SCIENCE FOUNDATIONS

Mole-to-particle conversions

Difficulty level: Intermediate

Science Foundations

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Overview of the concept

This is how a chemist works out how many individual molecules are in a spoonful of sugar or a breath of air, starting from an amount you can actually weigh. A spoonful of sugar holds an enormous number of molecules, far more than anyone could count, but the conversion tells you exactly how many. An air quality scientist uses the same idea to say how many pollutant particles are in each breath of city air. Knowing mole-to-particle conversions tells you how to move between a weight on a scale and a count of invisible particles.



Rule

Mole-to-particle conversions: one mole contains 6.02×10^{23} particles (see Avogadro's number).

Particles = moles $\times$ 6.02×10^{23}, and moles = $\frac{\text{particles}}{6.02 \times 10^{23}}$.

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Worked examples

EXAMPLE 1

Q How many molecules are in 0.5 moles of water?

SOLUTION

Write the rule:

particles = moles × 6.02×10^{23}.

Substitute:

particles = $0.5 \times 6.02 \times 10^{23} = 3.01 \times 10^{23}$ molecules

Write the answer as molecules.

The result is 3.01×10^{23} molecules.

EXAMPLE 2

Q How many moles are 1.204×10^{24} atoms?

SOLUTION

Write the rule:

moles = particles ÷ (6.02×10^{23}).

Substitute:

moles = $1.204 \times 10^{24} \div (6.02 \times 10^{23}) = 2$ mol

Write the answer in moles.

The result is 2 moles.

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Practice questions

1 1 mole of carbon dioxide to molecules?

- **A** 3.01×10^{23} molecules
- **B** 6.02×10^{23} molecules
- **C** 1.204×10^{24} molecules
- **D** 9.03×10^{23} molecules

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2 Which has more particles: 2 moles of carbon atoms or 2 moles of oxygen molecules?

- **A** 2 moles of carbon atoms
- **B** 2 moles of oxygen molecules
- **C** They have the same number of particles
- **D** You cannot tell without the masses

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3 **1.806×10^{24} particles to moles?**

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4 **A sample has 1 mole of particles. Another sample has 1.806×10^{24} particles. How many moles are there in total?**

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5 **Formula: particles from moles?**

A Moles times Avogadro's number

B Moles divided by Avogadro's number

C Particles times Avogadro's number

D Particles plus Avogadro's number

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6 Formula: moles from particles?

- A Particles times Avogadro's number
- B Moles times Avogadro's number
- C Particles divided by Avogadro's number
- D Moles plus Avogadro's number

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7 A student converts 2 moles to particles by dividing by Avogadro's number and gets a tiny decimal. What did the student do wrong?

- A Divided instead of multiplying
- B Multiplied instead of dividing
- C Used the wrong number for a mole
- D Nothing is wrong

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8 **Which is larger: 1 mole of particles or 6.02×10^{23} particles?**

- **A** 1 mole of particles
- **B** 6.02×10^{23} particles
- **C** They are the same amount
- **D** You cannot tell

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9 **A sample has 2 moles of particles. If you double the moles to 4, what happens to the number of particles?**

- **A** It stays the same
- **B** It doubles
- **C** It halves
- **D** It becomes zero

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10 How many moles is $2.5 \times 6.02 \times 10^{23}$ particles?

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ANSWER KEY

1. 6.02×10^{23} molecules

2. They have the same number of particles

3. 3 moles

4. 4 moles

5. Moles times Avogadro's number

6. Particles divided by Avogadro's number

7. Divided instead of multiplying

8. They are the same amount

9. It doubles

10. 2.5 moles

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