

Calculation and density		
Density is the mass of 1 cm ³ substance		$\rho = \frac{m}{V}$ $m = V \times \rho$ $V = \frac{m}{\rho}$
Density ρ in g/cm ³	Gram per cubic centimeter	
mass m in g	Gram	
Volume V in cm ³	Cubic centimeter	
Example:		
<p><u>Mass</u> On the chessboard is a queen of copper with a volume of 3cm³. Calculate the mass of the Queen?</p> <p>m = ? V = 3 cm³ $\rho = 8,96 \text{ g/cm}^3$</p> <p>m = V x ρ m = 3 cm³ x 8,96 g/cm³ m = 27 g</p>	<p><u>Volume</u> On the chessboard is a pawn of 10g copper. Calculate the volume of the pawn.</p> <p>m = 20 g V = ? $\rho = 8,96 \text{ g/cm}^3$</p> <p>V = m : ρ V = 20 g : 8,96 g/cm³ V = 2,2 cm³</p>	<p><u>Density</u> On the chessboard is also a tower of a different colour. The tower weighs 21,2g and has a volume of 2.5 cm³. From what material is the tower made?</p> <p>m = 21,2 g V = 2,5 cm³ $\rho = ?$</p> <p>$\rho = m : V$ $\rho = 21,2 \text{ g} / 2,5 \text{ cm}^3$ $\rho = 8,5 \text{ g/cm}^3$</p> <p>The tower is made from Brass</p>

Exercise

- 1) A block of aluminium occupies a volume of 15.0 mL and weighs 40.5 g. What is its density?
- 2) Mercury metal is poured into a graduated cylinder that holds exactly 22.5 mL. The mercury used to fill the cylinder weighs 306.0 g. From this information, calculate the density of mercury.
- 3) What is the weight of the ethyl alcohol that exactly fills a 200.0 mL container? The density of ethyl alcohol is 0.789 g/mL.
- 4) A rectangular block of copper metal weighs 1896 g. The dimensions of the block are 8.4 cm by 5.5 cm by 4.6 cm. From this data, what is the density of copper?
- 5) A flask that weighs 345.8 g is filled with 225 mL of carbon tetrachloride. The weight of the flask and carbon tetrachloride is found to be 703.55 g. From this information, calculate the density of carbon tetrachloride.
- 6) Calculate the density of sulfuric acid if 35.4 mL of the acid weighs 65.14 g.
- 7) Find the mass of 250.0 mL of benzene. The density of benzene is 0.8786 g/mL.
- 8) A block of lead has dimensions of 4.50 cm by 5.20 cm by 6.00 cm. The block weighs 1591 g. From this information, calculate the density of lead.



- 9) 28.5 g of iron shot is added to a graduated cylinder containing 45.5 mL of water. The water level rises to the 49.1 mL mark, From this information, calculate the density of iron.
- 10) What volume of silver metal will weigh exactly 2500.0 g. The density of silver is 10.5 g/cm^3 .
- 11) A cylindrical glass tube of length 27.75 cm and the radius 2.00 cm is filled with argon gas. The empty tube weighs 188.250 g. and the tube filled with argon weighs 188.870 g. Use the data to calculate the density of argon gas. (Volume of a cylinder = $\pi r^2 h$)

[Video: Calculate the Radius of a Cylinder of Aluminium](#)

- 12) If the density of silver is 10.50 g/cm^3 , and if the density of benzene is 0.8786 g/cm^3 , what mass of silver will have the same volume as 15.55 grams of benzene?
- 13) Calculate the mass of copper in grams (density = 8.94 g/cm^3) with the same volume as 100.0 grams of gold (density = 19.31 g/cm^3)
- 14) Calculate the mass of zinc in grams (density = 7.14 g/cm^3) with the same volume as 100.0 grams of aluminium (density = 2.70 g/cm^3)

Answers

Exercise

- 1) A block of aluminium occupies a volume of 15.0 mL and weighs 40.5 g. What is its density?

$m = 40.5 \text{ g}$ $V = 15 \text{ mL} = 15 \text{ cm}^3$ $\rho = ?$	$\rho = m : V$ $\rho = 40.5 \text{ g} / 15 \text{ cm}^3$ $\rho = 2.7 \text{ g/cm}^3$
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- 2) Mercury metal is poured into a graduated cylinder that holds exactly 22.5 mL. The mercury used to fill the cylinder weighs 306.0 g. From this information, calculate the density of mercury.

$m = 306.0 \text{ g}$ $V = 22.5 \text{ mL} = 22.5 \text{ cm}^3$ $\rho = ?$	$\rho = m : V$ $\rho = 306 \text{ g} / 22.5 \text{ cm}^3$ $\rho = 13.6 \text{ g/cm}^3$
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- 3) What is the weight of the ethyl alcohol that exactly fills a 200.0 mL container? The density of ethyl alcohol is 0.789 g/mL.

$m = ?$ $V = 200 \text{ mL} = 200 \text{ cm}^3$ $\rho = 0.789 \text{ g/cm}^3$	$m = V \times \rho$ $m = 200 \text{ cm}^3 \times 0.789 \text{ g/cm}^3$ $m = 158 \text{ g}$
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- 4) A rectangular block of copper metal weighs 1896 g. The dimensions of the block are 8.4 cm by 5.5 cm by 4.6 cm. From this data, what is the density of copper?

$m = 1896 \text{ g}$ $V = 8.4 \times 5.5 \times 4.6 = 212.52 \text{ cm}^3$ $\rho = ?$	$\rho = m : V$ $\rho = 1896 \text{ g} / 212.52 \text{ cm}^3$ $\rho = 8.9 \text{ g/cm}^3$
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- 5) A flask that weighs 345.8 g is filled with 225 mL of carbon tetrachloride. The weight of the flask and carbon tetrachloride is found to be 703.55 g. From this information, calculate the density of carbon tetrachloride.

$m = 703.55 - 345.8 = 357.75 \text{ g}$ $V = 225 \text{ mL} = 225 \text{ cm}^3$ $\rho = ?$	$\rho = m : V$ $\rho = 357.75 \text{ g} / 225 \text{ cm}^3$ $\rho = 1.59 \text{ g/cm}^3$
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- 6) Calculate the density of sulfuric acid if 35.4 mL of the acid weighs 65.14 g.

$m = 65.14 \text{ g}$ $V = 35.4 \text{ mL} = 35.4 \text{ cm}^3$ $\rho = ?$	$\rho = m : V$ $\rho = 65.14 \text{ g} / 35.4 \text{ cm}^3$ $\rho = 1.84 \text{ g/cm}^3$
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- 7) Find the mass of 250.0 mL of benzene. The density of benzene is 0.8786 g/mL.

$m = ?$ $V = 250 \text{ mL} = 250 \text{ cm}^3$ $\rho = 0.8786 \text{ g/cm}^3$	$m = V \times \rho$ $m = 250 \text{ cm}^3 \times 0.8786 \text{ g/cm}^3$ $m = 219.6 \text{ g}$
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- 8) A block of lead has dimensions of 4.50 cm by 5.20 cm by 6.00 cm. The block weighs 1591 g. From this information, calculate the density of lead.

$m = 1591 \text{ g}$ $V = 4.5 \times 5.2 \times 6 = 140.4 \text{ cm}^3$ $\rho = ?$	$\rho = m : V$ $\rho = 1591 \text{ g} / 140.4 \text{ cm}^3$ $\rho = 11.3 \text{ g/cm}^3$
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- 9) 28.5 g of iron shot is added to a graduated cylinder containing 45.5 mL of water. The water level rises to the 49.1 mL mark, From this information, calculate the density of iron.

$m = 28.5 \text{ g}$ $V = 49.1 - 45.5 = 3.6 \text{ cm}^3$ $\rho = ?$	$\rho = m : V$ $\rho = 28.5 \text{ g} / 3.6 \text{ cm}^3$ $\rho = 7.9 \text{ g/cm}^3$
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- 10) What volume of silver metal will weigh exactly 2500.0 g. The density of silver is 10.5 g/cm³.

$m = 2500 \text{ g}$ $V = ?$ $\rho = 10.5 \text{ g/cm}^3$	$V = m : \rho$ $V = 2500 \text{ g} : 10.5 \text{ g/cm}^3$ $V = 238 \text{ cm}^3$
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- 11) A cylindrical glass tube of length 27.75 cm and the radius 2.00 cm is filled with argon gas. The empty tube weighs 188.250 g. and the tube filled with argon weighs 188.870 g. Use the data to calculate the density of argon gas. (Volume of a cylinder = $\pi r^2 h$)

$m = 188.87 - 188.250 = 0.62 \text{ g}$ $V = \pi \times 2^2 \times 27.75 = 348.72 \text{ cm}^3$ $\rho = ?$	$\rho = m : V$ $\rho = 0.62 \text{ g} / 348.72 \text{ cm}^3$ $\rho = 0.00178 \text{ g/cm}^3$
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[Video: Calculate the Radius of a Cylinder of Aluminum](#)

- 12) If the density of silver is 10.50 g/cm³, and if the density of benzene is 0.8786 g/cm³, what mass of silver will have the same volume as 15.55 grams of benzene?

<p>Benzene</p> $m = 15.5 \text{ g}$ $V = ?$ $\rho = 0.8786 \text{ g/cm}^3$ $V = m : \rho$ $V = 15.5 \text{ g} : 0.8786 \text{ g/cm}^3$ $V = 17.70 \text{ cm}^3$	<p>Silver</p> $m = ?$ $V = 17.7 \text{ cm}^3$ $\rho = 10.5 \text{ g/cm}^3$ $m = V \times \rho$ $m = 17.7 \text{ cm}^3 \times 10.5 \text{ g/cm}^3$ $m = 185.8 \text{ g}$
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- 13) Calculate the mass of copper in grams (density = 8.94 g/cm^3) with the same volume as 100.0 grams of gold (density = 19.31 g/cm^3)

<p>Gold</p> <p>$m = 100 \text{ g}$</p> <p>$V = ?$</p> <p>$\rho = 19.31 \text{ g/cm}^3$</p> <p>$V = m : \rho$</p> <p>$V = 100 \text{ g} : 19.31 \text{ g/cm}^3$</p> <p>$V = 5.18 \text{ cm}^3$</p>	<p>Copper</p> <p>$m = ?$</p> <p>$V = 5.18 \text{ cm}^3$</p> <p>$\rho = 8.94 \text{ g/cm}^3$</p> <p>$m = V \times \rho$</p> <p>$m = 5.18 \text{ cm}^3 \times 8.94 \text{ g/cm}^3$</p> <p>$m = 46.3 \text{ g}$</p>
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- 14) Calculate the mass of zinc in grams (density = 7.14 g/cm^3) with the same volume as 100.0 grams of aluminium (density = 2.70 g/cm^3)

<p>Aluminium</p> <p>$m = 100 \text{ g}$</p> <p>$V = ?$</p> <p>$\rho = 2.7 \text{ g/cm}^3$</p> <p>$V = m : \rho$</p> <p>$V = 100 \text{ g} : 2.7 \text{ g/cm}^3$</p> <p>$V = 37 \text{ cm}^3$</p>	<p>Zinc</p> <p>$m = ?$</p> <p>$V = 37 \text{ cm}^3$</p> <p>$\rho = 7.14 \text{ g/cm}^3$</p> <p>$m = V \times \rho$</p> <p>$m = 7.14 \text{ cm}^3 \times 37 \text{ g/cm}^3$</p> <p>$m = 264 \text{ g}$</p>
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