : 1

19. A person standing on a railway platform close to a fast moving train always has a tendency to fall towards the train. This is a consequence of

1. Newton’s third law of motion
2. Archimedes principle
3. Bernoulli's theorem
4. None of these

Ans: 3

20. When air is blown in between the two light balls suspended close to each other, the two balls will ___

1. move apart
2. move close to each other
3. remain stationary
4. either move close or apart

Ans: 2

21. A gale blows over the roof of a house. The force on the roof due to gale is ___

1. in the down ward direction
2. in the upward direction
3. in the direction of the gale
4. zero

Ans: 2

22. A cylindrical vessel open at the top contains 20 litres of water. A small hole is provided at the bottom of the vessel so that water drains out.10 litres of water drains out in a time interval t_1 and the next 10 litres at time t_2. then

1. $t_1=t_2$
2. $t_1<t_2$
3. $t_1>t_2$
4. none of these

Ans: 2

The speed of water through hole is given by

$$v = \sqrt{2gh}$$

as water drains out h decreases, hence speed decreases.

t_1 is less than t_2

23. The free surface of a liquid at rest always tends to acquire minimum surface area due to ___

1. viscosity
2. pressure
3. surface tension
4. gravitational force

Ans: 3

24. insects can walk on the surface of water because ___

1. they are very light
2. they can swim on water
3. of the up thrust
4. of the surface tension

Ans: 4

25. Mercury does not wet glass because ___

1. the angle of contact is obtuse
2.the adhesive force is more
3. the cohesive force is more
4. both 1 and 3

Ans: 4

26. How does the coefficient of viscosity 'η' of the gases depend upon temperature?

1. $\eta \alpha T^{1/2}$
2. $\eta \alpha T^{-1/2}$
3. $\eta \alpha T^{2}$
4. $\eta \alpha T^{-2}$

Ans: 1

27. During wind storm, roofs of houses may be blown off because

1.wind creates high pressure over the roof

2.wind creates low pressure over the roof

3.roofs are not tightly bound

4. none of the above

Ans: 2

28. Mobility of a liquid decreases with ___

1. increase in viscosity
2. decrease in viscosity
3. increase in surface tension
4. decrease in surface tension

Ans: 1

mobility is varies inversely with viscosity

29. A fine hole is made at the bottom of a cylinder of height 50cm. What is the maximum speed with which water can flow out of the hole? g=10 ms^{-2}

1. √10 ms^{-1}
2. 1 ms^{-1}
3. 0.5 ms^{-1}
4. 10 ms^{-1}

ans: 1

$v = \sqrt{2gh} = \sqrt{2} \times 10 \times 0.50$

$= \sqrt{10} ms^{-1}$

30. Three liquids of equal masses are taken in three identical cubical vessels A,B and C. Their densities are ρ_A, ρ_B and ρ_C respectively. But $\rho_A < \rho_B < \rho_C$ .The force exerted by the liquid on the base of the cubical vessel is

_____

1.minimum in vessel C

2. maximum in vessel C

3.maximum in vessel A

4.the same in all the vessels

Ans: $P=\rho gh$, But $\rho = m/V$

$m=\rho V=\rho ah$,

$m/a = \rho h$

$p= mg/a$

$p \alpha g/a$

ans. is 4

31. Water is in streamline flow along a horizontal pipe with non uniform cross section. At a point in the pipe where the area of cross section is $10cm^2$, the velocity of water is 1 ms^{-1} and the pressure is 2000Pa. The pressure at another point where the cross sectional area is 5 cm^2 is _____

1. 2000 Pa
2. 4000 Pa
3. 500 Pa
4. 1000 Pa

Ans: 3

$a_1 v_1 = a_2 v_2$

$v_2 = a_1 v_1 / a_2 = 2\ ms^{-1}$

$P_1/\rho + 1/2 \times v_1^2 = P_2/\rho + 1/2 \times v_2^2$

$2000/\rho + 1/2 \times 1 = P_2/\rho + 1/2 \times 4$

$2000/\rho + 1/2 = P_2/\rho + 2$

$2000 - P_2 / \rho = 3/2$

$2000 - P_2 = 3000/2 = 1500$

$P_2 = 500\ Pa$

32. 27 identical drops of water are falling down vertically in air each with a terminal velocity $0.15ms^{-1}$.if they combine to form a single big drop, the terminal velocity is ____

1. $13.5\ ms^{-1}$
2. $1.35ms^{-1}$
3. $5.31\ ms^{-1}$
4. $0.15ms^{-1}$

Ans: 2

terminal velocity α radius^2

Vol. of big drop = Vol. of 27 small drops

$4/3\pi R^2 = 27 \times 4/3\pi r^2$

$R = 3r$

$V_s/V_b = r^2/R^2 = r^2/9r^2$

$V_b = 9 \times 0.15 = 1.35 ms^{-1}$

33. An air bubble of 1cm radius is rising at a sped of 0.5cms-1 through a liquid of density 0.8gcm-3. The coefficient of viscosity of a liquid (neglect the density of air) is ___

1. 843 poise 2. 438 poise
3. 348 poise 4. 834 poise

Ans : 3

terminal velocity

$v = 2(\rho - \sigma)r^2g/9\eta$

$\eta = 2(\rho - \sigma)r^2g/9v$

$= 2(0\text{-}0.8) \times 1 \times 980 / 9 \times -0.5$

$= 348.44$ poise

34. The dimensional formula of surface tension is ___

1. $M^1L^0T^{-2}$
2. $M^1L^2T^{-2}$
3. $M^1L^1T^2$
4. $M^1L^1T^{-1}$

Ans: 1

35. When a wire ring is dipped into a soap solution and taken out then ___

1. soap solution wets the ring
2. a thin circular film is formed
3. ring becomes heavy
4. ring becomes clean

Ans: 2

Due to surface tension

36. When the temperature is increased the angle of contact is ____

1. increases
2. decreases
3. remains same
4. becomes zero

Ans: 1.

37. If the angle of contact is less than 90°, then ___

1. there is a capillary rise
2. liquid surface will be concave upwards
3. liquid wets the surface
4. all the above are true

Ans: 4

38. The capillary rise or fall is given by _____

1. $h = \frac{2T\cos\theta}{r\rho g}$

2. $h = \frac{Tr\cos\theta}{2\rho g}$

3. $h = \frac{2Tr\cos\theta}{\rho g}$

4. $h = \frac{2r\cos\theta}{T\rho g}$

Ans: 1

39. The difference of pressure between the inside and outside of a spherical drop of water of radius 1mm is (surface tension of water is 70×10^{-3} N/m)

1. 140 Nm^{-2}
2. 70 Nm^{-2}
3. 35 Nm^{-2}
4. none of these

Ans: 1

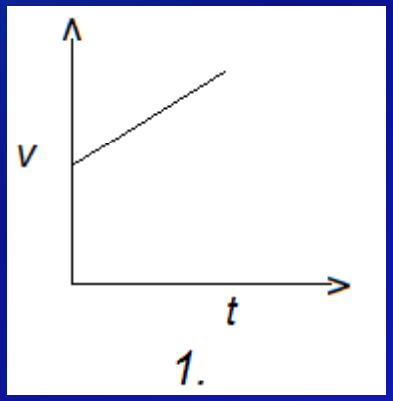
$p = 2T/r = 140\ Nm^{-2}$

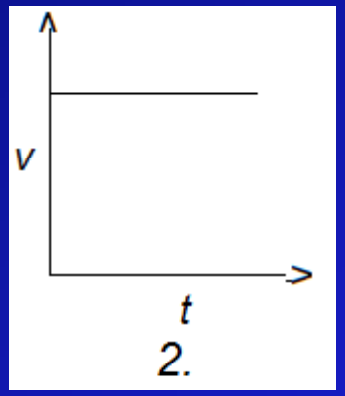
40. If a liquid drop is broken into a number of drops, then ____

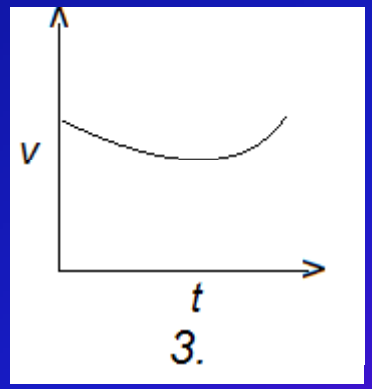
1. total surface area increases
2. temperature decreases
3. surface energy increases
4. all the above are correct

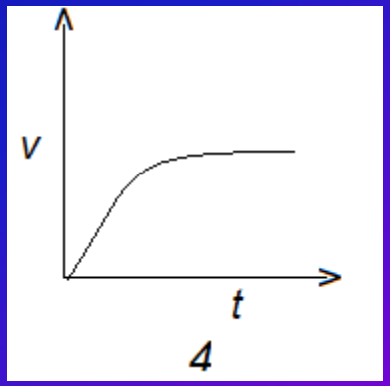
Ans: 4

41. Which of the following figure represents the velocity of a spherical body falling through a viscous liquid.









Ans: 4

42. A drop of water is breaks into two droplets of equal size , then ____

1.the sum of temperature of the two droplets is equal to the original drop.

2. the sum of the masses of the two droplets is equal to the mass of original drop.

3. the sum of the surface areas of two droplets is equal to the surface area of the original drop.

4. none of the above are true

Ans: 2

43. A liquid meniscus in a capillary tube will be convex if the angle of contact is _____

1. greater than 90°
2. less than 90°
3. equal to 90°
4. equal to 0°

Ans: 1

44. The angle of contact between pure water and clean glass is

1. 90°
2. 0°
3. 40°
3. 180°

Ans: 2 , 0°

45. A liquid does not wet the solid surface if the angle of contact is _____

1. zero
2. an acute one
3. 90°
4. an obtuse one

Ans : 4, an obtuse one

46. Two tubes of the same material but of different radii are dipped in a liquid. The height through which a liquid rises in one tube is 2.2cm and in the other 6.6cm.The ratio of their radii is ___

1. 9:1 2. 1:9 3. 3:1 4. 1:3

Ans: 3

for a given pair of substance

$h \alpha 1/r$

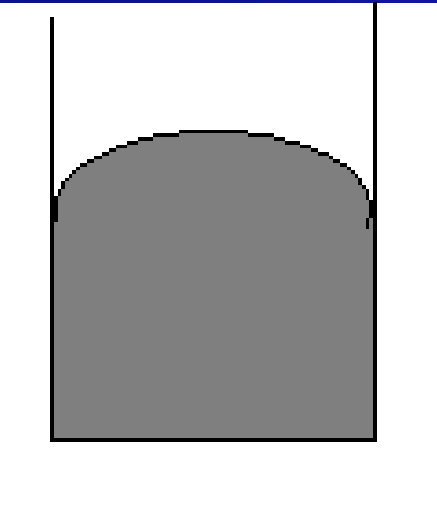
$h_2/h_1 = r_1/r_2 = 6.6/2.2 = 3/1$

$r_1 : r_2 = 3:1$

47. A liquid contained in a vessel. The liquid-solid adhesive force is very weak as compared to a the cohesive force in a liquid. The shape of a liquid surface near the solid will be _____

1. horizontal
2. concave
3. almost vertical
4. convex

Ans: 4



48. A body weighs 50grams in air and 40grams in water. How much would it weigh in a liquid of specific gravity 1.5?

1. 45 grams
2. 65 grams
3. 35 grams
4. 30 grams

Ans : 3

sp.gr= loss of wt in liquid / loss of wt in water

$= m_a - m_l / m_a - m_w$

$1.5 = m_a - m_l / 50 - 40$

$15 = m_a - m_l$

$m_l = 50-15 = 35$ grams

49. Water rises in plant fibres due to ____

1. osmosis
2. fluid pressure
3. viscosity
4. capillarity

Ans: 4, capillarity

50. A fish weighs 348g in air and 23g in pure water. What is the relative density of the fish?

1. 1.07
2. 1.007
3. 15.13
4. 2.07

Ans: 1

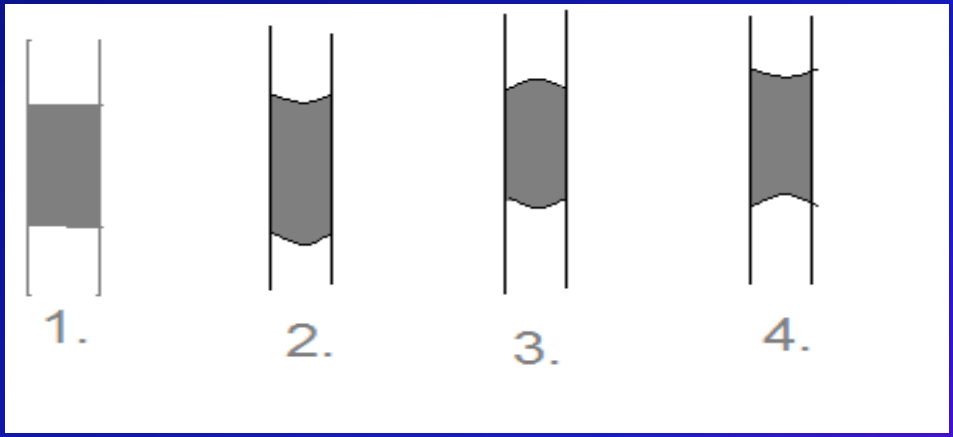
Relative density=wt in air/loss of wt in water

= 348/348-23

= 348/325

=1.07

51. A vertical glass capillary tube, open at both ends, contains some water. Which of the following shapes may be taken by the water in the tube?



Ans: 4

since the angle of contact is acute

52. Density of ice is d and that of water is d'. What will be the decrease in volume when a mass M of ice melts?

1. $\frac{M}{d' - d}$

2. $\frac{d' - d}{M}$

3. $M\left[\frac{1}{d} - \frac{1}{d'}\right]$

4. $\frac{1}{M}\left[\frac{1}{d} - \frac{1}{d'}\right]$

Ans: 3. M $\left[\frac{1}{d}-\frac{1}{d'}\right]$

Decrease in volume = vol. of ice – vol. of water of same mass

THANK YOU

AND

BEST OF LUCK