

WelTec/Whitireia Mathematics Series

Chemistry: Density and Specific Gravity Measurement

Density measurements are an essential part of health careers such as nursing, dental hygiene, nutrition and veterinary science. For example a nurse might need to calculate the bone density of a client, or a dentist might want to know the density of amalgam.

This hand-out is to get you using metric measures to solve nursing, and other health science trade related density problems.

Density

The density of an object is the mass of the object divided by its volume.

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

In the metric system, the densities of solids and liquids are usually measured in grams per cubic centimetres (g/cm^3). Since 1 millilitre (mL) has a volume of 1 cm^3 , then density can also be measured in g/mL .

The density of gases is usually measured in grams per litre (g/L).

Example 1

Find the density of cork if 5 grams of cork has a volume of 19.23 cm^3 .

Solution

$$\begin{aligned}\text{Density} &= \text{Mass} \div \text{Volume} \\ &= 5\text{g} \div 19.23\text{cm}^3 \\ &= 0.260 \text{ g}/\text{cm}^3 \\ &= 0.260 \text{ g}/\text{mL}\end{aligned}$$

Question 1

Find the density of aluminium if an 8 gram bar has a volume of 2.963 cm³.

$$\begin{aligned} \text{Density} &= \text{Mass} \div \text{Volume} \\ &= 8 \text{ g} \div 2.963 \text{ cm}^3 \\ &= 2.699 \text{ g/cm}^3 \\ &= 2.699 \text{ g/mL} \end{aligned}$$

Answer

Question 2

A copper sample has a mass of 44.65 grams (g) and a volume of 5.0 millilitres (mL). What is the density of copper?

$$\begin{aligned} \text{Density} &= \text{Mass} \div \text{Volume} \\ &= 44.65 \text{ g} \div 5.0 \text{ mL} \\ &= 8.93 \text{ g/mL} \end{aligned}$$

Answer

Question 3

A silver bar has a mass of 294 grams (g) and a volume of 28.0 cubic centimetres (cm³). What is the density of silver?

$$\begin{aligned} \text{Density} &= \text{Mass} \div \text{Volume} \\ &= 294 \text{ g} \div 28.0 \text{ cm}^3 \\ &= 10.5 \text{ g/cm}^3 \\ &= 10.5 \text{ g/mL} \end{aligned}$$

Answer

Specific Gravity

Specific gravity is the ratio between the density of a substance and the density of water. Specific gravity is calculated by dividing the density of a sample by the density of water, which is 1.00 g/mL at 4°C.

Example 2

What is the specific gravity of oil that has a density of 0.925 g/mL?

Solution

$$\begin{aligned}\text{Specific Gravity Oil} &= \text{Density of Oil} \div \text{Density of Water} \\ &= 0.925 \text{ g/mL} \div 1 \text{ g/mL} \\ &= 0.925\end{aligned}$$

Question 4

What is the specific gravity of ice if 35.0 grams of ice has a volume of 38.2 milliliters?

$$\begin{aligned}\text{Answer} \quad \text{Density of Ice} &= 35.0 \text{ g} \div 38.2 \text{ mL} \\ &= 0.916 \text{ g/mL} \\ \text{Sp Gr Ice} &= \frac{\text{Density of Ice}}{\text{Density of Water}} \\ &= 0.916 \text{ g/mL} \div 1 \text{ g/mL} \\ &= 0.916\end{aligned}$$

Question 5

What is the specific gravity of maple wood if it has a density of 0.75 g/mL?

{Hint: The density has been given to you}

$$\begin{aligned}\text{Answer} \quad \text{Density of maple Wood} &= 0.75 \text{ g/mL} \\ \text{Sp Gr Maple Wood} &= \frac{\text{Density Maple Wood}}{\text{Density Water}} \\ &= 0.75 \text{ g/mL} \div 1 \text{ g/mL} \\ &= 0.75\end{aligned}$$

Question 6

What is the specific gravity of cement if 9.0 grams of cement has a volume of 3.0 milliliters?

{Hint: Find the density first}

Answer
Density of Cement = $9.0 \text{ g} \div 3.0 \text{ mL}$
= 3.0 g/mL
Sp Gr Ice = $\frac{\text{Density of Ice}}{\text{Density of Water}}$
= $3.0 \text{ g/mL} \div 1 \text{ g/mL}$
= 3.0