

CLASS - IX

SUBJECT - PHYSICS

CHAPTER - 4

TEACHER - CHARANJEET

KAUR

Good Morning Students!

This lesson is of class-IX, for the subject of Physics, Topic - 'Pressure in Fluids' which is covered in chapter - 4 'Pressure in Fluids and Atmospheric Pressure' and is given on Page Number - 84 of your Physics textbook, titled - 'Concise Physics by Selina Publications', and is being submitted to you on 15th April, 2023.

FLUID - A substance which can flow is called a fluid. Thus, all liquids and gases comes in the category of fluids. Solids exert pressure only on the surface on which it is placed (as shown in figure - 1)

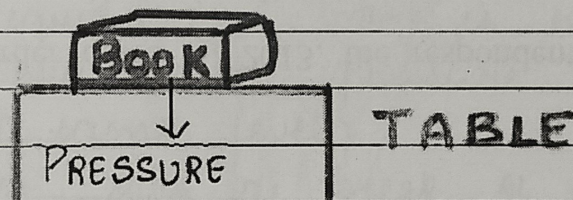


FIGURE-1

Fluids exert pressure on the bottom as well as on the walls of the container due to its tendency to flow in all directions.

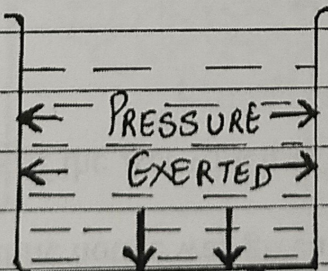


FIGURE-2

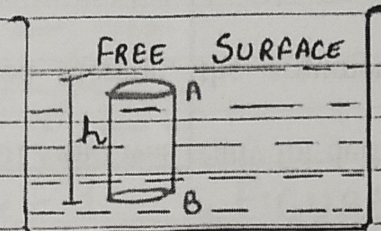
(Pressure exerted is in all directions)

PRESSURE EXERTED BY A LIQUID COLUMN

$$P = h \rho g$$

where, h = depth of the point from free surface,
 ρ = density of liquid, and
 g = acceleration due to gravity

FIGURE - 3



NOTE - There is atmospheric pressure above the free surface of liquid, thus total pressure at point B (in figure - 3) will be :

$$P_B = P_0 + h \rho g$$

where, P_0 = atmospheric pressure, and $h \rho g$ = Pressure due to liquid column.

Pressure exerted by a liquid column is directly proportional to :

- depth of the object from free surface, and
- density of liquid, i.e. more is the density of liquid, more will be the pressure exerted by the liquid at same level.

Now, you may take a break of 5 minutes and answer the given question below.

(You may pause the video/audio, and write the answer in your Physics notebook.)

Q1

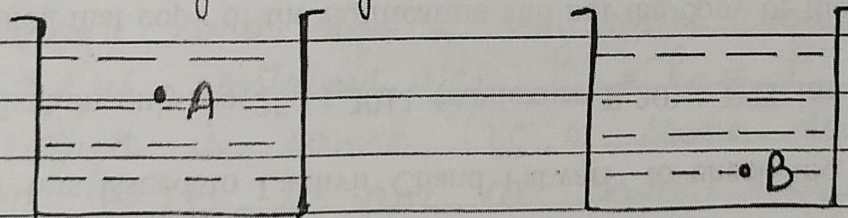


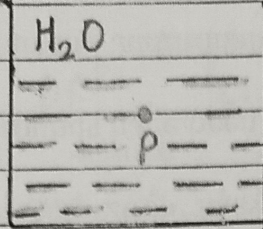
FIGURE-4

CASE-1

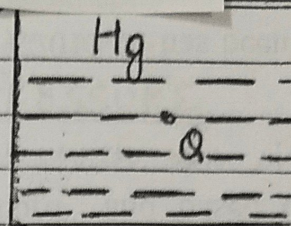
CASE-2

Observe figure - 4 and name the case where the liquid is exerting more pressure on the point object (which is placed at point A in case-1 and at point B in case-2). Also write reason in support of your answer.

Q2.



Case - 1



Case-2

FIGURE-5

Give reason, for which case pressure will be exerted more when object is placed at same level from the free surface.

(After writing the answer, you may resume this interactive session further.)

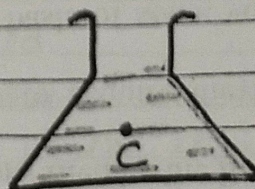
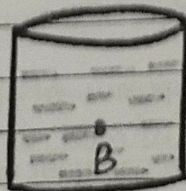
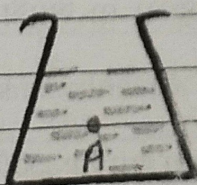
Ans 1. Point B is at more depth than point A and as pressure is directly proportional to depth. Thus, pressure exerted by liquid at point B is more than that exerted at point A.

Ans 2. Pressure of liquid column $\propto$ density of liquid (ρ)
 ρ of water (1000 kg/m^3) is less than ρ of mercury ($13.6 \times 10^3 \text{ kg/m}^3$), thus pressure at point Q is more than pressure experienced at point P.

Pressure inside a liquid does not depend on:

- a) The shape and size of the vessel in which the liquid is contained i.e. $P_A = P_B = P_C$, provided the liquid is same (i.e. of same density) and points A, B, C are at same level from the free surface (i.e. depth is same).
 (Observe figure - 6, the pressure in all three cases is same).

FIGURE-6



b) the area of surface on which it acts.

LAWS OF LIQUID PRESSURE

- 1) Inside the liquid, pressure increases with the increase in depth from its free surface.
- 2) In a stationary liquid, pressure is same at all points on a horizontal plane.
- 3) Pressure is same in all directions about a point inside the liquid.
- 4) Pressure at same depth is different in different liquids and pressure increases with the increase in density of liquid.
- 5) A liquid seeks its own level.

Students, you may all take a break for 5-10 minutes and in the meantime go through the summary of the concepts learnt till now (written below).

- Thrust (acts normal to the surface) = weight of body

$$\text{Thrust} = mg$$
 (vector quantity)
- Pressure = $\frac{\text{Thrust}}{\text{Area}}$ (scalar quantity)

⇒ $P \propto 1/\text{Area}$, i.e. more is the area, less pressure is exerted by that body.

- Pressure due to column of a liquid,

$$P = P_0 + h\rho g$$

$$P_0 = 1 \text{ atm} = 1.013 \times 10^5 \text{ Pa}$$

- Pressure in liquid does not depend on:
 - a) shape of the container, and
 - b) size of the container.

- A solid object exerts pressure only on the surface on which it is placed
- Fluid exerts pressure on the bottom as well as the walls of the container in which it is stored

CHAPTER - 4

CHARANJEET

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Now you may all resume this interactive session further and open your textbooks a page - 93 'Numericals of exercise - 4 (A)'

NUMERICALS

1) For nail A: Area = $2 \text{ mm}^2 = 2 \times 10^{-6} \text{ m}^2$
 so, Pressure on nail A = $\frac{\text{Force (N)}}{\text{Area (m}^2\text{)}} = \frac{1.5}{2 \times 10^{-6}}$

$$P = 7.5 \times 10^5 \text{ N/m}^2 = 7.5 \times 10^5 \text{ Pa}$$

For nail B: Area = $6 \text{ mm}^2 = 6 \times 10^{-6} \text{ m}^2$
 so, Pressure on nail B = $\frac{\text{Force (N)}}{\text{Area (m}^2\text{)}} = \frac{1.5}{6 \times 10^{-6}}$

$$P = 2.5 \times 10^5 \text{ Pa}$$

2) Mass of iron block = 7.5 kg

a) Thrust = Weight of iron block = mg
 Thrust = $7.5 \times 10 = 75 \text{ N}$

b) Pressure = $\frac{\text{Thrust}}{\text{Area}}$, Area = $(12 \times 8) \text{ cm}^2 = 96 \times 10^{-4} \text{ m}^2$
 Pressure = $\frac{75}{96 \times 10^{-4}} = \frac{75}{96} \times 10^4 = \frac{750000}{96}$

$$\text{Pressure} = 7812.5 \text{ Pa}$$

3) $h = 1.5 \text{ m}$, $\rho = 10^3 \text{ kg/m}^3$, $g = 9.8 \text{ m/s}^2$
 Area = $100 \text{ cm}^2 = 100 \times 10^{-4} \text{ m}^2$

a) $P = h \rho g = 1.5 \times 10^3 \times 9.8$
 $P = 1.47 \times 10^4 \text{ N/m}^2$

b) Thrust = $P \times A$
 Thrust = $1.47 \times 10^4 \times 100 \times 10^{-4} = 147 \text{ N}$

Students, try numerical number - 4, 5, 6 and 7 yourself which is further based on formula $P = h \rho g$.
 (Thank you students)

(LAST PAGE)