

**Science 8**  
**Unit 2: FLUIDS**  
**Topic 4: Introduction To Density**

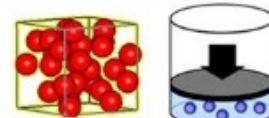


Student Name: \_\_\_\_\_

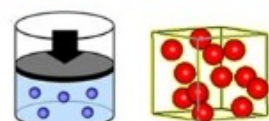
---

**Density:** is the amount of mass in a certain unit volume of a substance. It describes how closely packed together the particles are in a material. High density indicates that the particles are packed together closely.

**More Dense**

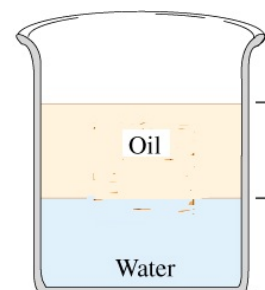


**Less Dense**



**How can you compare the density of liquids?**

Less dense liquids float on top of denser liquids. For example, olive oil is less dense than water. If you add olive oil and water to a glass, the olive oil would float on top of the water.



**Effects of Temperature on Density**

The particle theory states that the particles of a substance spread out as they gain energy when heated. Hence, the particles take up more space, which means that the density of a substance decreases.

Greater the temperature => Less dense a substance becomes

Cooler the temperature => more dense a substance becomes

Think of a hot air balloon. As energy is added to the air inside the balloon, the heated air gets less dense than the air outside the balloon. That is why a hot air balloon floats.

**Why does water break the rule?**

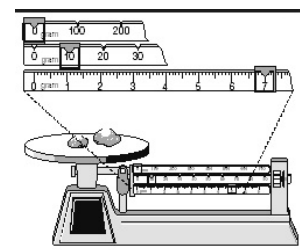
Most substances are denser in their solid form, water is an exception to this rule. When water freezes, the particles move slightly farther apart as they become fixed in position. This means that ice is actually less dense than liquid water, so it floats. This why a pond freezes at the surface.

## Measuring Density

Both mass and volume are required when calculating density.

### Mass:

Mass can be measured using a scale or balance.



### Volume:

For objects that are block shaped, volume can be calculated by measuring the block and then using the equation:

$$\text{volume} = \text{length} \times \text{width} \times \text{height}.$$

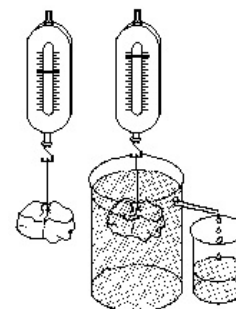
For objects with irregular shape displacement is the method used to find the volume.

### Calculating Density:

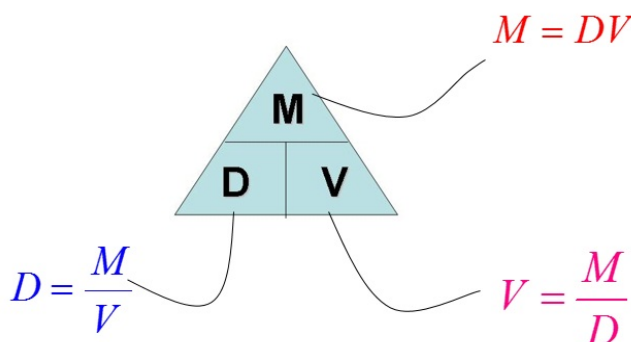
Density can be calculated using the following formula:

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

Overflow can



A triangle can be used to rearrange the formula:


$$M = DV$$
$$D = \frac{M}{V}$$
$$V = \frac{M}{D}$$

The mass units for solids, liquids, and gases are often grams (g) or kilograms (kg). If the object is a solid, the volume units are often cubic centimetres (cm<sup>3</sup>). For example, a density of 11g/cm<sup>3</sup>. Water has a density of 1 g/mL. If the object is a fluid, the volume units are often millilitres (mL).

Example 1:

What is the density of a 4 cm<sup>3</sup> rock that has a mass of 24 g?



Example 2:

A 5 ml sample of motor oil has a mass of 4.5 g. What is the density of the motor oil?



Example 3:

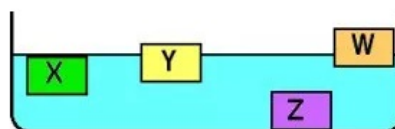
Complete the chart:

Substance	Mass(grams)	Volume( $\text{cm}^3$ )	Density( $\text{g}/\text{cm}^3$ )
Salt	20.00	9.26	
Gold	0.72		19.32
Wood $\nabla$ (Birch)		8.00	0.66

**PART A: MULTIPLE CHOICE.**

Instruction: Circle the correct answer below each question. Also, transfer your answers to the bubble sheet provided.

- Density is a characteristic property of a substance. This means that the density of water
  - Changes depending on the volume
  - Stays the same regardless of the volume
  - Is greater for a greater mass of water
  - Is less for a smaller mass of water
- A person can float in the water of the Dead Sea. Why can a person do this?
  - The density of the saltwater is greater than the man's density.
  - He is not a very heavy person.
  - This person must be lying on a submerged airbed.
  - His body is more dense than the density of the saltwater.
- The diagram shows four different substances which have been placed in a basin of water. Which one of the following statements is TRUE

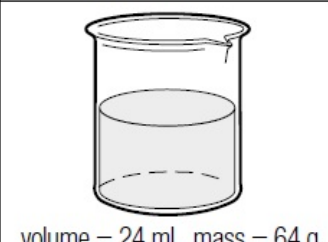
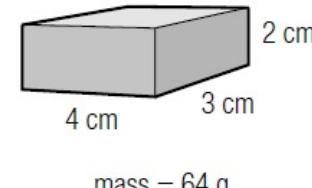


- X has the same density as the water, and W is the least dense.
  - Z is the densest and Y is the second densest.
  - W is more dense than Y and the density of X is equal to  $1 \text{ g}/\text{cm}^3$ .
  - X is the least dense and Z is the most dense.
- Which one of the following statements is CORRECT?
    - The iceberg contains a lot of trapped air which keeps the block afloat.
    - The density of an iceberg and seawater are equal.
    - The seawater's density must be less than that of the iceberg.
    - The density of the iceberg is less than the density of the seawater.
  - An object should float in a liquid if it is
    - More dense than the liquid
    - Less dense than the liquid
    - Lighter than metal
    - Shaped like a ball
  - A tiny piece of sand is very light but sinks in water. This is because
    - Sand is a solid
    - Sand is less dense than water
    - There is more water than sand
    - Sand is more dense than water

7. Whether or not an object floats in water will depend upon both its
- (A) Mass and volume
  - (B) Density and width
  - (C) Length and mass
  - (D) Volume and colour
8. If two objects have the same volume but one has a greater mass, the one with greater mass
- (A) Has a lower density
  - (B) Has a higher density
  - (C) Will float
  - (D) Will sink
9. If two objects have the same volume but one is made up of smaller and heavier atoms, the one with small heavy atoms will
- (A) Be larger than the other
  - (B) Be less dense than the other
  - (C) Be more dense than the other
  - (D) Float
10. If you cut a wooden block in half, each half would have
- (A) Half the density of the original piece
  - (B) Twice the density of the original piece
  - (C) The same density as the original piece
  - (D) No density at all
11. If two objects have the same mass but different volumes
- (A) The one with the larger volume has the lower density
  - (B) They must have the same density
  - (C) The one with the larger volume has the higher density
  - (D) The one with the larger volume is twice as dense
12. Wood floats in water. If you measured the mass of the same volume of wood and water
- (A) The water would have a greater mass
  - (B) The water would have a lower mass
  - (C) The mass of the wood and water would be the same
  - (D) The mass of the wood and water would both be 100 grams
13. A candle floats in water but sinks in alcohol. This is because
- (A) The candle has less mass in alcohol
  - (B) The water has less mass than the alcohol
  - (C) The water is more dense than the alcohol
  - (D) Water and alcohol are both liquids
14. Which one of the following conditions will cause the density of a liquid to decrease?
- (A) Cooling the liquid
  - (B) Heating the liquid
  - (C) Dividing the liquid into two equal volumes
  - (D) Adding more of the liquid to the container
15. The density of hot liquid
- (A) Is greater than the density of cold liquid
  - (B) Is less than the density of cold liquid
  - (C) The same as the density of cold liquid
  - (D) Depends on the volume of liquid

16. The density of hot and cold liquids are different mainly because
- (A) The molecules in hot liquids move slower and are slightly closer together
  - (B) The molecules in hot liquids are larger
  - (C) The molecules in hot liquids move faster and are slightly further apart
  - (D) The molecules in cold liquids move faster and are further apart
17. How would you determine the volume of an irregularly-shaped rock?
- (A) Put the rock on a triple beam balance.
  - (B) Determine the density of the object and divide it by its mass.
  - (C) Use a ruler to measure its length, width, and height. Then multiply the dimensions together.
  - (D) Put the rock in a graduated cylinder filled with water and see how much water is displaced
18. The density of an object is
- (A) The mass divided by the volume  $D = m/v$
  - (B) The volume divided by the mass  $D = v/m$
  - (C) The same as its weight
  - (D) The same as the size of the object
19. Which one of the following is not a unit of density?
- (A)  $\text{kg/m}^3$
  - (B)  $\text{g/cm}^3$
  - (C)  $\text{kg/m}$
  - (D)  $\text{g/m}^3$

Use the following diagrams to answer questions 20 to 22.

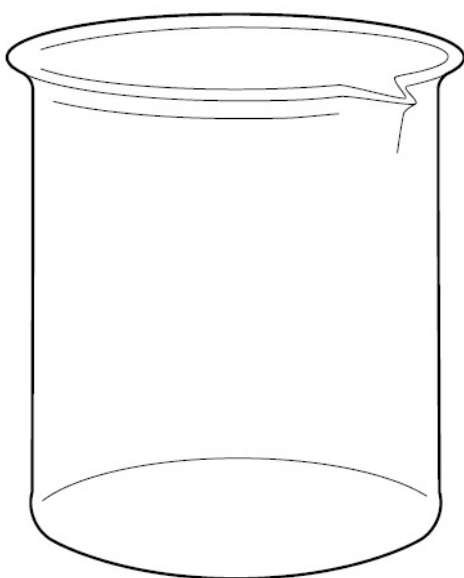
substance X	substance Y
	

20. The volume of substance Y is  $24 \text{ cm}^3$ .
- (A) The statement is true.
  - (B) The statement is false.
  - (C) There is not enough information to determine the density.
21. Which of the following compares the density of substance X and substance Y?
- (A) Substance X is denser than substance Y.
  - (B) Substance Y is denser than substance X.
  - (C) Both substances have the same density.
22. If substance Y is placed in a beaker of water ( $1.00 \text{ g/cm}^3$ ), what will happen?
- (A) Substance Y will sink in water.
  - (B) Substance Y will float on water.
  - (C) Substance Y will dissolve in water.

23. Which of the following metals will sink in a basin of mercury whose density is  $13.6 \text{ g/cm}^3$ ?
- (A) Iron of density  $7.9 \text{ g/cm}^3$
  - (B) Lead of density  $11.3 \text{ g/cm}^3$
  - (C) Uranium of density  $19.5 \text{ g/cm}^3$
  - (D) Aluminium of density  $2.7 \text{ g/cm}^3$
24. A graduated cylinder containing 50 mL of water has a mass of 70 g. As you put the object into the graduated cylinder, the water rises to 80 mL and the total mass increases to 90 g. What is the mass, volume, and density of the object?
- (A)  $m = 20 \text{ g}$ ;  $V = 10 \text{ mL}$ ;  $D = 2 \text{ g/mL}$
  - (B)  $m = 20 \text{ g}$ ;  $V = 30 \text{ mL}$ ;  $D = 1.5 \text{ g/mL}$
  - (C)  $m = 20 \text{ g}$ ;  $V = 30 \text{ mL}$ ;  $D = 0.6 \text{ g/mL}$
  - (D)  $m = 30 \text{ g}$ ;  $V = 20 \text{ mL}$ ;  $D = 1.5 \text{ g/mL}$

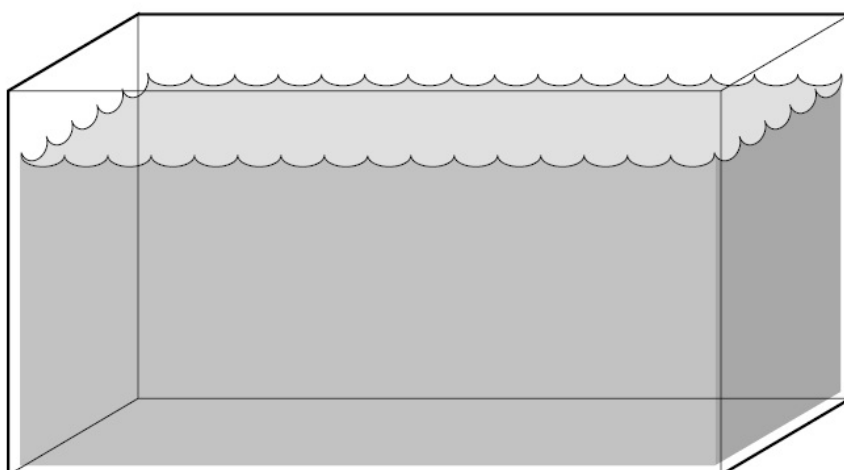
**PART B: SHORT AND LONG ANSWER**

1. The table below lists the densities of five different fluids. If the fluids were added to a beaker, how would they be layered? Draw and label the layers in the beaker below.



Substance	Density (g/mL)
gasoline	0.69
glycerol	1.26
corn syrup	1.40
vegetable oil	0.92
rubbing alcohol	0.79

2. Water has a density of  $1.00 \text{ g/mL}$ . Draw and label each of the following objects in the tank of water. Show whether they will sink or float.




Object	Density
cork	$0.24 \text{ g/cm}^3$
ice	$0.92 \text{ g/cm}^3$
gold ring	$19.32 \text{ g/cm}^3$
block of wood	$0.66 \text{ g/cm}^3$
marble	$2.5 \text{ g/cm}^3$

3. Use your detective skills to find the identity of the mystery objects. First calculate the density of the object. Then use the Table of Densities to decide what the object is made of.


**Table of Densities**

Solids	Density (g/cm <sup>3</sup> )	Solids	Density (g/cm <sup>3</sup> )
marble	2.56	copper	8.92
quartz	2.64	gold	19.32
diamond	3.52	platinum	21.4

1.  While digging in the backyard, you find an old coin. Its mass is 26.76 g and its volume is 3 cm<sup>3</sup>. What is the density of the coin?


Calculation:

What is the coin made of? \_\_\_\_\_

2.  You think you have found a diamond. Its mass is 5.28 g, and its volume is 2 cm<sup>3</sup>. What is the density of the object?

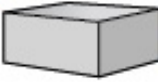
Calculation:

What did you find? \_\_\_\_\_

3.  You find a ring with a mass of 107 g. You fill a graduated cylinder up with 10 mL of water and put the ring into the cylinder. The water rises up to the 15 mL mark. What is the density of the ring?

Calculation:

What is the ring made of? \_\_\_\_\_

4.  There is a block on your desk that acts as a paperweight. Its measurements are: 3 cm by 4 cm by 6 cm. The block has a mass of 184.32 g. What is the density of the block?

Calculation:

What is the block made of? \_\_\_\_\_