

# Moles, isotopes and chemical formulas

AP Chemistry · Test

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Class: \_\_\_\_\_ Mark: \_\_\_\_ / 20

This test covers moles, mass spectra, formulas and mixtures. It has 8 questions worth 20 marks. A periodic table and calculator are allowed. No hints are given.

**Level:** AP Chemistry · **Curriculum:** AP Chem Unit 1

Time: 40 minutes · 8 questions · Total: 20 marks · Calculator allowed

## Question 1 Moles of methane (2 marks)

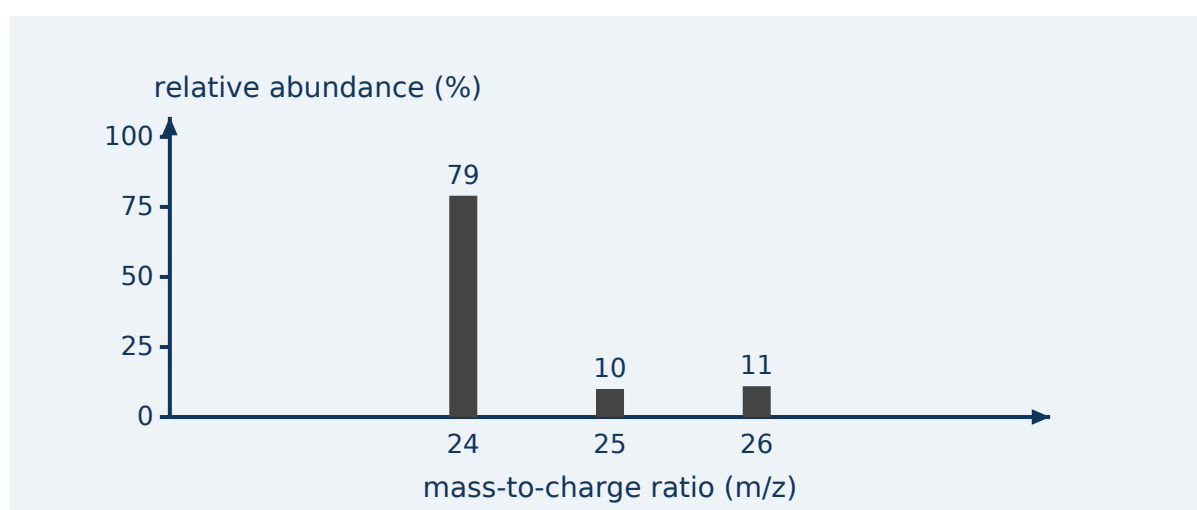
A cylinder holds 8.00 g of methane,  $\text{CH}_4$  ( $M = 16.043 \text{ g/mol}$ ).

- Calculate the amount in moles. (1 mark)
- Calculate the number of molecules. (1 mark)

## Question 2 Mass spectrum of an element (3 marks)

The figure shows the mass spectrum of element Z.

- State the relative abundance of the heaviest isotope. (1 mark)
- Calculate the average atomic mass using the mass numbers. (1 mark)
- Identify Z. (1 mark)



Mass spectrum of element Z.

**Question 3 Empirical formula** (3 marks)

A compound contains 26.6 % K, 35.4 % Cr and 38.0 % O by mass. Determine its empirical formula, showing the mole ratio. (3 marks)

**Question 4 Molecular formula** (2 marks)

A compound has empirical formula CH and molar mass 78.1 g/mol. Determine its molecular formula. (2 marks)

**Question 5 Iron in an ore** (3 marks)

An ore is pure  $\text{Fe}_2\text{O}_3$  ( $M = 159.69 \text{ g/mol}$ ,  $A_r(\text{Fe}) = 55.845$ ).

- Calculate the mass percent of iron. (1 mark)
- Calculate the mass of iron in 1.00 kg of ore. (2 marks)

**Question 6 Why a non-integer average?** (2 marks)

Explain why the average atomic mass of an element is not a whole number even though each isotope has a nearly whole-number mass. (2 marks)

**Question 7 Limestone in a mixture** (3 marks)

A 5.00 g mixture of calcium carbonate and sand is treated with excess acid.  $\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2\text{O} + \text{CO}_2$ . The  $\text{CO}_2$  collected has a mass of 0.880 g.

- Calculate the moles of  $\text{CO}_2$ . (1 mark)
- Calculate the mass percent of  $\text{CaCO}_3$  in the mixture ( $M = 100.09 \text{ g/mol}$ ). (2 marks)

**Question 8 Spot the error** (2 marks)

A student calculates the molar mass of  $\text{Al}_2(\text{SO}_4)_3$  as  $27 + 32 + 64 = 123 \text{ g/mol}$ . Identify the error and give the correct value. (2 marks)