

Gravitation - Lesson 17

Pressure in Fluids



It should be clear that a solid body, when kept on a surface, exerts thrusts downwards due to its weight and the bottom surface area is accounted for distributing the pressure. But what about fluids? How do they exert pressure? Is it the same ways as solids? It cannot be if it was true that a fluid exerts thrust only at the bottom surface, then while inflating a balloon, we would have seen the balloon stretch only from the bottom. But while inflating a balloon, it inflates from all the sides. This leads us to a fantastic fact that fluids which include liquids and gases, exert thrust and pressure undiminished in all directions. But another astonishing fact is that their weight, as for all matter, always acts towards the ground, and the surface of the liquid will always align itself in such a manner that the weight is acting perpendicular to it. For example, if you fill water in a glass, the water's surface at the top will always remain parallel to the surface of the earth, no matter how you tilt or deform the glass. It's an amazing fact to try!

You should, now, be able to answer the following questions:

1. How is the pressure distributed in fluids?
2. While inflating a balloon, why doesn't it inflate in a single direction?

3. Why is the surface of water flat no matter on what surface it is kept?

Conclusion

Fluids exert equal pressure in all directions which is perpendicular to the surface.

Note to Teacher

The objective of the lesson is to elucidate the fact that water or all fluids in general react a bit differently under gravity. Unlike solids, they exert equal pressure at all sides. The text also draws attention to the fact that surface of the water always aligns in specific way. This lesson is a great prelude to buoyancy.

Student Worksheet

1. Which of the following is a fluid at room temperature:
 - (a) Mercury
 - (b) Air
 - (c) Water
 - (d) Wood
2. Is it true that a fluid exerts thrust only at the bottom of the vessel that it is stored? Why?
3. Fluids exert thrust and pressure undiminished in all directions. But will an object experience the same amount of pressure when immersed at different levels inside of that fluid?

Answers

1. Undiminished in all directions
2. Because air is a fluid and fluids apply pressure in all directions
3. Because the force on the surface of the water is always perpendicular. As gravity acts towards the center of the earth, therefore the surface of the water is always perpendicular to that.

Student Worksheet Answers

1. (a), (b) and (c)
2. No. Because fluids exerts thrust and pressure undiminished in all directions.
3. No. The level of fluid above the object will determine the downward force and the amount of fluid below the object will determine the upward force. The new force will change as the object changes its position. At the top, the object will experience a net upward force and as it is immersed deeper and deeper, it will experience more and more downward force.