

How atoms join to make molecules

Grade 8 science (Year 9 · Class 8) · Worksheet answers

Each answer shows the formula or sum used and then the result in bold. Check your counting against the method before you look at the final number.

Level: Grade 8 science (Year 9 · Class 8) · **Curriculum:** MS-PS1-1

Problem 1 Water formula

1. Two H and one O: **H₂O**.
2. $2 + 1 =$ **3 atoms**.
3. Hydrogen and oxygen: **2 elements**.

Problem 2 Reading subscripts

1. O₂ has 2 atoms, N₂ has 2 atoms, CO₂ has $1 + 2 = 3$ atoms: **2, 2 and 3**.
2. O₂ and N₂ contain only one kind of atom: **O₂ and N₂**.

Problem 3 Coefficient and subscript

1. The coefficient 3 means 3 molecules.
2. The subscript 2 means 2 hydrogen atoms in each molecule.
3. Each molecule has 3 atoms, so $3 \times 3 =$ **9 atoms**.

Problem 4 Atom or molecule

1. Helium, written He, is a gas whose particles are single atoms.
2. Cl₂, CH₄ and NH₃ are made of bonded atoms, so they are molecules.
3. $1 + 4 =$ **5 atoms**.

Problem 5 True or false

1. False: a molecule contains several atoms, so it is larger than one of its atoms.
2. True: the subscript is 2.
3. True, as in H₂O.
4. False: O is one atom, but O₂ is a molecule of two atoms. **Statements 2 and 3 are true.**

Problem 6 Model X

1. One carbon atom and two oxygen atoms.
2. **CO₂**.
3. $1 + 2 =$ **3 atoms**.

Problem 7 Counting in acid

1. HCl: $1 + 1 = 2$. H_2SO_4 : $2 + 1 + 4 = 7$. NH_3 : $1 + 3 = 4$.
2. **H_2SO_4** has the most, with 7 atoms.

Problem 8 Glucose in a drink

1. C = 6, H = 12, O = 6.
2. $6 + 12 + 6 = 24$ atoms.
3. $12 \div 24 = 0.50$, so **50 %** of the atoms are hydrogen.

Problem 9 Several molecules

1. The coefficient is 4, so 4 molecules.
2. C: $4 \times 1 = 4$. H: $4 \times 4 = 16$.
3. $4 + 16 =$ **20 atoms**.

Problem 10 Methane model

1. One C and four H: **CH_4** .
2. **4 bonds**, one from the carbon to each hydrogen.
3. The colours are a code and the balls and sticks are a simplified picture; real atoms have no colour and no solid sticks joining them.

Problem 11 Ethanol model

1. Carbon: 2. Hydrogen: 6. Oxygen: 1.
2. **$\text{C}_2\text{H}_6\text{O}$** .
3. The picture has 8 sticks: **8 bonds** (9 atoms joined in one connected group).

Problem 12 Size of a molecule

1. $0.28 \times 10^{-9} \text{ m} = 2.8 \times 10^{-10} \text{ m}$.
2. $1.0 \times 10^{-3} \div 2.8 \times 10^{-10} = 3.6 \times 10^6$, so about **3.6 million molecules**.

Problem 13 Spot the errors

1. (i) The subscript is on the wrong atom. (ii) He counted only the oxygen atoms of one molecule; one CO_2 has 3 atoms.
2. (i) Water is **H_2O** . (ii) 3 CO_2 contains $3 \times 3 =$ **9 atoms**.

Problem 14 Oxygen and ozone

1. O_2 has 2 atoms and O_3 has 3 atoms.
2. The number of atoms in each molecule is different, so the particles are different and they

have different properties.

3. $5 \times 3 = \mathbf{15 \text{ atoms}}$.

Problem 15 Formula from a description

1. NH_3 .

2. C_2H_4 .

3. CCl_4 .

4. $\text{NH}_3 = 4 \text{ atoms}$, $\text{C}_2\text{H}_4 = 6 \text{ atoms}$, $\text{CCl}_4 = 5 \text{ atoms}$.

Problem 16 Model kit puzzle

1. Carbon: $18 \div 6 = 3$. Hydrogen: $30 \div 12 = 2.5$. Oxygen: $24 \div 6 = 4$.

2. Hydrogen runs out first, giving **2 complete models**.

3. Used: C 12, H 24, O 12. Left: **6 carbon, 6 hydrogen, 12 oxygen**.

Problem 17 Atom percentages in propane

1. $3 + 8 = 11 \text{ atoms}$.

2. $3 \div 11 \times 100 = \mathbf{27 \%}$ (27.3 %).

3. $8 \div 11 \times 100 = \mathbf{73 \%}$ (72.7 %).

4. $27.3 + 72.7 = 100.0$, so the check works.

Problem 18 Same atoms, different molecules

1. Both have 2 C, 6 H and 1 O, so 9 atoms.

2. The atoms are joined in a different order and pattern, so the molecules have different shapes and different properties.

3. They would use the same balls but connect them with sticks in a different arrangement.

Same atoms, different arrangement.

Problem 19 Comparing five substances

1. H_2 and N_2 contain only one kind of atom.

2. $\text{H}_2 = 2$, $\text{H}_2\text{O} = 3$, $\text{N}_2 = 2$, $\text{NH}_3 = 4$, $\text{H}_2\text{O}_2 = 4$.

3. NH_3 and H_2O_2 tie with 4 atoms each, so $10 \times 4 = \mathbf{40 \text{ atoms}}$.

4. H_2O_2 has one more oxygen atom than H_2O , which makes it a different substance.

Problem 20 Scaling up an atom

1. $0.070 \div 1 \times 10^{-10} = \mathbf{7.0 \times 10^8 \text{ times}}$.

2. $1.0 \times 10^{-4} \times 7.0 \times 10^8 = 7.0 \times 10^4 \text{ m}$.

3. $7.0 \times 10^4 \text{ m} \div 1000 = \mathbf{70 \text{ km}}$.