SCIENCE FOUNDATIONS

Avogadro's number

Difficulty level: Intermediate

Science Foundations

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Overview of the concept

This is how chemists count unimaginably tiny particles, like working out how many molecules are in a glass of water or a breath of air. A single glass of water holds more molecules than there are stars you could ever count, so chemists count them in huge groups instead of one by one. A pinch of salt and a breath of air are the same story, with far too many particles to count singly. Avogadro's number is the size of the group chemists use, so a number they can work with stands in for a number nobody could ever count.



Rule

Avogadro's number: one mole of anything contains 6.02×10^{23} particles.

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 Convert 3 moles of carbon atoms to atoms.

SOLUTION

1 mol = 6.02×10^{23} atoms

Multiply: $3 \times 6.02 \times 10^{23} = 1.806 \times 10^{24}$

1.806×10^{24} atoms

The result is 1.806×10^{24} atoms.

EXAMPLE 2

Q Convert 3.01×10^{23} molecules to moles.

SOLUTION

1 mol = 6.02×10^{23} molecules

Divide: $3.01 \times 10^{23} \div 6.02 \times 10^{23} = 0.5$

0.5 mol

The result is 0.5 moles.

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Practice questions

1 What is Avogadro's number?

- A 6.02×10^{24} per mole
- B 3.01×10^{23} per mole
- C 6.02×10^{23} per mole
- D 1.806×10^{24} per mole

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2 How many atoms are in 5 moles of carbon?

- A 3.01×10^{24} atoms
- B 3.01×10^{23} atoms
- C 1.204×10^{24} atoms
- D 6.02×10^{23} atoms

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3 One mole of oxygen gas (O_2) contains 6.02×10^{23} molecules. How many oxygen atoms are in one mole of O_2?

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

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4 How many moles is 6.02×10^{23} molecules?

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5 Which of these is equal to 1 mole?

- A 6.02×10^{23} particles
- B 6.02×10^{24} particles
- C 3.01×10^{23} particles
- D 1.806×10^{24} particles

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6 Moles to particles: multiply or divide?

- A Multiply
- B Divide
- C Add
- D Subtract

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7 Particles to moles: multiply or divide?

A Multiply

B Divide

C Add

D Subtract

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8 Which sample contains more particles: 1 mole of carbon or 2 moles of oxygen?

A 1 mole of carbon

B 2 moles of oxygen

C They contain the same number

D Cannot tell

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9 A student says 1.204×10^{24} particles is 2 moles. Is the student correct?

- **A** Yes
- **B** No

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10 What unit goes with Avogadro's number?

- **A** Per mole
- **B** Per atom
- **C** Per gram
- **D** Per litre

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ANSWER KEY

1. 6.02×10^{23} per mole

2. 3.01×10^{24} atoms

3. 1.204×10^{24} atoms

4. 1 mole

5. 6.02×10^{23} particles

6. Multiply

7. Divide

8. 2 moles of oxygen

9. Yes

10. Per mole

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