INDIAN SCHOOL AL WADI AL KABIR		
Class: XI	DEPARTMENT OF SCIENCE -2023-24 SUBJECT: PHYSICS	DATE:15/11/2024
WORKSHEET NO:9 WITH ANSWERS	TOPIC: **MECHANICAL PROPERTIES OF FLUIDS**	A4 FILE FORMAT (PORTFOLIO)
CLASS & SEC:	NAME OF THE STUDENT:	ROLL NO.

OBJECTIVE TYPE QUESTIONS

PROPERTIES OF FLUIDS

1. A liquid is allowed to flow into a tube of truncated cone shape. Identify the correct statement from the following:
   (a) the speed is high at the wider end and high at the narrow end.
   (b) the speed is low at the wider end and high at the narrow end.
   (c) the speed is same at both ends in a stream line flow.
   (d) the liquid flows with uniform velocity in the tube.
2. After terminal velocity is reached, the acceleration of a body falling through a fluid is
   (a) equal to g
   (b) zero
   (c) less than g
   (d) greater than g
3. The pressure at the bottom of a tank containing a liquid does not depend on
   (a) acceleration due to gravity
   (b) height of the liquid column
   (c) area of the bottom surface
   (d) nature of the liquid
4. A liquid is allowed to flow into a tube of truncated cone shape. Identify the correct statement from the following:
   (a) the speed is high at the wider end and high at the narrow end.
   (b) the speed is low at the wider end and high at the narrow end.
   (c) the speed is same at both ends in a stream line flow.
   (d) the liquid flows with uniform velocity in the tube.
5. Pressure applied to enclosed fluid is
   (a) increased and applied to every part of the fluid
   (b) diminished and transmitted to wall of container
   (c) increased in proportion to the mass of the fluid and then transmitted
   (d) transmitted unchanged to every portion of the fluid and wall of containing vessel

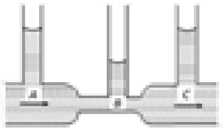
6. Spherical balls of radius ‘r’ are falling in a viscous fluid of viscosity ‘η’ with a velocity ‘v’. The retarding viscous force acting on the spherical ball is
   a) inversely proportional to ‘r’ but directly proportional to velocity v
   b) directly proportional to both ‘r’ and velocity ‘v’

c) inversely proportional to both 'r' and velocity 'v'
d) directly proportional to 'r' but inversely proportional to velocity 'v'

7. A manometer connected to a closed tap reads 3.5×10^5 N/m^2 .When the valve is opened ,the reading of manometer falls to 3×10^5 N/m^2,then the velocity of the flow of water is
   a) 100m/s b) 10m/s c)1m/s d) 25m/s

8. The velocity of kerosene oil in a horizontal pipe is 5m/s. If g= 10m/s^2 , then the velocity head of oil will be
   a) 1.25m b) 12.5m c) 0.125m d) 125m

9. In the following fig. is shown the flow of liquid through a horizontal pipe. Three tubes A, B and Care connected to the pipe. The radii of the tubes A, B and C at the junction are respectively 2cm, 1cm and 2cm. It can be said that the



   a) height of the liquid level in the tube A is maximum
   b) height of the liquid level in the tubes A and B is the same
   c) height of the liquid level in all the 3 tubes is the same
   d) height of the liquid level in the tubes A and C is the same

10. In which one of the following cases will the liquid flow in a pipe be most stream lined.
    a) liquid of high viscosity and high density flowing through a pipe of small radius
    b) liquid of high viscosity and low density flowing through a pipe of small radius
    c) liquid of low viscosity and low density flowing through a pipe of large radius
    d) liquid of low viscosity and high density flowing through a pipe of large radius

11. Two water pipes of diameters 2cm and 4cm are connected with the main supply line.The velocity of flow of water in the pipe of 2cm diameter is
    a) 4 times that in the other pipe
    b) $\frac{1}{4}$ times that in the other pipe
    c) 2 times that in the other pipe
    d) $\frac{1}{2}$ times that in the other pipe

ASSERTION AND REASONING

DIRECTION: In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:
(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).
(b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).
(c) Assertion (A) is true but reason (R) is false.
(d) Both Assertion and Reason are false.

12. Assertion : The angle of contact of a liquid decrease with increase in temperature.
    Reason : With increase in temperature, the surface tension of liquid increase.
13. Assertion : A needle placed carefully on the surface of water may float, whereas a ball of the same material will always sink.
    Reason : The buoyancy of an object depends both on the material and shape of the object.

14. Assertion : The concept of surface tension is held only for liquids.
Reason : Surface tension does not hold for gases.
15. Assertion : It is better to wash the clothes in cold soap solution.
Reason : The surface tension of cold solution is less than the surface tension of hot solution.
16. Assertion : The shape of a liquid drop is spherical.
Reason : The pressure inside the drop is greater than that of outside.
17. Assertion : Hot soup tastes better than the cold soup.
Reason : Hot soup has high surface tension and it does not spread properly on our tongue.
18. Assertion: Aeroplanes are made to run on the runway before take-off, so that they acquire the necessary lift.
Reason: This is as per Bernoulli's theorem.

CASE STUDY QUESTIONS

19. The property due to which the free surface of liquid tends to have minimum surface area and behaves like a stretched membrane is called surface tension. It is a force per unit length acting in the plane of interface between the liquid and the bounding surface *i.e.*, S = F/L, where F = force acting on either side of imaginary line on surface and L = length of imaginary line. Surface tension decreases with rise in temperature. Highly soluble impurities increases surface tension and sparingly soluble impurities decreases surface tension.

i. The excess pressure inside a soap bubble is three times than excess pressure inside a second soap bubble, then the ratio of their surface area is
(a) 9 : 1
(b) 1 : 3
(c) 1 : 9
(d) 3 : 1

ii. Which of the following statements is not true about surface tension?
(a) A small liquid drop takes spherical shape due to surface tension.
(b) Surface tension is a vector quantity.
(c) Surface tension of liquid is a molecular phenomenon.
(d) Surface tension of liquid depends on length but not on the area.

iii. Which of the following statement is not true about angle of contact?
(a) The value of angle of contact for pure water and glass is zero.
(b) Angle of contact increases with increase in temperature of liquid.
(c) If the angle of contact of a liquid and a solid surface is less than 90°, then the liquid spreads on the surface of solid.
(d) Angle of contact depend upon the inclination of the solid surface to the liquid surface.

iv. Which of the following statements is correct?
(a) Viscosity is a vector quantity.
(b) Surface tension is a vector quantity.
(c) Reynolds number is a dimensionless quantity.
(d) Angle of contact is a vector quantity.

v. A liquid does not wet the solid surface if the angle of contact is
(a) 0°
(b) equal to 45°
(c) equal to 90°
(d) greater than 90°

SHORT ANSWER QUESTIONS

20. Define the following:

[a] viscosity
[b] coefficient of viscosity
[c] terminal velocity
[d] critical velocity
[e] Magnus effect
[f] surface tension
[g] capillarity
[h] angle of contact

21. Ploughing of fields is essential for preserving moisture in the soil. Explain
22. Why the tip of the nib of a pen is split?
23. Why does water wet the surface whereas mercury does not?
24. If two row - boats happen to sail parallel and close to each other, they experience a force which pulls them towards each other. Give reason.
25. Straw are used to take soft drinks. Why?
26. The new earthen pots keep water cooler than old one. Why?
27. A large force is required to draw apart normally two glass plate enclosing a thin water film.
28. Machine parts are jammed in winter. Why?
29. Are there some conditions for Stoke's law to be obeyed. If no, explain. If yes, mention those conditions.

LONG ANSWER QUESTIONS

30. State pascal’s law. A cylindrical jar of cross-section area 0.01 m^2 is filled with water to a height of 50cm. It carries a tight-fitting piston of negligible mass. Calculate pressure at the bottom of jar when a mass of 1kg is placed on the piston. ($g = 10\ m/s^2$).
31. Water rises to a height of 20mm in a capillary tube. If the radius of the tube is made 2/3 rd of its previous value, to what height will the water now rises in the tube.
32. Water rises to a height of 10cm in a capillary tube. In the same tube the level of mercury is depressed by 3.42cm. Find ratio of surface tension of water and mercury. [Density of mercury = 13.6 g/cm3, $\theta_w = 0°$, $\theta m = 135°$.]
33. The pressure of air in a soap bubble of 0.7cm diameter is 8mm of water above the atmospheric pressure. Calculate the surface tension of soap solution [$g = 980 cm/s^2$][68.6 N/m]
34. Find the pressure at the tip of a drawing pin of area 0.2 mm square if it is pushed against a board with a force of 5 kg wt.
35. Force on a phonograph needle is 120 gf. The needle end has a circular cross-section of radius 0.1 mm. Find the pressure (in atm) it exerts on the record. Given, 1 atm = 1.013×10^5 Pa. Use $g = 10\ ms^2$.
36. The density of the atmosphere at sea level is 129 kg/m^3. Assume that it does not change with altitude. Then how high would the atmosphere extend? $g = 9.8\ ms^2$, Atmospheric pressure =1.013×10^5 Pa

ANSWERS

no	ANSWER	marks
1.	(b) the speed is low at the wider end and high at the narrow end.	1
2.	(b) zero	1
3.	(c) area of the bottom surface	1
4.	(b) the speed is low at the wider end and high at the narrow end	1
5.	(d) transmitted unchanged to every portion of the fluid and wall of containing vessel	1
6.	b) directly proportional to both 'r' and velocity 'v'	1
7.	b) 10m/s Applying Bernouilli's theorem to the fluid before and after the volume is opened, $p_1 + \frac{1}{2}\rho v_1^2 = p_2 + \frac{1}{2}\rho v_2^2$ where velocity of water before the tap is opened $v_1 = 0$ Given : $P_1 = 3.5 \times 10^5 Nm^{-2}$, $P_2 = 3 \times 10^5 Nm^{-2}$ and $\rho = 1000 kg/m^3$ $3.5 \times 10^5 + \frac{1}{2}(1000)(0) = 3 \times 10^5 + \frac{1}{2}(1000)v_2^2$ Thus we get $v_2^2 = 1 \times 10^2$ $\Rightarrow v_2 = 10 m/s$	1
8.	a) 1.25m Velocity head $h = \frac{v^2}{2g} = \frac{(5)^2}{2 \times 10} = 1.25$ m	1
9.	d) height of the liquid level in the tubes A and C is the same	1
10.	b) liquid of high viscosity and low density flowing through a pipe of small radius	1
11.	a) 4 times that in the other pipe AV = Constant $\Rightarrow \frac{V_1}{V_2} = \frac{A_2}{A_1} = \frac{d_2^2}{d_1^2}, \frac{V_1}{V_2} = \frac{4^2}{2^2} = 4$	1
12	(c) Assertion (A) is true but reason (R) is false. With increase in temperature surface tension of the liquid decreases and angle of contact also decreases.	1
13.	(c) Assertion (A) is true but reason (R) is false.	1
14.	(b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A). We know that the intermolecular distance between the gas molecules is large as compared to that of liquid. Due to it the forces of cohesion in the gas molecules are very small and these are quite large for liquids. Therefore, the concept of surface tension is applicable to liquid but not to gases.	1
15.	(d) Both Assertion and Reason are false.	1

	The soap solution, has less surface tension as compared to ordinary water and its surface tension decreases further on heating. The hot soap solution can, therefore spread over large surface area and also it has more wetting power. It is on account of this property that hot soap solution can penetrate and clean the clothes better than the ordinary water.	
16.	(b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A). The free surface of liquid tries to acquire a minimum area due to surface tension, hence liquid drop is spherical because sphere has minimum area than other shape.	1
17.	(c) Assertion (A) is true but reason (R) is false. With increase in temperature of liquid its surface tension decreases so that it tends to acquire larger area. Hence hot soup having low value of surface tension spread properly on our tongue & provides better taste than cold soup.	1
18	(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).	1
19	i. (c) ii. (b) : Surface tension is a scalar quantity because it has no specific direction for a given liquid. iii. (d) : Angle of contact does not depend upon the inclination of the solid surface to the liquid surface. iv. (c) : Viscosity is a scalar quantity. Surface tension is a scalar quantity. Reynolds number is a dimensionless quantity. v. (d) : A liquid does not wet the solid surface if the angle of contact is obtuse.	3
20.	Refer the notes	
21	Ploughing of fields is essential for preserving moisture in the soil. By ploughing, the fine **capillaries** in the soil are broken. This ensures that water does not rise to the surface of the soil due to capillary action and evaporate	2
22	The tip of the nib of a pen is split in order to provide a **capillary** which helps the ink to rise to the end of the nib and enables it to write continuously.	2
23	The **forces of adhesion** between the molecules of water and glass is more than the forces of cohesion between the molecules. Due to this, water wets the glass surface. In mercury, the forces of adhesion between the molecules and glass is less than the forces of cohesion between the molecules. Due to this, mercury does not wet the glass surface.	2
24	According to **Bernoullis theorem** when velocity of liquid flow increases pressure decreases and vice-versa.	2
25.	Straws make use of capillary action as a result of the difference in pressure. When we suck through the straw, the pressure indide the straw becomes less than the atmospheric pressire. The difference in the pressure forces the soft drink to rise in the straw and we able to take the soft drink conveniently.	2

26.	Due to capillary action, water oozes out of the pores of the new earthern pot. In old pots, most of the capillaries are blocked. So the cooling is not so effective.	2
27.	The thin layer of water between the glass plates forms a concave surface all around. This decreases the pressure on the inner side of the liquid film. Thus, a large amount of force is required to pull them apart against the **atmospheric pressure**.	2
28.	Lubricating oil is generally used between various parts of a machine to reduce the friction in winter, since the temperature is low viscosity of oil between the machine parts increases considerably, resulting in jamming the machine parts.	2
29	Ans: -Yes, The body falling in the viscous medium must be perfectly rigid and smooth. There is no slip between the body and the medium. The motion of body in the medium does not cause any turbulent motion or eddies in the medium. The size of the body must be small but it should be greater than the distance between the The medium is homogeneous and continuous for a moving body in it.	2
30.	Statement Pressure at top= $\frac{mg}{A} = \frac{1 \times 10}{10^{-2}} = 10^3$Pa Pressure at depth h increases by = $\rho gh = 10^3 \times 10 \times 1$ $= 5 \times 10^3$Pa $\Rightarrow$ Total pressure= $10^3 + 5 \times 10^3 = 6000$Pa	3
31	Given : h1=20 mm r1=r r2=2r/3 Using h1r1=h2r2 So, 20×r=h2×2r/3 $\Longrightarrow$ h2=3×20/2=30 mm	2

32	The height h through which a liquid will rise in a capillary tube of radius r is given by $h = \frac{2S\cos\theta}{r\rho g}$ where S is the surface tension, ρ is the density of the liquid and θ is the angle of contact. For identical capillary tubes and two liquids (water '1' & mercury '2') $\frac{h_1}{h_2} = \frac{2S_1\cos\theta_1}{r\rho_1 g} \times \frac{r\rho_2 g}{2S_2\cos\theta_2}$ $\Rightarrow \frac{h_1}{h_2} = \frac{S_1\cos\theta_1}{\rho_1} \times \frac{\rho_2}{S_2\cos\theta_2}$ $\Rightarrow \frac{S_1}{S_2} = \frac{h_1}{h_2} \times \frac{\cos\theta_2}{\cos\theta_1} \times \frac{\rho_1}{\rho_2}$ $\Rightarrow \frac{S_1}{S_2} = \frac{10}{-3.42} \times \frac{\cos 135^\circ}{\cos 0^\circ} \times \frac{1}{13.6}$ $\Rightarrow \frac{S_1}{S_2} = \frac{10}{-3.42} \times \frac{-0.707}{1} \times \frac{1}{13.6}$ $\Rightarrow \boxed{\frac{S_1}{S_2} = 0.152 \approx \frac{1}{6.5}}$	2
33	**Step 1: Given** Excess pressure=8 mm of water= 0.008 m of water. Diameter of bubble=0.7 cm= 0.007 m Radius(r)=0.007/2 m = 0.0035 m Let Excess pressure = P T is surface tension The density of water(ρ) = 1000 $\frac{kg}{m^3}$ **Step 2: Formula used** P = ρ*g*h P = 4 $\frac{T}{r}$ (Surface tension) **Step 3: Finding surface tension** Excess pressure(P)= 8 mm of water = 1000*9.8*0.008 Pa = 78.4 Pa P=4$\frac{T}{r}$ (78.4*0.0035)/4=T T=0.0686 $\frac{N}{m}$ T= 68.66$\frac{dyne}{cm}$ **Hence, the surface tension inside the bubble is 68.66** $\frac{dyne}{cm}$.	2
34	**Solution.** Here, $A = 0{\cdot}2$ mm sq $= 0{\cdot}2 \times 0{\cdot}2$ sq mm $= 0{\cdot}04 \times 10^{-6}\ m^2$, $F = 5$ kg wt $= 5 \times 10$ N Pressure, $P = \frac{F}{A} = \frac{5\times10}{{\cdot}04\times10^{-6}}$ $\mathbf{= 1{\cdot}25 \times 10^9\ Pa}$	2
35	**Solution.** Here, $F = 120\ gf = 0{\cdot}120\ kg\,f$ $= 0{\cdot}120 \times 10 = 1{\cdot}2$ N, $r = 0{\cdot}1$ mm $= 10^{-4}$ m Pressure, $P = \frac{F}{\pi r^2} = \frac{1{\cdot}2}{(22/7)\times(10^{-4})^2}$ Pa $= \frac{1{\cdot}2\times7}{22\times10^{-8}\times1{\cdot}013\times10^5}$ atm $\mathbf{= 377\ atm}$	2

36	**Solution.** Atmospheric pressure, $P_a = h \rho g$ or $h = \frac{P_a}{\rho g} = \frac{1{\cdot}013 \times 10^5}{1{\cdot}29 \times 9{\cdot}8} = \mathbf{7989\ m}$	2

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