Taking it Further: Pressure

Answer the questions below.

1. Describe the relationship between pressure and temperature of a gas.
   As temperature increases, pressure increases
2. Explain what is meant by pressure.
   The force exerted per unit area.
3. Explain why gas pressure increases with temperature.
   Particles gain energy so collide with the walls of the container more frequently and with more force.
4. Which state(s) of matter can be compressed?
   Only gases
5. Suggest why it hurts more when a person stands on your foot with a high heel than a flip flop.
   They exert the same force over a smaller area, so there is more pressure.

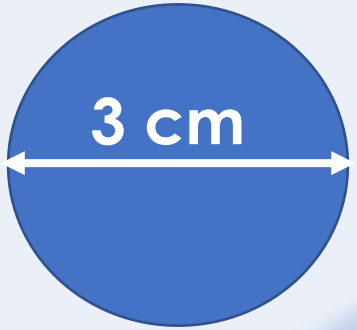
Do Now

Taking it Further: Pressure

Do Now:

1. Describe the relationship between pressure and temperature of a gas.
2. Explain what is meant by pressure.
3. Explain why gas pressure increases with temperature.
4. Which state(s) of matter can be compressed?
5. Suggest why it hurts more when a person stands on your foot with a high heel than a flip flop.

Drill:



1. State the SI unit for force.
2. State the equation used to calculate area of a circle.
3. Calculate the area of this circle.

Do Now

Taking it Further: Pressure

Read Now:

When you apply the brakes in a car, you apply a force to the pedal to make the car come to rest. How does that small force that you apply with your foot manage to make a whole car stop? The answer is hydraulics. Hydraulics means anything to do with liquids under pressure, and the brakes in a car use a hydraulic braking system. Liquids are incompressible, because there is no space between the particles. This means that when a force is applied to a liquid, the pressure is transmitted through the liquid because the force cannot be used to compress the liquid. This means the liquid can exert the same pressure on the other side.

1. Describe the arrangement of particles in a liquid.
2. Explain the term 'hydraulics'.
3. Explain why liquids are described as incompressible.
4. Explain why a gas could not have the same effect.
5. Give an example of a use of hydraulics.

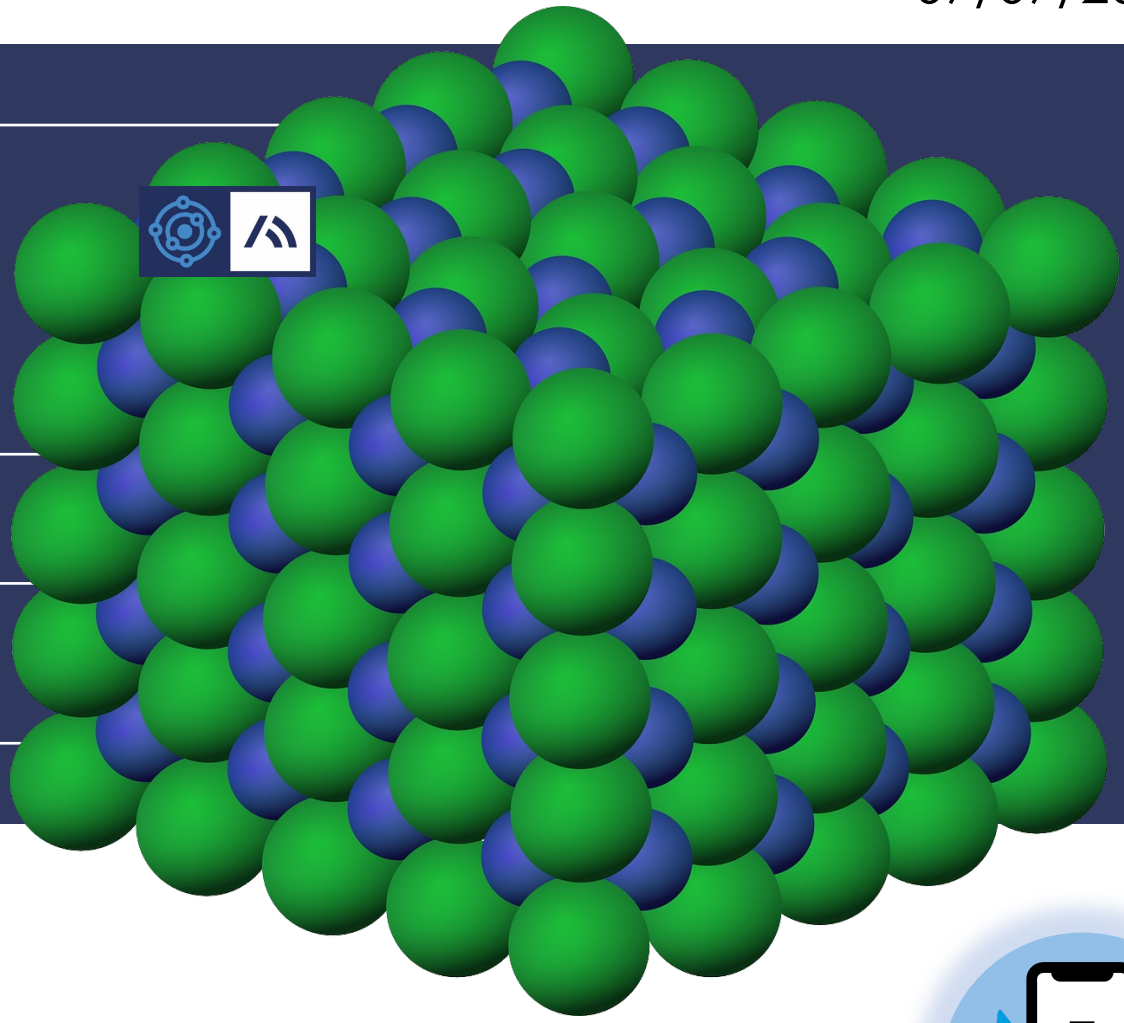
Do Now

07/07/2023

Taking it Further: Pressure

P4.1.5

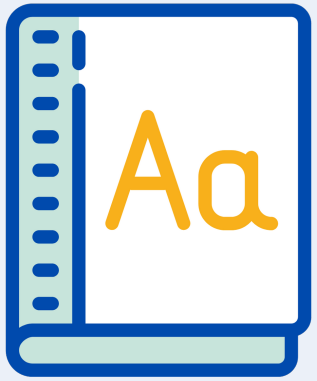
Science Mastery



Following this lesson, students will be able to:

- Recall and apply the equation pressure = force/area
- Describe the property of liquids that makes them useful in hydraulic systems
- Use the equation to solve hydraulic calculations

Key Words:



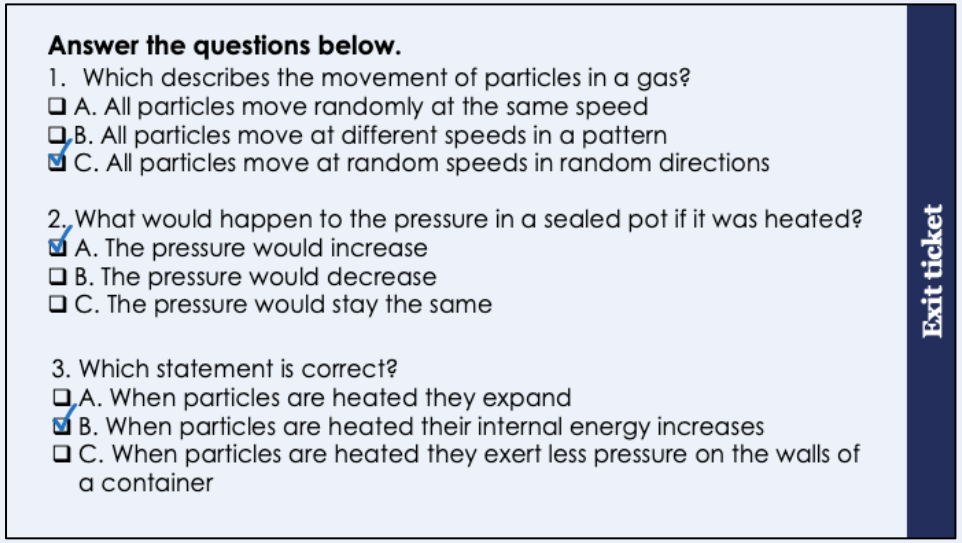
liquid	**pressure**	**force**	**area**
incompressible		**hydraulics**	

Lesson Objectives

This is the fix-it portion of the lesson

The **fix-it** is an opportunity to respond to gaps in knowledge, especially those identified by the previous lesson's exit ticket.

- The teacher should customise this slide as needed, to facilitate
  - **reteach**, **explanation, demonstration** or **modelling** of ideas and concepts that students have not yet grasped or have misunderstood.
  - **practise** answering specific questions or of key skills.
  - **redrafting** or **improving** previous work.



Fix-it

Vocabulary

Fluid

‘Anger is the fluid love bleeds when cut.’

C. S. Lewis

General Definition

Adjective: (of a substance) able to flow easily

Adjective: not settled or stable; likely or able to change

Scientific Definition

A substance that has no fixed shape and yields easily to external pressure; a gas or (especially) a liquid

Synonyms

Adaptable
Flexible
Fluent

Antonyms

Firm
Static
Rigid

General Example

The ballet dancer’s movements were fluid and beautiful to watch

Scientific Example

In steady fluid flow, the fluid’s density remains constant at every point.

Pressure in Fluids

Fluids are substances with **no fixed shape**.

Liquids and gases are fluids.

Fluid particles exert a **force** on any **surface** they collide with.

The force acts at right angles to the surface.

They are exerting a force on an area, so they are exerting pressure.

We can use the equation:

$$\textbf{pressure} = \frac{\textbf{force}}{\textbf{area}}$$

This is an equation you will need to **remember**.

Worked Example

A fluid exerts a force of 100 N over an area of 0.5 m^2.
Calculate the pressure on the surface.

This is an equation you will need to **remember**.

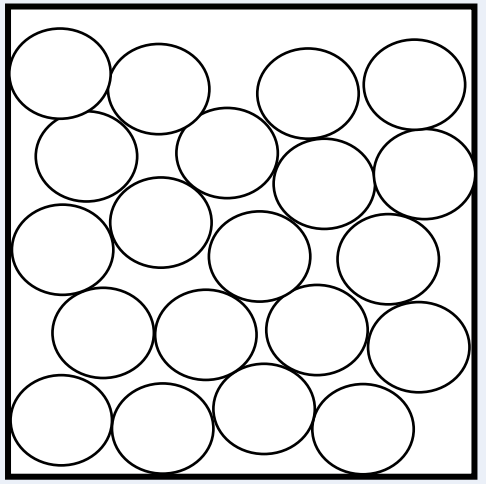
$$\mathbf{pressure} = \frac{\mathbf{force}}{\mathbf{area}}$$

$$\mathbf{pressure} = \frac{\mathbf{100\ N}}{\mathbf{0.5\ m^2}}$$

$$\mathbf{pressure} = \mathbf{200} \quad \mathbf{Pa\ or\ N/m^2}$$

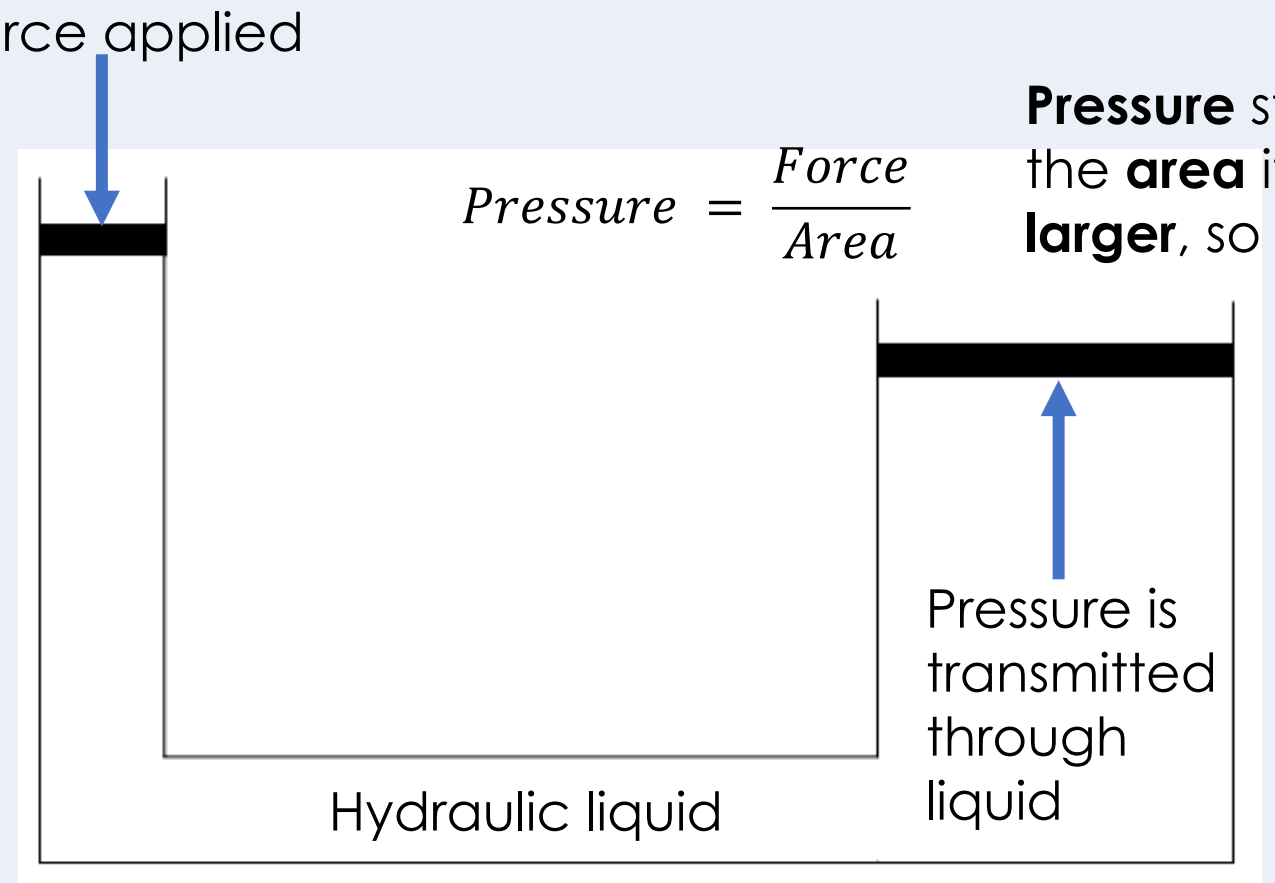
Hydraulic Systems

Particles of a fluid exert a force on any surface they collide with.



A **liquid** is a fluid that cannot be **compressed**, so liquids can be used in **hydraulic** systems.

$$Pressure = \frac{Force}{Area}$$



$$Pressure = \frac{Force}{Area}$$

Pressure stays the **same**, but the **area** it is acting on is **larger**, so the **force increases**

Liquid exerts a force on the other surface

Which statements do you agree with?

The larger the force applied, the greater the pressure

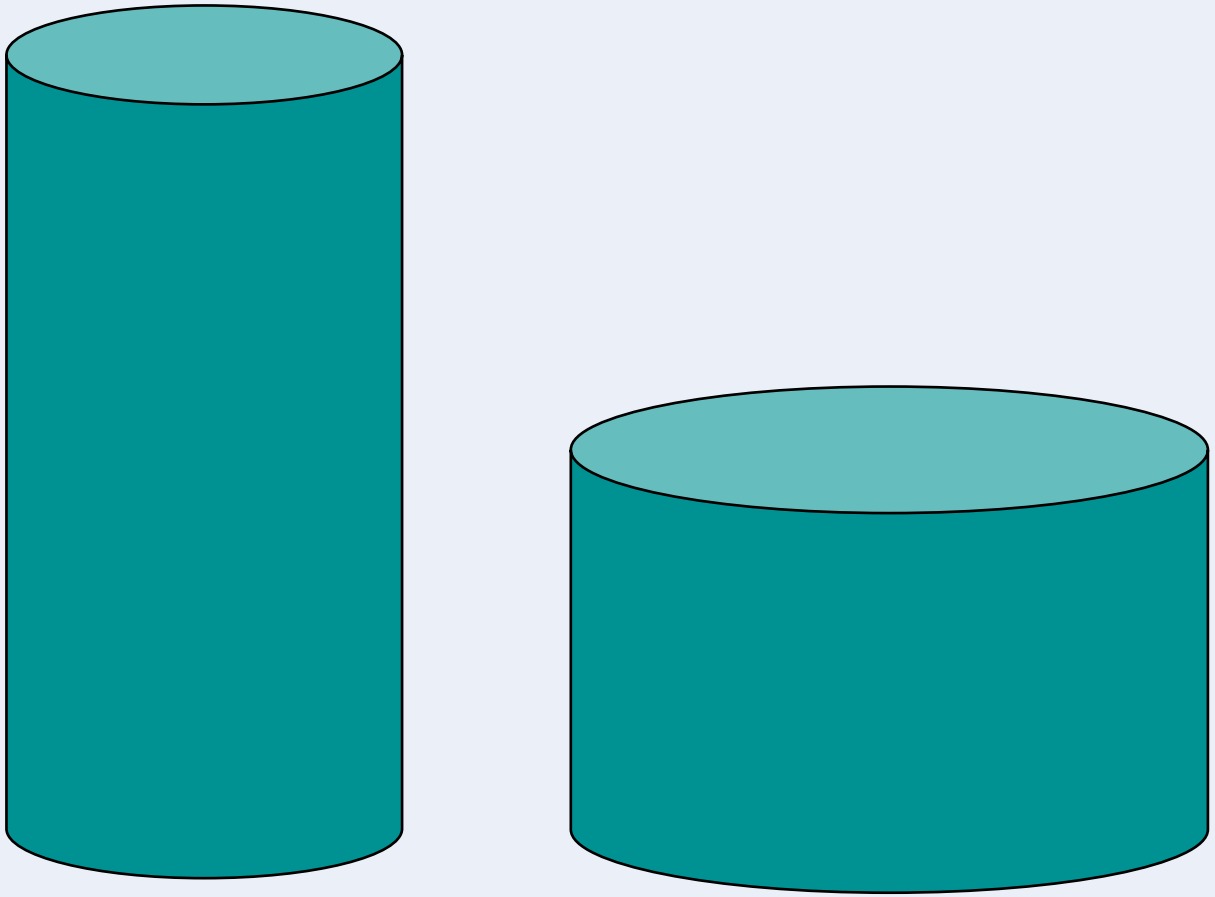
The larger the area the force acts on, the greater the pressure

Pressure is the force exerted per unit area

Fluids are liquids

Talk Task

Can you explain which design is better for a water storage tank?



Both of these tanks contain the same volume of water.

This means there is the same weight acting downwards on the bottom of each container.

Which is more likely to withstand the weight of the water?

Why?

Talk Task

Pressure, force and area

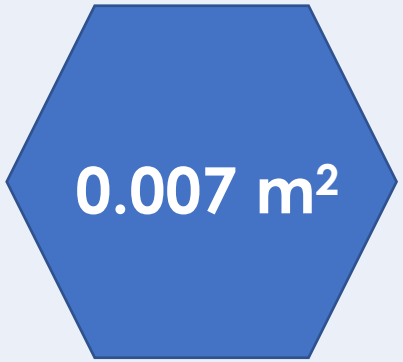
Talk Task

These water bottles all have different shapes but contain the same volume of water.

The bottom shape of each water bottle is shown and their cross-sectional areas.

Which water bottle will experience the greatest pressure from the water in it?

The bottle with the smallest cross-sectional area



The bottles each contain 500 ml of water, which has a mass of 500 g. Calculate the pressure exerted on round bottle.

$$W = mg$$

$$W = 0.5\ kg \times 10\ N/kg$$

$$W = 5\ N$$

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

$$p = \frac{5}{0.005}$$

$$p = 1000\ Pa$$

Drill

1. State the equation that links pressure, force and area.
2. State the units for force.
3. State the units for area.
4. State the units for pressure.
5. Describe the effect of increasing the force on the pressure.
6. Describe the effect of increasing the area on the pressure.
7. State the property of liquids that makes them useful in hydraulic systems.
8. Explain why this property makes them useful in hydraulic systems.

Check for understanding

Drill answers

1. $\text{Pressure} = \frac{\text{Force}}{\text{Area}}$
2. Newtons (N)
3. m^2
4. Pa (or N/m^2)
5. Increasing force increases pressure
6. Increasing area decreases pressure
7. They cannot be compressed
8. This means they can be used to transmit forces

Check for understanding

Answer the questions below.

1. What property of liquids makes them suitable for using in hydraulics?

- ☐ A. They can be compressed
- ☑ B. They cannot be compressed
- ☐ C. They do not have a fixed shape

2. Pressure is exerted by a fluid on a surface. If the area of the surface remains constant but a greater force is applied, what happens to the pressure?

- ☑ A. The pressure would increase
- ☐ B. The pressure would decrease
- ☐ C. The pressure would stay the same

3. What force would be exerted by a liquid with pressure 50 N/cm^2 on an area of 0.1 cm^2?

- ☑ A. 5 N
- ☐ B. 0.002 N
- ☐ C. 500 N

Exit ticket

Feedback

Lesson P4.1.5	
What was good about this lesson?	What can we do to improve this lesson?

Send us your feedback by clicking this link. Thank you!