Density

Answer the questions below.

1. Put the states of matter in order of increasing internal energy.
   Solid→ liquid → gas
2. In which state of matter are particles held most tightly together?
   Solid
3. Compare the arrangement of of particles in liquids and gases.
   Particles in a liquid are held close together in an irregular arrangement but particles in a gas are spread randomly.
4. Define internal energy.

   The sum of all the kinetic and potential energy of all the particles in a system.
5. Name a piece of apparatus that can be used to measure the volume of a liquid.

   Measuring cylinder, pipette, beaker

Do Now

Density

Do Now:

1. Put the states of matter in order of increasing internal energy.
2. In which state of matter are particles held most tightly together?
3. Compare the arrangement of of particles in liquids and gases.
4. Define internal energy.
5. Name a piece of apparatus that can be used to measure the volume of a liquid.

Drill:

1. State the formula to calculate the volume of a cube.
2. Calculate the volume of a cube with sides of length 4 cm.
3. Calculate the surface area of the cube in Q2.

Do Now

Density

Read Now:

Matter makes up everything, and matter is made of atoms. Atoms can exist individually or as part of compounds or molecules. When we talk about matter, we can describe all these different arrangements of atoms as 'particles'. Density is a fundamental property of matter. It describes how close together the particles are, specifically the mass of particles within a given volume. The SI unit for mass is the kilogram, but often in chemistry the masses we work with are so small that we can use the gram.

1. Explain what matter is made of.
2. Define density.
3. State the SI unit of mass.
4. Identify which state of matter is the most dense.
5. How many grams are in 1 kg?

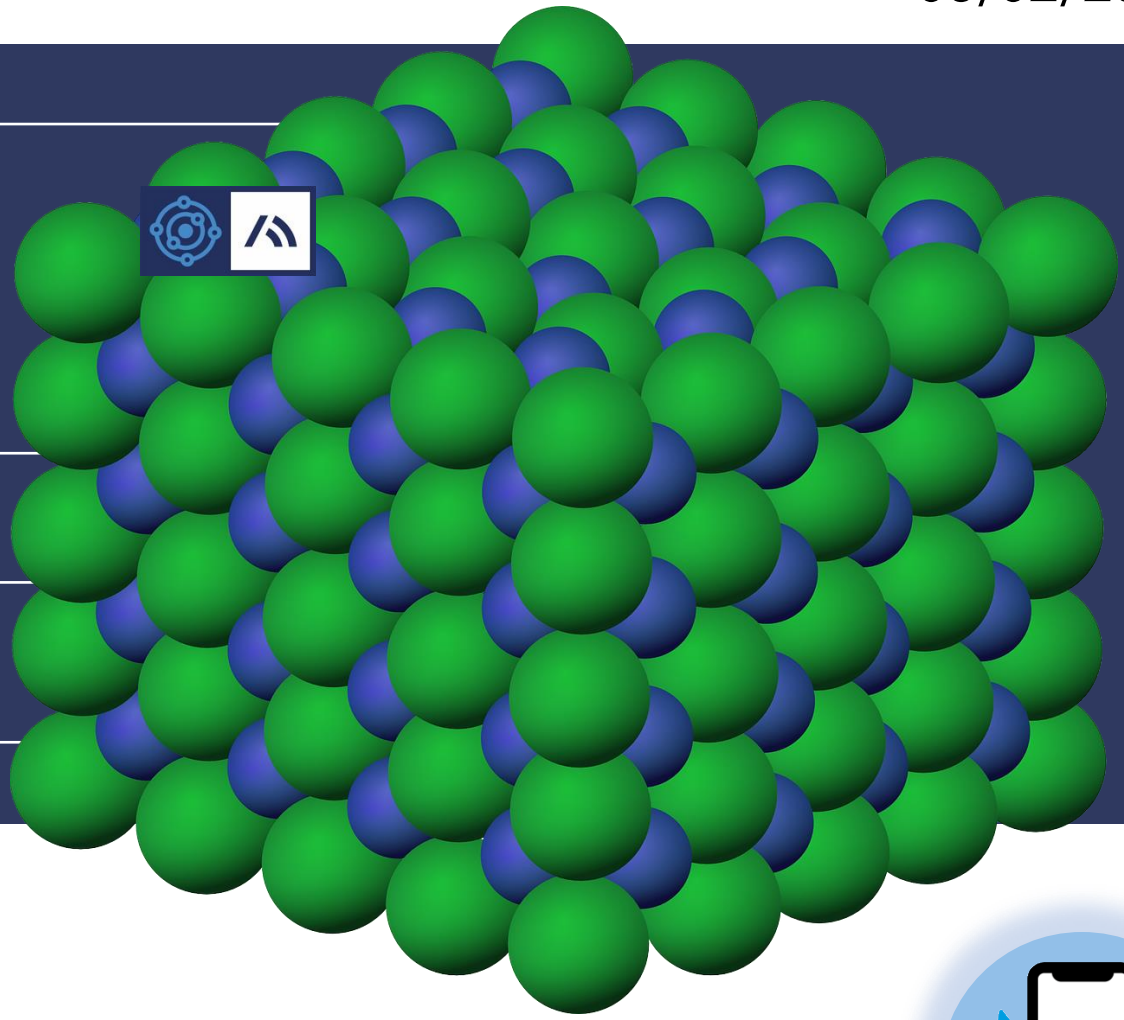
Do Now

03/02/2025

Density

P4.1.2

Science Mastery

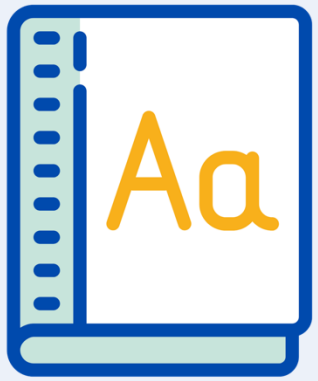


Lesson Objectives

Following this lesson, students will be able to:

- Define density
- Calculate the density of regularly shaped solids
- Compare the density of objects with the same mass or the same volume

Key Words:



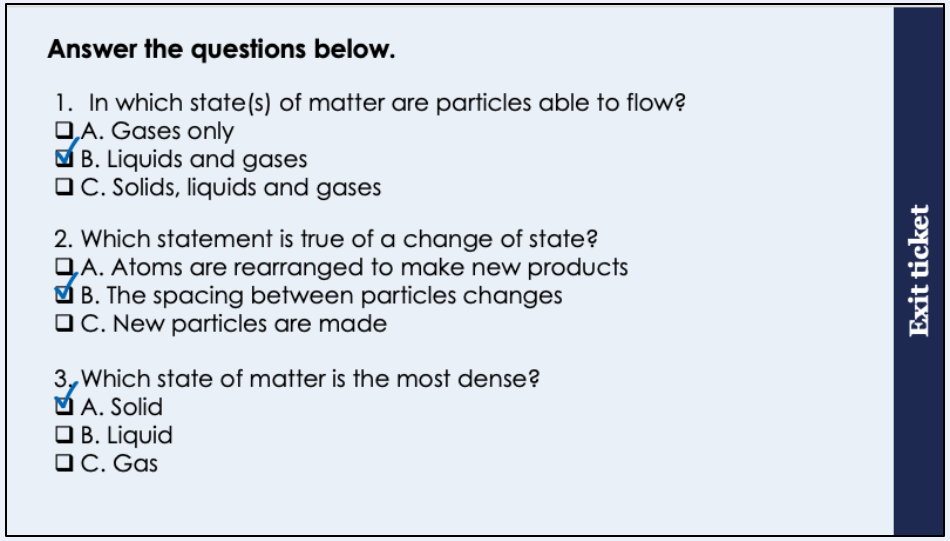
density | **mass** | **volume**

regular

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.

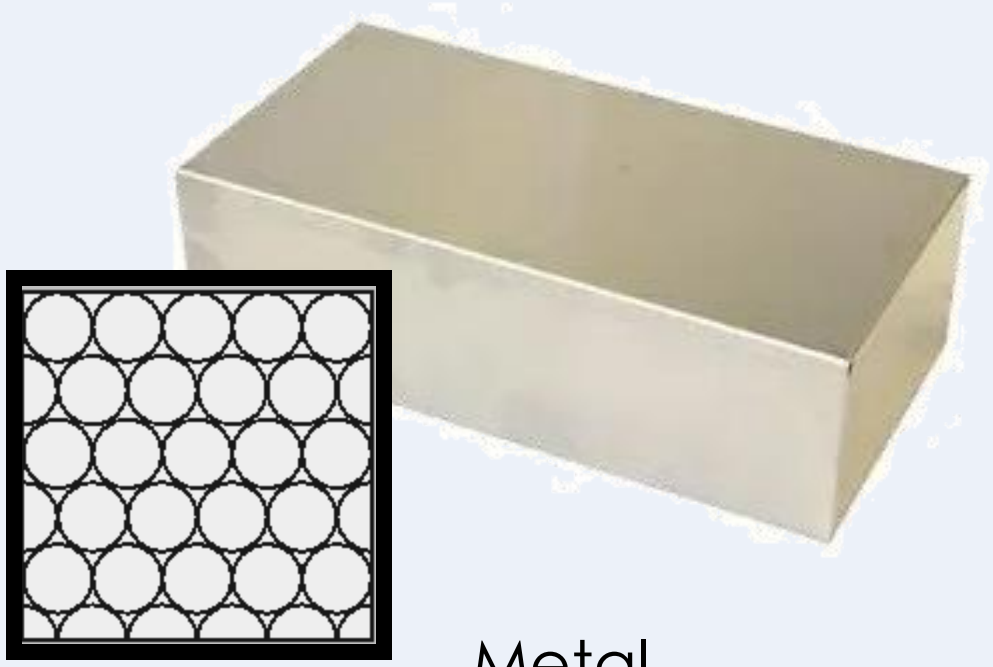


Fix-it

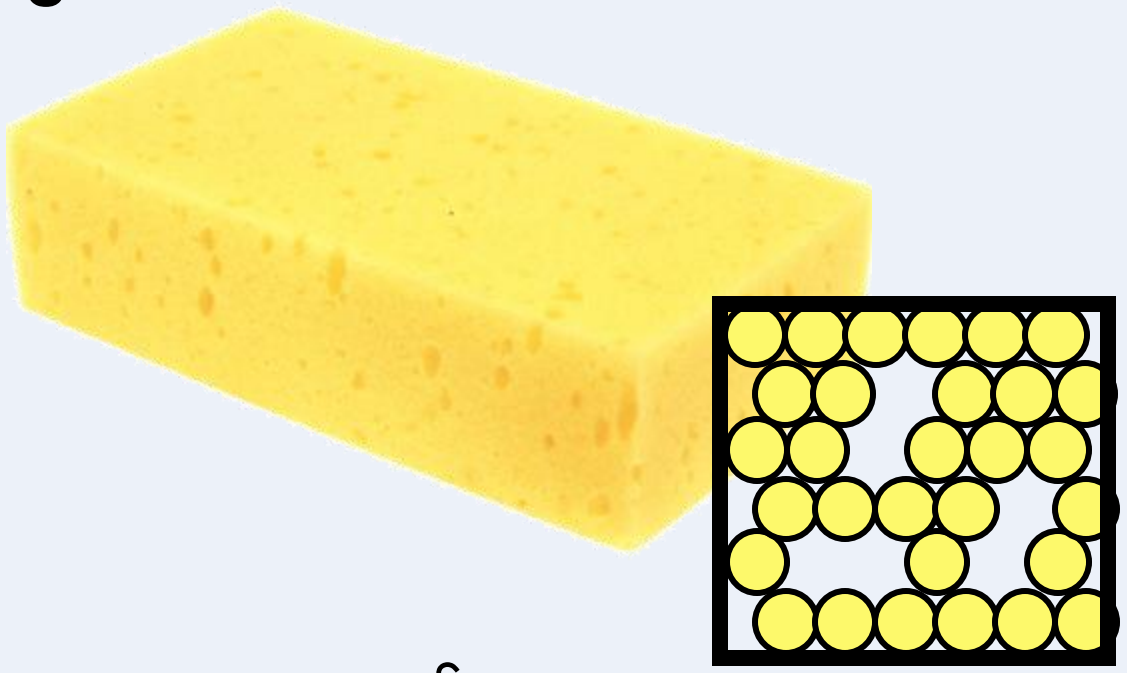
Float or sink?

These items take up the same amount of space. They have the same *volume*.

Would you expect them both to sink or float in water?
Why is this? Clue: Sketch a particle diagrams for each item.



Metal

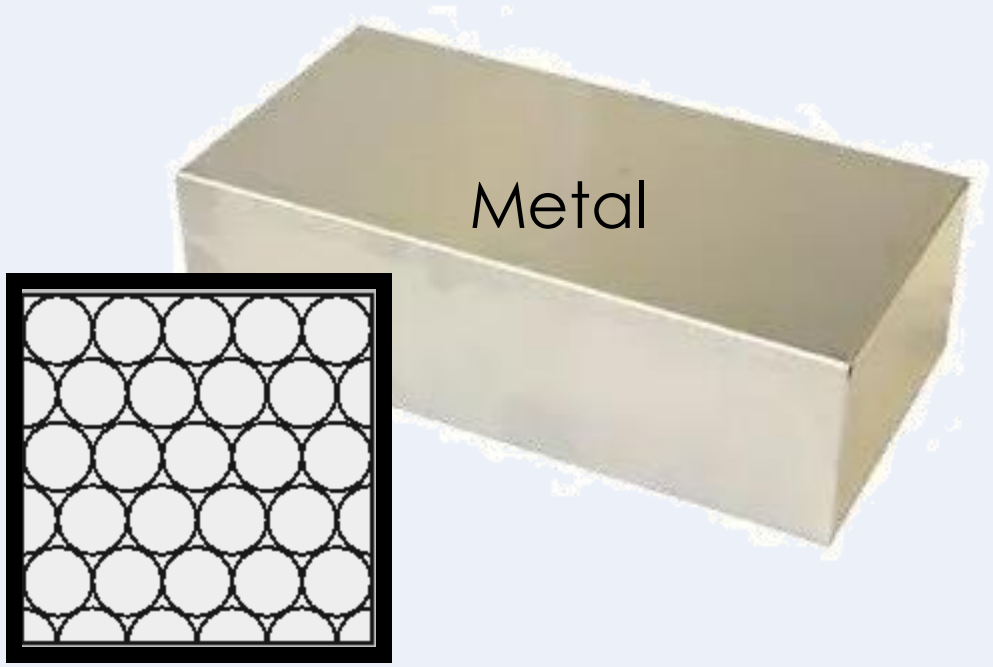


Sponge

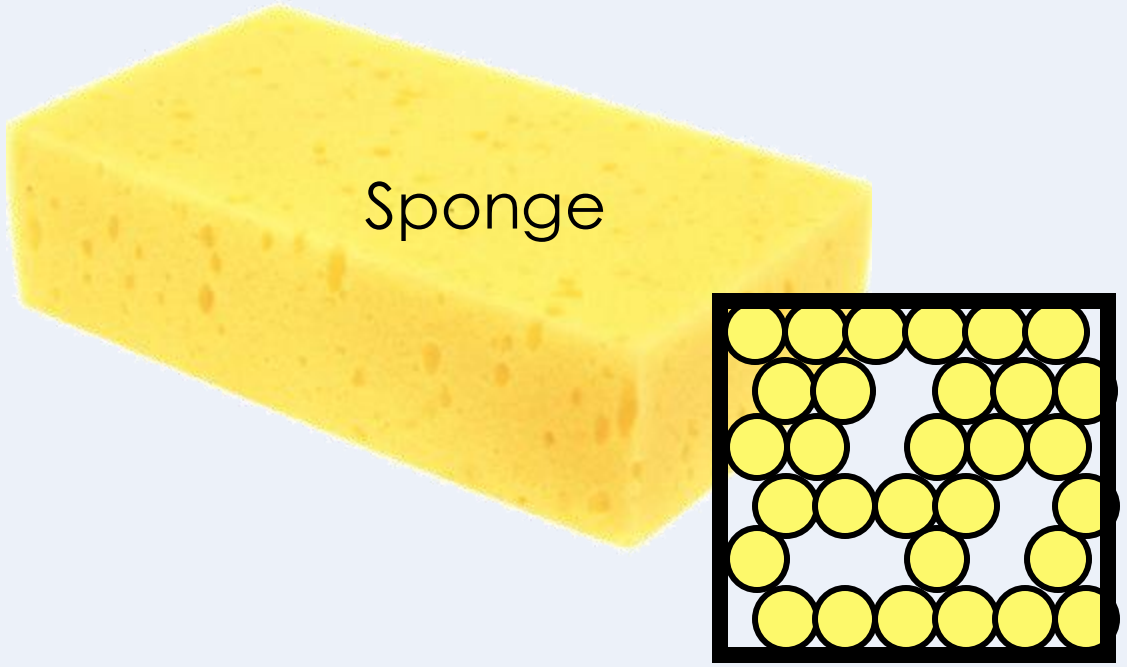
Density

The **density** of an object is the **mass per unit volume**.

This means **how much matter** (particles) is packed into **a certain volume.**



Higher density:
More particles in a given volume



Lower density:
Fewer particles in a given volume

Calculating Density

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

In order to calculate the density of an object, we need to know its **mass** and **volume**.

Mass (m) is measured in **kilograms** (**g**).
Volume (V) is measured in **metres cubed** (**m^3**).

$$\rho = \frac{m}{V}$$

Mass
measured in (kg)

Density
measured in (kg/m^3)

Volume
measured in (m^3)

Calculating Density

A block of metal has a mass of 12 kg. The volume of the block is 0.002 m^3.
Calculate the density of the block.

Answer:

Mass: 12 kg
Volume: 0.002 m^3.

$$\rho = \frac{m}{v}$$

$$\rho = \frac{12}{0.002}$$

$$\rho = 6000 \text{ kg/m}^3$$

Comparing Density

Metal

Sponge

The metal block has a density of 6000 kg/m^3.

Would you expect the density of the sponge to be greater or less than 6000 kg/m^3?

What would you expect when you compared the mass of the two objects?

Converting between cm^3 and m^3

How many cm are there in 1 m?

100

What is the volume of this shape in cm^3?

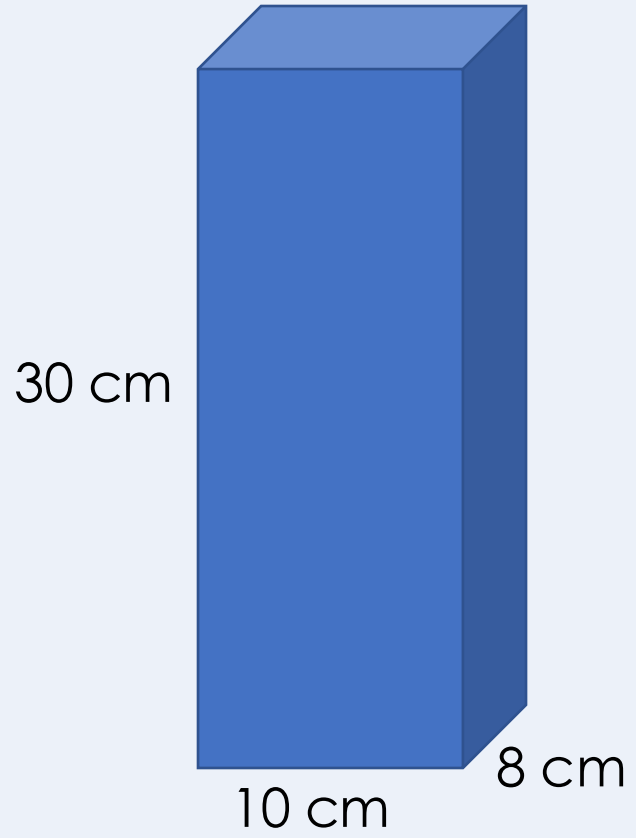
30 x 10 x 8
= 2400 cm^3

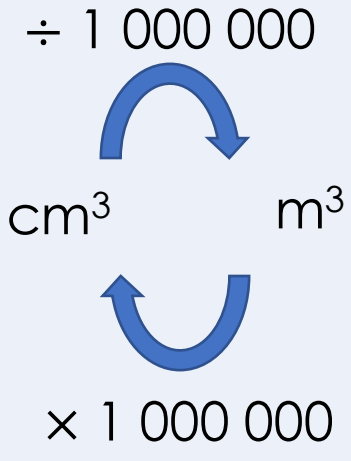
What is the volume of this shape in m^3?

Convert each length into m first
0.3 x 0.1 x 0.08
= 0.0024 m^3

2400/0.0024 = 1 000 000

This factors in the conversion of the three quantities.





Which statements do you agree with?

Density is a measure of how heavy something is

To calculate density, use the weight and volume of an object

Density is a measure of how closely packed particles are

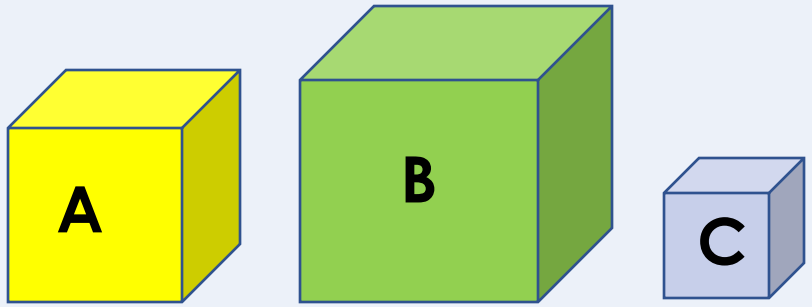
Density = mass x volume

Talk Task

Comparing Density

These three cubes are made of **different materials**.

They all have the **same mass**.



What can be said about the density of these cubes?

Describe a method you could use to calculate the density of each.

Stretch:
If all the cubes had the same density, what would you expect to note of their masses?

Talk Task

Density and the states of matter

What happens to the density of a substance during a change of state?

What happens to the density of a substance when it freezes?

What happens to the density of a substance when it boils?

Why?

Are there any exceptions?

Talk Task

Density column

This image shows a density column. Different liquids are added to a test tube and then left to settle.

After a period of time, the different substances form layers.

By which property have these substances been separated?

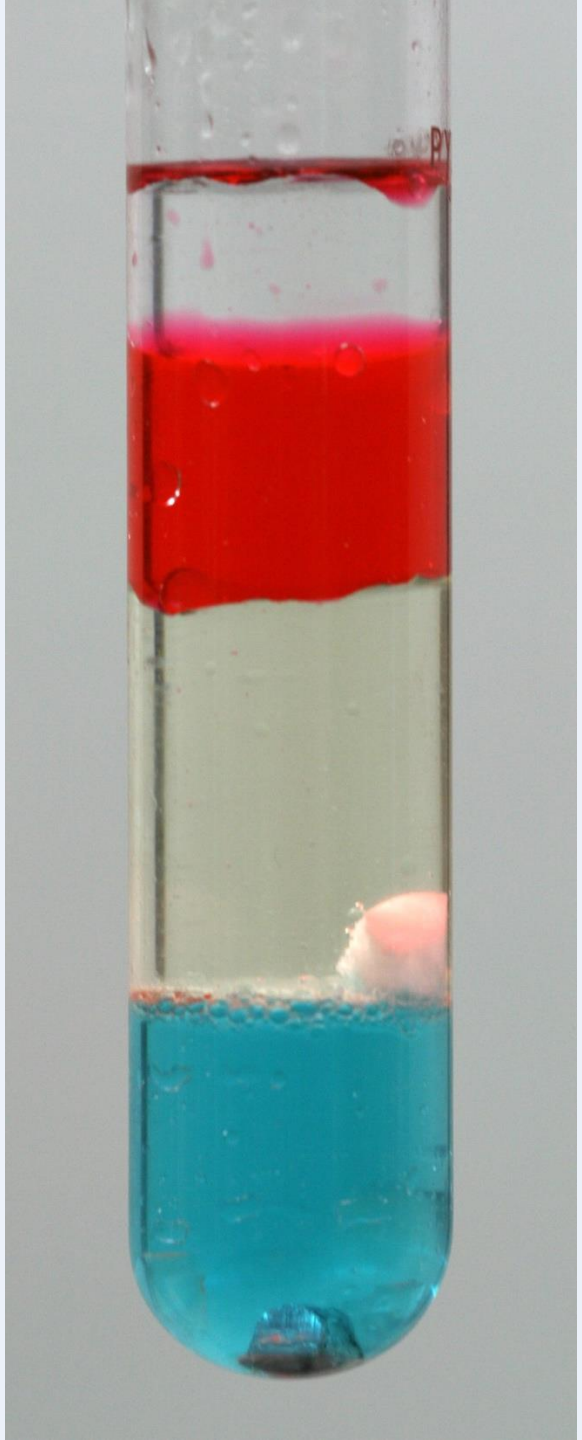
Density

Which liquid is the most dense? How do you know this?

The blue liquid, as it is has settled at the bottom.

How would the particle arrangement differ between the red and blue liquids

Both are liquids, so the particle diagrams would look similar, but there would be more particles per unit volume in the blue liquid.



Talk Task

Drill

1. Define density.
2. Explain what density means in terms of particles.
3. Identify the state of matter which has the greatest density.
4. State the equation used to calculate density.
5. State the SI unit for mass.
6. State the SI unit for volume.
7. State the equation used to calculate the volume of a regularly-shaped solid.

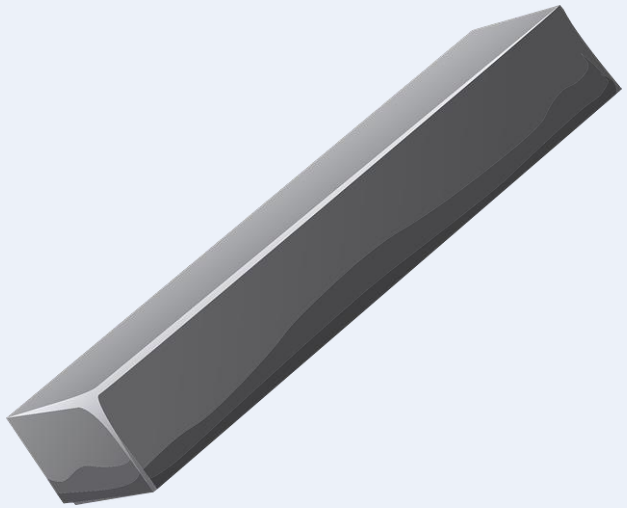
Check for understanding

Drill answers

1. The mass per unit volume.
2. Density is a measure of how closely packed particles are in a volume.
3. Solid
4. $\rho = \frac{m}{V}$
5. kg
6. m^3
7. $V = lbh$

Check for understanding

I: Calculating mass, volume and density



This block of steel has a mass of 23 550 g and a volume of 3000 cm^3.

Calculate the density of the steel.

What is the equation that links density, mass and volume?

Density = $\frac{\text{Mass}}{\text{Volume}}$

Density = $\frac{23\ 550}{3\ 000}$

Density = 7.85 g/cm^3

Another block of the same type of steel has a mass of 14 130 g. Calculate its volume.

Density = $\frac{\text{Mass}}{\text{Volume}}$

7.85 = $\frac{14\ 130}{\text{Volume}}$

Volume = $\frac{14\ 130}{7.85}$

Volume = 1 800 cm^3

Apply

We: Calculating mass, volume and density

This snooker ball has a mass of 160 g and a volume of 92 cm^3.

Calculate the density of the ball.

What is the equation that links density, mass and volume?

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

$$\text{Density} = \frac{160}{92}$$

$$\text{Density} = 1.74 \text{ g/cm}^3$$

A different manufacturer makes snooker balls with the same density. Calculate the mass of a ball that has a volume of 98 cm^3.

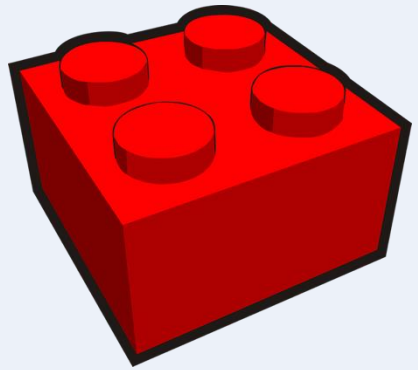
$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

$$1.74 = \frac{\text{Mass}}{98}$$

$$\text{Mass} = 170.52 \text{ g}$$

Apply

You: Calculating mass, volume and density



This plastic building block has a volume of 2.2 cm^3. Its mass is 1.25 g.

Calculate the density of the block.

What is the equation that links density, mass and volume?

Density = $\frac{\text{Mass}}{\text{Volume}}$

Density = $\frac{1.25}{2.2}$

Density = 0.57 g/cm^3

The same material is used to make a brick that is double the volume.

Calculate the mass of the bigger brick.

Density = $\frac{\text{Mass}}{\text{Volume}}$

0.57 = $\frac{\text{Mass}}{4.4}$

Mass = 2.5 g

Apply

Answer the questions below.

1. Which statement is correct?

- ☐ A. Density is a measure of how heavy the particles in a substance are
- ☑ B. Density is a measure of how many particles are in a given volume
- ☐ C. Density is a measure of how many particles there are in a substance

2. Two cubes have the same volume but different masses. Which statement is correct?

- ☐ A. The cube with the least mass is the most dense
- ☐ B. Both the cubes have the same density
- ☑ C. The cube with the greatest mass is the most dense

3. What is the mass of a block of iron that has a volume of 1 m^3? Iron has a density of 7800 kg/m^3.

- ☑ A. 7800 kg
- ☐ B. 7.8 kg
- ☐ C. 0.000128 kg

Exit ticket

Feedback

Lesson P4.1.2	
What was good about this lesson?	What can we do to improve this lesson?

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