

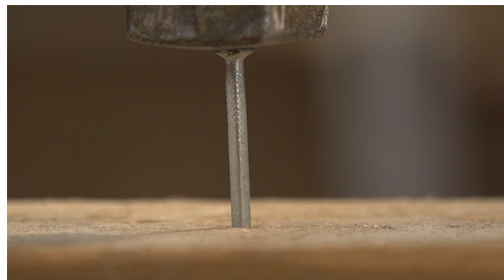
# Grade 8 Science

## Unit 3: Fluids

When you swing a hammer and land your blow on a thick piece of wood, you damage the wood by putting a small dent in it, but the hammer does not go into the wood.



When you repeat the exact same action, placing a nail between the hammer and the wood, the nail is driven into the wood.



Why is there a difference?

# Pressure

- What is a force? A push or a pull that can cause movement  
Measured in Newtons (N)
- What is pressure? A force per unit of area  
Measured in Pascals (Pa)
- What is a Pascal? A Pascal is defined as 1 N per m<sup>2</sup>  
1 kPa = 1000 Pa

If pressure is measured in units of N/m<sup>2</sup>, and the definition is a force per unit area, what would be the equation used to calculate pressure?

$$\begin{array}{l} \text{force} \swarrow \\ \frac{N}{m^2} \longrightarrow \text{Pressure} = \frac{\text{Force}}{\text{Area}} \\ \nwarrow \text{area} \end{array}$$

# Pressure

Let's look at an example question:

Nathan shoots a basketball and bricks it off the backboard. As it hits, the ball compresses and 150 cm<sup>2</sup> (0.015 m<sup>2</sup>) of the ball hits the backboard. If the ball hits with a force of 200 N, how much pressure is put on the backboard?

$$\begin{array}{l} F = 200 \text{ N} \\ A = 0.015 \text{ m}^2 \\ P = ? \end{array} \quad \begin{array}{l} P = \frac{F}{A} \quad \checkmark \\ P = \frac{200}{0.015} \\ P = 13333.\bar{3} \text{ Pa} \\ P = 13.\bar{3} \text{ kPa} \end{array} \quad \begin{array}{l} \therefore \text{There is } 13.\bar{3} \text{ kPa} \\ \text{of pressure on the} \\ \text{backboard. } \checkmark \\ 3/3 \end{array}$$

\* Remember, for pressure it needs to be m<sup>2</sup>

# Pressure

Some questions dealing with pressure will state that there is an object resting on a surface and ask you to determine the pressure on the surface. If you are told the area of the footprint, but instead of being told the force applied by the object you are told the mass of the object, can you still determine the pressure?

The force of gravity applies a force of 9.8 N/kg on all objects.

A 13 kg object has a base that is 1.2 m<sup>2</sup>. How much pressure does it exert on the ground?

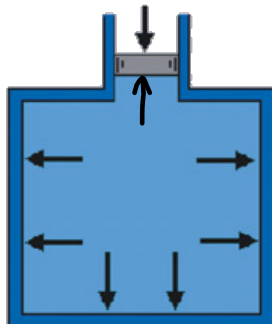
$$\begin{array}{llll} m = 13 \text{ kg} & F = mg & F = 127.4 \text{ N} & P = \frac{F}{A} \checkmark \\ g = 9.8 \text{ N/kg} & F = 13(9.8) & A = 1.2 \text{ m}^2 & \frac{127.4}{1.2} \\ F = ? & F = 127.4 \text{ N} \checkmark & P = ? \checkmark & \frac{4}{4} \\ & & & P = 106.1\bar{6} \text{ Pa} \end{array}$$

∴ The object applies 106.1 $\bar{6}$  Pa of pressure on the ground. ✓

# Pascal's Law

Our unit is titled "Fluids," and the pressure we have been discussing has been based on solids. Pressure is exerted in a fluid in the same manner, using the same equation. However, there is a very important property of fluids that makes fluid pressure very useful:

Pascal's Law: Pressure exerted on a fluid is transferred uniformly throughout the fluid.



If the top panel is pressed down it applies a pressure to the fluid under it. That pressure presses equally on all sides of the container.



# Pascal's Law

Pascal's Law can be very useful. Have a look at this example:

$P_i = \frac{F_i}{A_i}$

*small*

*same everywhere*

$P_i = P_o$

*Big*

*Although we increase the force, it moves only a small amount.*

$P_o = \frac{F_o}{A_o}$

Pascals Law says uniform pressure:

$\therefore P_i = P_o$

$\frac{F_i}{A_i} = \frac{F_o}{A_o}$

*small*  $\rightarrow$   $\frac{F_i}{A_i}$   $\leftarrow$  *Big*

$\therefore F_i$  is small and  $F_o$  is big

$\rightarrow$  we increased the force.

# Pressure

Please use the remaining time to work on the practice pressure problems I have prepared. Similar to the density problems, there is a good chance you will see a similar question on your unit test.

**Pressure**

Pressure is the amount of force exerted per unit area on a surface that is perpendicular to the force. In mathematical terms:

$$P = \frac{F}{A}$$

Pressure is measured in Pascals, which is 1 Newton per square meter. (Note: commonly used is the kilogram-force, which is 1000 times greater per square meter.)

For example, if a person has a weight of 600 N (20 kg) and is standing on one foot (approximately 0.02 m<sup>2</sup>), the pressure exerted on the ground will be:

Force = 600 N      In answer -  $\frac{600 \text{ N}}{0.02 \text{ m}^2}$

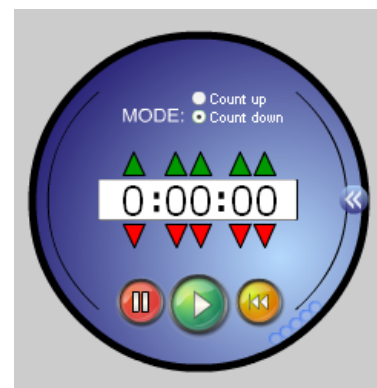
Area = 0.02 m<sup>2</sup> = 0.04 m<sup>2</sup>      In answer -  $\frac{600 \text{ N}}{0.04 \text{ m}^2}$

Pressure = ?      In answer -  $\frac{600 \text{ N}}{0.04 \text{ m}^2} = 15,000 \text{ Pa}$

Complete the following questions related to pressure:

- A block, resting on the ground, has a cross-sectional area of 2 m<sup>2</sup> and is being pushed with a force of 100 N. What is the pressure exerted by the block on the ground?

- An aquarium holds 100 L of water (recall that 1 L of water weighs 1 kg). The base of the aquarium is 1 m by 0.5 m. What pressure is exerted on a table by the filled aquarium?
- There is a load (over 100 kg) that Sam's handcart is only 20 cm<sup>2</sup>. If Sam is able to push with a force of 70 N and Sam can push with a force of 50 N, who can exert a larger pressure on an object?
- If a box is applying 20 kPa of pressure on a table and the area of the box is 10 cm<sup>2</sup>, what would the weight of the box be?



## Attachments

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3-13 Pressure.pdf