

Counting atoms with the mole

Chemistry grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · Worksheet

Name: _____ Date: _____ Class: _____

These problems train you to find relative formula masses, convert between mass and moles, and count particles with the Avogadro constant. They suit GCSE and IGCSE students, O Level, WAEC and KCSE learners, NGSS high school chemistry and Class 9-10 students. Write units on every line and use the A_r values given in each problem.

Level: Chemistry grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · **Curriculum:** HS-PS1-7, GCSE C3

Problem 1 Mole and Avogadro (easy)

Wanjiru is learning the basic idea of the mole.

1. State the value of the Avogadro constant.
2. State the number of atoms in 1 mol of carbon.
3. Calculate the number of atoms in 2 mol of carbon.

Problem 2 Mass of one mole of atoms (easy)

Use A_r values: C 12, Mg 24, S 32, Cu 63.5.

1. State the mass of 1 mol of each element.

Problem 3 Relative formula masses (easy)

Use A_r values: H 1, C 12, N 14, O 16, Na 23, S 32, Ca 40.

1. Calculate the relative formula mass of CO_2 .
2. Calculate the relative formula mass of NaOH .
3. Calculate the relative formula mass of CaCO_3 .
4. Calculate the relative formula mass of H_2SO_4 .

Problem 4 Moles of water (easy)

Bilal has 36 g of water in a beaker.

1. State the molar mass of water.
2. Calculate the amount of water in moles.

Problem 5 Mass from moles (easy)

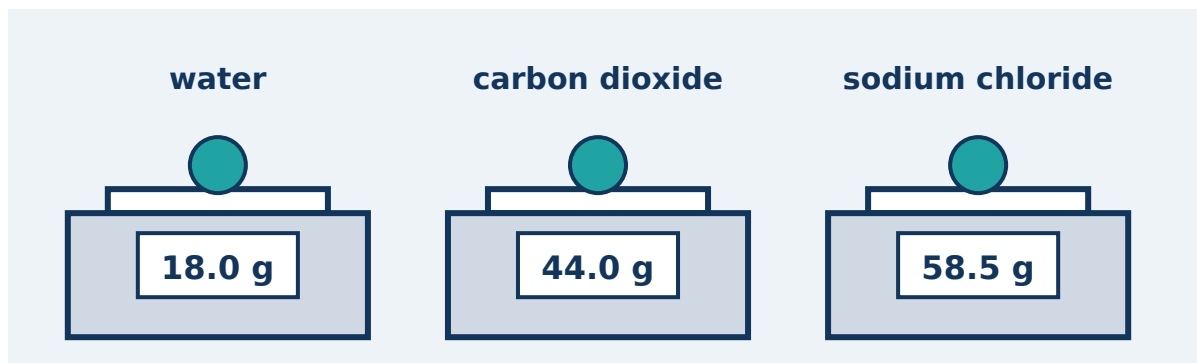
Emma needs 0.50 mol of sodium chloride ($M = 58.5 \text{ g/mol}$) for a model of seawater.

1. Write the formula that links mass, amount and molar mass.

2. Calculate the mass she should weigh.

Problem 6 Reading the balances (easy)

The balances show three samples. Use A_r values H 1, C 12, O 16, Na 23, Cl 35.5.



Three samples on balances.

1. Calculate the molar mass of each substance.
2. Calculate the amount in moles in each sample.
3. State the number of particles in each sample.

Problem 7 Atoms from moles (easy)

Kofi has 0.20 mol of sulfur atoms.

1. Calculate the number of atoms of sulfur.

Problem 8 Brackets in formulae (medium)

Calculate the relative formula mass of each compound. A_r values: H 1, N 14, O 16, Mg 24, Al 27, S 32, C 12.

1. $\text{Ca}(\text{OH})_2$ (Ca = 40)
2. $\text{Al}_2(\text{SO}_4)_3$
3. $(\text{NH}_4)_2\text{CO}_3$
4. $\text{Mg}(\text{NO}_3)_2$

Problem 9 Moles from mass (medium)

Calculate the amount in moles in each sample. A_r values: C 12, O 16, H 1, S 32, Al 27.

1. 4.4 g of carbon dioxide, CO_2
2. 49 g of sulfuric acid, H_2SO_4
3. 2.7 g of aluminium, Al

Problem 10 Mass from moles, harder (medium)

Calculate the mass of each amount. A_r values: Ca 40, C 12, O 16, H 1, Fe 56.

1. 0.25 mol of calcium carbonate, CaCO_3
2. 3.0 mol of water, H_2O

3. 0.10 mol of iron, Fe

Problem 11 Molecules in a raindrop (medium)

A monsoon raindrop in Pune has a mass of 0.050 g.

1. Calculate the amount of water in the drop.
2. Calculate the number of water molecules in the drop.

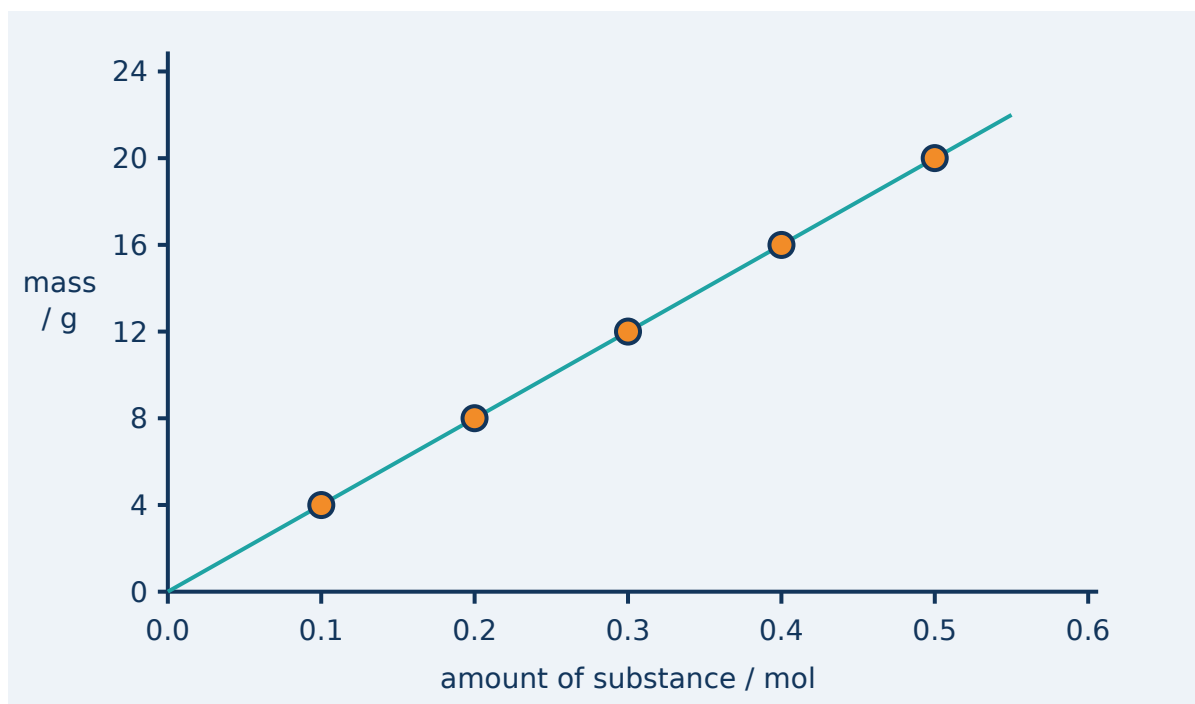
Problem 12 Atoms in methane (medium)

Mei has 0.40 mol of methane, CH₄.

1. Calculate the number of molecules.
2. State the number of atoms in one molecule.
3. Calculate the total number of atoms.

Problem 13 Mass against moles (medium)

The graph shows the mass of different amounts of a white solid.



Mass against amount for a white solid.

1. Read the mass of 0.30 mol from the graph.
2. Calculate the gradient of the line and state its unit.
3. Show that sodium hydroxide, NaOH, fits the gradient. A_r: Na 23, O 16, H 1.

Problem 14 A tablet of paracetamol (medium)

One tablet contains 500 mg of paracetamol, C₈H₉NO₂. A_r values: C 12, H 1, N 14, O 16.

1. Convert 500 mg to grams.
2. Calculate the molar mass of paracetamol.

3. Calculate the amount in moles in one tablet.

Problem 15 Spot the errors (medium)

Hyun-woo makes four statements.

1. The molar mass of oxygen gas is 16 g/mol.
2. The relative formula mass of Ca(OH)_2 is $40 + 16 + 1 = 57$.
3. 0.50 mol is 6.02×10^{23} particles.
4. $n = M \div m$.
5. Correct each statement.

Problem 16 Magnesium or aluminium (hard)

Diego has 10 g of magnesium and 10 g of aluminium. A_r : Mg 24, Al 27.

1. Calculate the amount in moles of each metal.
2. Calculate the number of atoms in each sample.
3. State which sample has more atoms and by what percentage.

Problem 17 Iron in haematite (hard)

Haematite is iron(III) oxide, Fe_2O_3 . A_r : Fe 56, O 16.

relative formula mass of $\text{Fe}_2\text{O}_3 = 160$ (the full bar)



Mass of iron and oxygen in one formula unit of Fe_2O_3 .

1. Calculate the percentage of iron by mass.
2. Calculate the mass of iron in 2.50 kg of pure haematite.
3. Calculate the amount in moles of Fe_2O_3 in 160 g.

Problem 18 Ions in a solution (hard)

A solution contains 0.20 mol of aluminium sulfate, $\text{Al}_2(\text{SO}_4)_3$.

1. State the number of Al^{3+} ions and SO_4^{2-} ions in each formula unit.
2. Calculate the amount of Al^{3+} and of SO_4^{2-} .
3. Calculate the total number of ions in the solution.

Problem 19 Mass of one particle (hard)

Ravi wants the mass of a single particle. A_r : C 12, H 1, O 16.

1. Calculate the mass in grams of one molecule of water.
2. Calculate the mass in grams of one atom of carbon.
3. Calculate the number of carbon atoms in 1.00 g of carbon.

Problem 20 Baking soda (hard)

Chiamaka uses 8.4 g of sodium hydrogencarbonate, NaHCO_3 , for baking. A_r: Na 23, H 1, C 12, O 16.

1. Calculate the molar mass.
2. Calculate the amount in moles.
3. Calculate the number of sodium ions.
4. Calculate the number of oxygen atoms.