Pressure

Molecules of fluid sometimes ____________ with ____________ of container.

\[ P = \frac{F}{A} \]

- \( P \) = ____________
- \( F \) = Force ____________ to surface
- \( A \) = ____________ of surface

Unit: \( N/m^2 = \text{Pa} \) (pascal)

- 1 Pa is ________________ so we usually use ____________ or ____________

In a ____________ the pressure is exerted ____________ to ____________ surfaces
A ____________ fluid ____________ produce a force ____________ to a surface since it is not ____________ parallel to surface

You are drinking a juice box. In the process you suck all the juice and air out of the box. The top of the box is 7.5 cm by 5 cm. If the air pressure is \( 1.013 \times 10^5 \) Pa, how much force is acting on the top of the box?

Would the force of the side of the box be more or less than the top?

The force that squashes the juice box is from the ____________ of all the air.

**Atmospheric Pressure at Sea Level**

\( 1.013 \times 10^5 \) Pa = 1 atmosphere (1 atm)

**Pressure Varies with Depth**

- The column of static fluid experiences several ____________ forces
- Since the fluid is not moving, it is in equilibrium and ____________
- If the pressure is known at a depth, the pressure lower down can be found by adding ____________
- This assumes \( \rho \) is ____________ with depth
- This is a good estimate for ____________, but not for ____________ unless \( h \) is small

\[ P_2 = P_1 + \rho gh \]

Would Hoover Dam need to be just as strong if the entire lake behind the dam was reduced to an inch of water behind the dam, but the same depth as the lake?

What is the total pressure at points A and B?
1. How is pressure related to the sharpness of a knife and its ability to cut?
2. Why is force exerted by static fluids always perpendicular to a surface?
3. Toe dancing (as in ballet) is much harder on toes than normal dancing or walking. Explain in terms of pressure.
4. Atmospheric pressure exerts a large force (equal to the weight of the atmosphere above your body—about 10 tons) on the top of your body when you are lying on the beach sunbathing. Why are you able to get up?
5. As a woman walks, her entire weight is momentarily placed on one heel of her high-heeled shoes. Calculate the pressure exerted on the floor by the heel if it has an area of 1.50 cm$^2$ and the woman’s mass is 55.0 kg. Express the pressure in Pa. (In the early days of commercial flight, women were not allowed to wear high-heeled shoes because aircraft floors were too thin to withstand such large pressures.) (OpenStax 11.11) $3.59 \times 10^6$ Pa
6. Nail tips exert tremendous pressures when they are hit by hammers because they exert a large force over a small area. What force must be exerted on a nail with a circular tip of 1.00 mm diameter to create a pressure of $3.00 \times 10^9$ N/m$^2$?
7. What depth of mercury creates a pressure of 1.00 atm? (OpenStax 11.14) 0.760 m
8. The greatest ocean depths on the Earth are found in the Marianas Trench near the Philippines. Calculate the pressure due to the ocean at the bottom of this trench, given its depth is 11.0 km and assuming the density of seawater is constant all the way down. (OpenStax 11.15) $1.10 \times 10^8$ Pa
9. Verify that the SI unit of $\rho g h$ is N/m$^2$. (OpenStax 11.16) work
10. Water towers store water above the level of consumers for times of heavy use, eliminating the need for high-speed pumps. How high above a user must the water level be to create a gauge pressure of $3.00 \times 10^5$ N/m$^2$? (OpenStax 11.17) 30.6 m
11. What pressure is exerted on the bottom of a 0.500-m-wide by 0.900-m-long gas tank that can hold 50.0 kg of gasoline by the weight of the gasoline in it when it is full? (OpenStax 11.20) $1.09 \times 10^4$ N/m$^2$
12. The left side of the heart creates a pressure of 120 mmHg by exerting a force directly on the blood over an effective area of 15.0 cm$^2$. What force does it exert to accomplish this? (OpenStax 11.22) 24.0 N
13. The human lungs can function satisfactorily up to a limit where the pressure difference between the outside and inside of the lungs is one-twentieth of an atmosphere. If a diver uses a snorkel for breathing, how far below the water can she swim? Assume the diver is in salt water whose density is 1025 kg/m$^3$. (Cutnell 11.24) 0.50 m