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The National
Orthodox School
Shmaisani

Revision Sheet | Lower Secondary
Stage (6-8)

1st Semester | 2023-2024

Subject: Chemistry   **Chapter:** Periodic trends/ Density
Objectives:

- Define Density
- Learn how to calculate density
- Differentiate between the density of regular and irregular solids
- Examine how to calculate the density of liquids

What is Density?

Density is defined as the mass (amount of matter) of a substance that is found in a certain volume.

How do we calculate density?

1- $DENSITY = \frac{MASS}{VOLUME} = kg/m^3$ OR g/cm^3

To solve density problems, list the known and unknown values, then use one of the following.

▸ When a problem requires you to calculate density, use the density equation, $\boxed{D = \dfrac{M}{V}}$

▸ You can solve for mass by multiplying both sides of the density equation by volume.

$$D V = \frac{M \cancel{V}}{\cancel{V}} \quad \text{or} \quad \boxed{M = D V}$$

▸ You can solve for volume by dividing both sides of the equation above by density.

$$\frac{M}{D} = \frac{\cancel{D} V}{\cancel{D}} \quad \text{or} \quad \boxed{V = \frac{M}{D}}$$

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Practice questions

1) A metal cylinder has a mass of 6.20g and a volume of 124 cm³. What is the density of the cylinder?

$$D = \frac{m}{v} = \frac{6.2}{124} = 0.05 \; g/cm^3$$

2) What is the mass of an object that has a density of $8\frac{g}{cm^3}$ and a volume of 64 cm³?

$$m = D \times V = 8 \times 64 = 512g$$

3) A piece of tin has a mass of 16.52 g and a volume of 2.26 cm^3. What is the density of tin?

$$D = \frac{m}{V} = \frac{16.52}{2.26} = 7.31 \; g/cm^3$$

4) A man has a 50.0 cm^3 bottle completely filled with 163 g of a slimy green liquid. What is the density of the liquid?
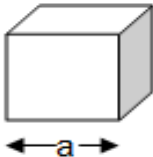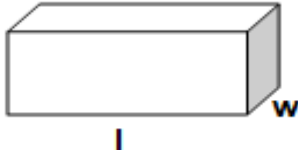
$$D = \frac{m}{V} = \frac{163}{50} = 3.26 g/cm^3$$

5) What is the volume of 325 g of metal with a density of 9.0 g/ cm^3?

$$V = \frac{m}{D} = \frac{325}{9} = 36.11 \; cm^3$$

Density of regular shaped object/cube

To find the volume of a regular- shaped solid, we use the following rule:

Length x Width x Height (L x W x H)

Figure	Formula	Variables
Cube	a^3	a = length of edge
Rectangular prism	$l \times w \times h$	l = length w = width h = height

Example:

Find the volume of cube has a length of 3 cm.

Solution: V = 3 x 3 x 3 = 27 cm^3.

Check you understanding:

1) A rectangular fish tank is 60.00 m long, 200.00 m wide, and 200.00 m deep.

(a) What volume of water can it hold?

$m = L \times w \times h$

$60 \times 200 \times 200 = 2400000 = 2.4 \times 10^6 \ m^3$

(b) What is the mass of the water?

$m = D \times V$

$10^3 \times 2.4 \times 10^6 = 2.4 \times 10^9 \ kg$

1) Calculate the density of a 500 g rectangular block with the following dimensions: length=8 cm, width=6 cm, height=5 cm.

$$V = l \times w \times h = 8 \times 6 \times 5 = 240 \; cm^3$$

$$D = \frac{m}{V} = \frac{500}{240} = 2.08 \; g/cm^3$$

2) A gold cube is 150.00 mm long, 10.00 cm wide, and 0.95 m thick. If gold has a density of 19.3 g/ cm^3, calculate the mass of the gold cube.

$$l = \frac{150mm}{10} = 15 \; cm$$

$$w = 10 \; cm$$

$$t = 0.95m \times 100 = 95 \; cm$$

$$V = l \times w \times t = 15 \times 10 \times 95 = 14{,}250 \; cm^3$$

$$m = D \times V = 19.3 \times 14250 = 275{,}025 \; g$$

Density of an irregularly shaped object

Use a graduated cylinder filled with a fluid to find the volume of the object.

a) Record the initial volume of fluid.

b) Drop the object into the graduated cylinder.

c)Record the volume of the fluid with the object.

To determine the volume:

volume of fluid with object – initial volume of fluid

Example:

A graduated cylinder is filled to the 30mL mark with water. You drop in a rock. The water level rises to 48mL.

Solution: V = 48mL – 30mL = 18mL= 18 cm^3

Check your understanding:

1) An irregular object with a mass of 118 g displaces 25mL of water when placed in a graduated cylinder. Calculate the density of the object.

$$D = \frac{m}{V} = \frac{118}{25} = 4.72 \, g/cm^3$$

2) A graduated cylinder is filled with water to a level of 40.0 mL. When a piece of copper is lowered into the cylinder, the water level rises to 63.4 mL. Find the volume of the copper sample. If the density of the copper is 8.9 g/cm3, what is its mass?

$$V_{copper} = V_2 - V_1 = 63.4 - 40 = 23.4ml = 23.4cm^3$$
$$m = D \times V = 8.9 \times 23.4 = 208.26 \, g$$

Density of Liquids

- Just like solids, liquids also have their own characteristic density.

- The volume of a liquid can be measured directly with a graduated cylinder.

- To measure the mass of the liquid we do the following:

  ➢ An empty measuring cylinder is put on a top- pan balance and its mass is found (M1)

  ➢ The liquid is poured into the measuring cylinder and the mass is found on the balance as (M2)
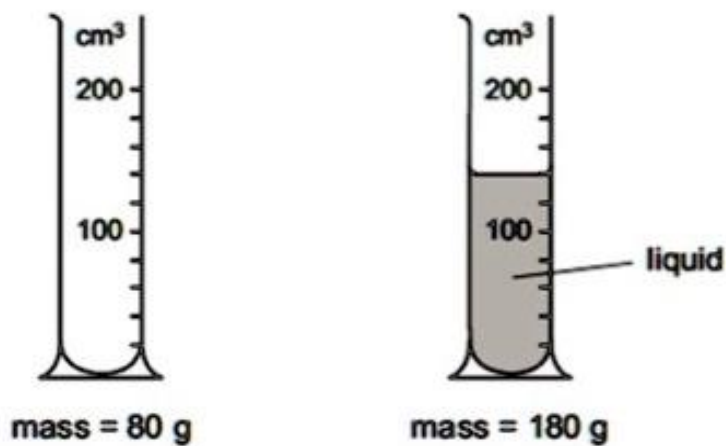
  ➢ Thus Mass= M2-M1

Check your understanding:

The diagram shows an experiment to find the density of a liquid.
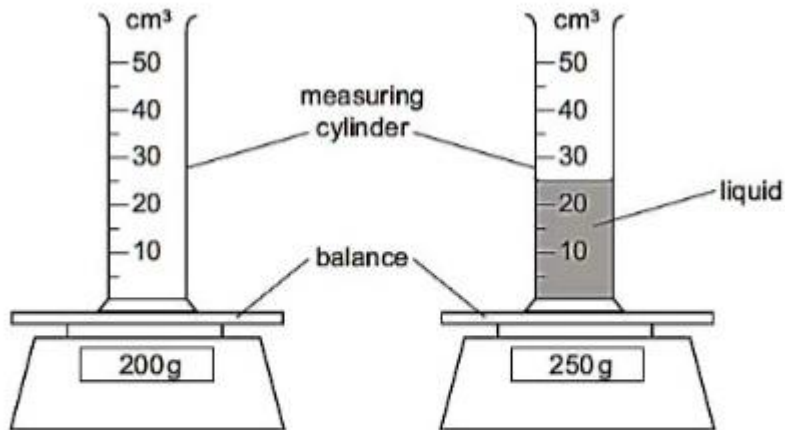
What is the density of the liquid?
   A. 0.5 g / cm³
➡ B. 2.0 g / cm³
   C. 8.0 g / cm³
   D. 10.0 g / cm³

The masses of a measuring cylinder before and after pouring some liquid into it are shown in the diagram.

mass = 80 g   mass = 180 g

What is the density of the liquid?

$$D = m/V = (180-80) / 140$$
$$= 100/140$$
$$= 0.71 \, g/cm^3$$