	INDIAN SCHOOL AL WADI AL KABIR	
Class: XI	**Department: SCIENCE 2022 – 23** **SUBJECT : PHYSICS**	**Date of submission:** **19.01.2023**
Worksheet No:09 **WITH ANSWERS**	**Topic: MECHANICAL PROPERTIES OF FLUIDS**	**Note:** **A4 FILE FORMAT**
NAME OF THE STUDENT-	**CLASS & SECTION**	**ROLL NO.**

Multiple choice questions:

1. A block of aluminium of mass 1 kg and volume 3.6 x 10^{-4} m^3 is suspended from a string and then completely immersed in a container of water. The decrease in tension in the string after immersion is
(use g = 10 ms^{-2})

(a) 9.8 N (b) 6.2 N (c) 3.6 N (d) 1.0 N

2. A U-tube is partially filled with water. Oil which does not mix with water is next poured into one side until water rises by 25 cm on the other side. If the density of oil be 0.8, the oil level will stand higher than the water level by

(a) 6.25 cm (6) 12.50 cm (c) 31.75 cm (d) 62.50 cm

3. Two water droplets merge with each other to form a larger droplet. In this process

(a) energy is liberated
(b) energy is absorbed
(c) energy is neither liberated nor absorbed
(d) some mass is converted into energy

4. A long cylindrical glass vessel has a small hole of radius r at its bottom. The depth to which the vessel can be lowered vertically in a deep water (surface tension S) without any water entering inside is

(a) $\frac{4S}{r\rho g}$ (b) $\frac{3S}{r\rho g}$ (c) $\frac{2S}{r\rho g}$ (d) $\frac{S}{r\rho g}$

5. Two soap bubbles A and B are formed at the two open ends of a tube. The bubble A is smaller than bubble B. If the valve on the tube connecting the two bubbles is opened and air can flow freely between the bubbles, then

(a) there is no change in the size of the bubbles
(b) the two bubbles will become of equal size
(c)A will become smaller and B will become larger
(d) B will become smaller and A will become larger

6. The work done in increasing the size of a soap film from 10 cm x 6 cm to 10 cm x 11 cm is 3×10^{-4}J. The surface tension of the film is

(a) 1.5×10^{-2} Nm^{-1} (b) 3.0×10^{-2} Nm^{-1} (c) 6.0×10^{-2} Nm^{-1} (d) 11.0×10^{-2} Nm^{-1}

7. What change in surface energy will be noticed when a drop of radius R splits up into 1000 droplets of radius r, surface tension is T.

(a) $4\pi R^2T$ (b)$7\ \pi R^2T$ (c)$16\ \pi R^2T$ (d)$36\ \pi R^2T$

8. In a surface tension experiment with a capillary tube water rises up to 0.1 m. If the same experiment is repeated on an artificial satellite, which is revolving around the earth, water will rise in the capillary tube up to a height of

(a) 0.1 m (b) 0.2 mn (c) 0.98 m (d) full length of tube.

9. A capillary tube of radius R is immersed in water and water rises in it to a height H. Mass of water in capillary tube is M. If the radius of the tube is doubled, mass of water that will rise in capillary will be

(a) 2 M (b) M (c) M/2 (d) 4 M

10. A capillary tube is dipped in water with the lower end 10 cm below the surface. Water rises in the tube to a height of 5 cm. The pressure required to blow a bubble at the lower end of the tube will be (atmospheric pressure = 10^5 Nm^{-2} and g = 10 m/s^2)

(a) 10^5 Nm^{-2} (b) 1.015×10^5 Nm^{-2} (c)2.2×10^5 Nm^{-2} (d) 2.5×10^5 Nm^{-2}

11. Under a pressure head, the rate of orderly volume of liquid flowing through a capillary tube is *Q*. If the length of capillary tube were doubled and diameter of the bore is halved, the rate of flow would become

(a) Q/4 (b) Q/8 (c) Q/32 (d) 16 Q

12. When water flows at a rate *Q* through a tube of radius *r* placed horizontally, a pressure difference *p* develops across the ends of the tube. If the radius of the tube is doubled and the rate of flow halved, the pressure difference will be

(a) 80 p (b) p (c) p/8 (d) p/32

13. Two spheres of equal masses but radius r_1 and r_2 are allowed to fall in liquid of infinite column. The ratio of their terminal velocities is

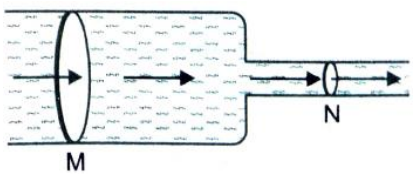
(a) 1 (b) $r_1 : r_2$ (c) $r_2 : r_1$ (d) $\sqrt{r1} : \sqrt{r2}$

14. Two drops of the same radius are falling through air with a steady velocity of 5 cm s^{-1} • If the
two drops coalesce, the terminal velocity would be

(a) 10 cms^{-1} (b) 2·5 cms^{-1} (c) 5 $(4)^{1/3}$ cm s^{-1} (d) 5 $(3)^{1/3}$ cm s^{-1}

15. A horizontal tube of non-uniform cross-section has radii of 0·1 m and 0·05 m respectively at M and N, as shown in the fig. For a streamline flow of liquid, the rate of liquid flow is

(a) continuously changes with time
(b) greater at M than at N
(c) greater at N than at M
(d) same at Mand N



16. For a ball falling in a liquid with constant velocity, ratio of resistance force due to the liquid to that due to gravity is

(a) 1 (b) $\frac{2a^2\rho g}{9\eta^2}$ (c) $\frac{2a^2(\rho-\sigma)g}{9\eta}$ (d) none of these.

17. There is a hole at the bottom of a large open vessel. If water is filled up to a height h, it flows out in time t. If water is filled to a height 4 h, it will flow out in time

(a) 4 t (b) t/4 (c) t/2 (d) 2 t

18. The work done by pressure in forcing 1 m^3 of water through a pipe if the pressure difference across the pipe is 10^4 Pa, is

(a) 10^5 J (b) 10^4 J (c) 10^3 J (d) 10^2 J

19. The tangential force or viscous force on any layer of the liquid is directly proportional to the velocity gradient *dv/dx*. Then the direction of velocity gradient is

(a) parallel to the direction of the flow of the liquid
(b) opposite to the direction of the flow of the liquid
(c) independent of the direction of the flow of the liquid
(d) perpendicular to the direction of flow of the liquid

20. It is observed that during storm, the roofs of some houses are blown off. It is because

(a) the wind creates high pressure over the roof
(b) the wind creates low pressure over the roof
(c) of the structure and shape of the roof
(d) of natural calamity

[21]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

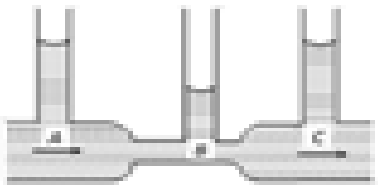
[22]A manometer connected to a closed tap reads 3.5 x10^5 N/m^2 .When the valve is opened ,the reading of manometer falls to 3 x 10^5 N/m^2,then the velocity of the flow of water is

[a] 100m/a [b] 10m/s [c]1m/s [d] 25m/s

[23] The velocity of kerosene oil in a horizontal pipe is 5m/s. If = 10m/s^2 , then the velocity head of oil will be

[a] 1.25m [b] 12.5m [c] 0.125m[d] 125m

[24]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

[25]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

[26] 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

ANSWER KEY

ANSWERS OF MCQs; -1. (c),2. (a), 3. (a), 4. (c), 5. (c), 6. (b), 7. (d), 8. (d), 9. (a), 10. (b), 11. (c), 12. (d), 13. (c), 14. (c), 15. (d),16. (a), 17. (d), 18. (b),19. (a), 20. (b). [21]b [22] b [23] a [24]d [25]b [26]a

SHORT ANSWER QUESTIONS

[1] 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
[2] Ploughing of fields is essential for preserving moisture in the soil. Explain
In terms of capillary rise
[3]Why the tip of the nib of a pen is split?
capillarity
[4]Why does water wet the surface whereas mercury does not?
Angle of contact
[5] 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.
Bernoulli's theorem

[6] Straw are used to take soft drinks. Why?
Capillary rise
[7]The new earthen pots keeps water cooler than old one. Why?
Capillary rise
[8]A large force is required to draw apart normally two glass plate enclosing a thin water film.
viscosity

Assertion and Reason type questions;

DIRECTIONS. In each of the following questions, read the two statements and choose if
(A) both Assertion and Reason are true and the Reason is correct explanation of the Assertion.
(B) both Assertion and Reason are true, but the Reason is not a correct explanation of the Assertion.
(C) Assertion is true and Reason is false.
(D) both, Assertion and Reason are false.

1. Assertion. The stream of water flowing at high speed from a garden hose pipe tends to spread like a fountain when held vertically up but tends to narrow down when held vertically down.
Reason. In any steady flow of an incompressible fluid, the volume flow rate of the fluid remains constant.
(a)(A) (b) B (c) C (d) D
2. Assertion: A bubble comes from the bottom of a lake to the top.
Reason: Its radius increases.
(a)(A) (b) B (c) C (d) D
3. Assertion: The angle of contact of a liquid with a solid decrease with increase in temperature.
Reason: With increase in temperature, the su1facc tension of the liquid increases.
(a)(A) (b) B (c) C (d) D
4. 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 on an object depends both on the material and shape of the object.
(a)(A) (b) B (c) C (d) D
5. Assertion: Aeroplanes are made to nm on the runway before takeoff, so that they acquire the necessary lift.
Reason: According to Bernoulli's theorem as velocity increases pressure decreases and vice-versa.
(a)(A) (b) B (c) C (d) D
ANSWERS OF A &R; -1. (a),2. (b), 3. (d), 4. (c), 5. (a)

SHORT ANSWER TYPE QUESTIONS: -

1. 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.

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, $P = \frac{F}{A} = \frac{5 \times 10}{\cdot 04 \times 10^{-6}} = \mathbf{1{\cdot}25 \times 10^9\ Pa}$

2. 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 x 10^5 Pa. Use g = 10 ms^2.

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

$= \frac{1{\cdot}2 \times 7}{22 \times 10^{-8} \times 1{\cdot}013 \times 10^5}$ atm $= \mathbf{377\ atm}$

3. What is the pressure on a swimmer 10 m below the surface of lake? g = 10 ms^2, atmospheric pressure = 1.01 x 10^5 Pa.

Solution. Here, $h = 10$ m, $P_a = 1{\cdot}01 \times 10^5$ Pa
Total pressure $= P_a + \rho\, g\, h$
$= 1{\cdot}01 \times 10^5 + 1000 \times 10 \times 10$
$= 2{\cdot}01 \times 10^5$ Pa $\approx$ **2 atm**

4. 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 x 10^5 Pa.

Solution. Atmospheric pressure, $P_a = h\, \rho\, g$

or $h = \frac{P_a}{\rho\, g} = \frac{1{\cdot}013 \times 10^5}{1{\cdot}29 \times 9{\cdot}8} = \mathbf{7989\ m}$

5. A cylinder has a radius 20 cm. To what height should it be filled with water so that thrust in its walls is equal to that on its bottom? Find the mass of water filled in cylinder.

Solution. Let h be the height of water filled in cylinder and ρ be the density of water. Then

thrust at the bottom of vessel
F = pressure × area $= (h\, \rho\, g) \times \pi r^2$

Thrust on the walls of vessel,
F' = average pressure × area

$$F' = \left(\frac{h \rho g}{2}\right) \times (2\pi rh) = \pi r h^2 \rho g$$

When $F = F'$, then $h\, \rho\, g \times \pi r^2 = \pi\, r h^2\, \rho\, g$
or $h = r = \mathbf{20\ cm}$

6. To lift an automobile of 2000 kg, a hydraulic pump with a large piston 30 cm^2 in area is employed. Calculate the force that must be applied to pump a small piston of mercury area 10 cm^2 to achieve it.

Solution. Here, $F_2 = Mg = 2000 \times 9{\cdot}8 = 19600$ N

$A_2 = 30$ cm square $= 30 \times 30$ sq cm

$= 900 \times 10^{-4}$ m^2

$A_1 = 10$ sq cm $= 10 \times 10^{-4}$ m^2

As $\frac{F_1}{A_1} = \frac{F_2}{A_2}$ so $F_1 = \frac{F_2 \times A_1}{A_2}$

$= \frac{19600 \times 10 \times 10^{-4}}{900 \times 10^{-4}}$

$= 217{\cdot}8$ N

7. Two syringes of different cross-sections (without needles) filled with water are connected with a tightly fitted rubber tube filled with water. Diameters of the smaller piston and larger piston are 10 cm and 3.0 cm respectively. (a) Find the force on the larger piston when a force of 10 N is applied to the smaller piston. (b) The smaller piston is pushed in through 6.0 cm, how much does the larger piston move out?

(*a*) As, $F_2 = F_1 \times \frac{A_2}{A_1} = F_1 \times \frac{\pi(D_2/2)^2}{\pi(D_1/2)^2}$

$= F_1 \frac{D_2^2}{D_1^2} = 10 \times \frac{3^2}{1^2} = \mathbf{90\,N}$

(*b*) According to work energy principle,

$F_1 l_1 = F_2 l_2$

or $l_2 = \frac{F_1}{F_2} l_1 = \frac{10}{90} \times \frac{6}{100} = 6{\cdot}7 \times 10^{-3}$ m

$= 6{\cdot}7$ mm

8. Machine parts are jammed in winter. Why?

Ans: - 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.

9. Discuss the effect of temperature on viscosity of liquids and gases.

Ans: -The viscosity of liquid decreases rapidly with rise of temperature.

10. Are there some conditions for Stoke's law to be obeyed. If no, explain. If yes, mention those

conditions.

Ans: -Yes,

1. The body falling in the viscous medium must be perfectly rigid and smooth.
2. There is no slip between the body and the medium.
3. The motion of body in the medium does not cause any turbulent motion or eddies in the medium.
4. The size of the body must be small but it should be greater than the distance between the
5. The medium is homogeneous and continuous for a moving body in it.

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