

Exercise walk-through

1.3

Elemental Composition of Pure Substances

AP Chemistry

Formulas and mixtures

Empirical formula recipe

percent $\rightarrow$ mass $\rightarrow$ mole $\rightarrow$ divide by small $\rightarrow$
multiply til whole

40%C, 6.7%H, 53.3%O $\Rightarrow$ 1:2:1 $\Rightarrow$ **empirical formula** CH_2O .

Molecular formula = a whole-number multiple of the empirical one.

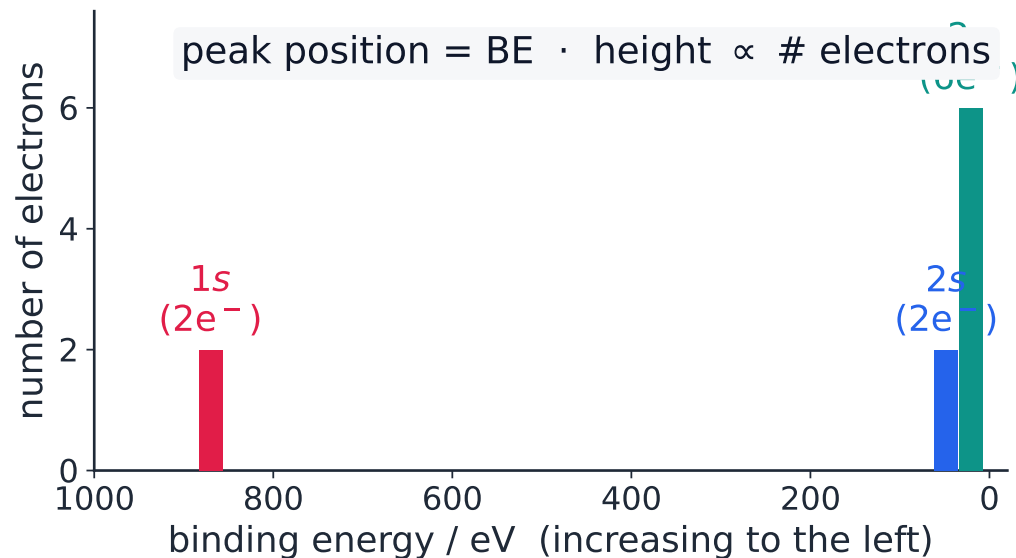
A **mixture** has variable composition; a **compound** is fixed.

- **homogeneous** – uniform (a solution)
- **heterogeneous** – visibly different parts

Molarity

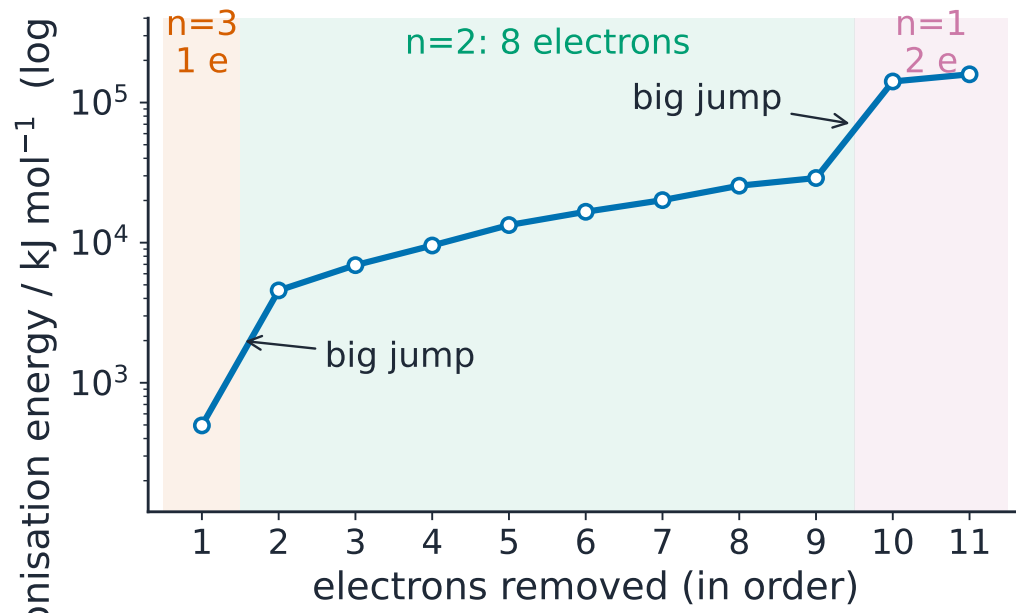
$$c = \frac{n}{V} \quad \left(\frac{\text{mol}}{\text{L}} \right)$$

The photoelectron spectrum of neon: one peak – one



The photoelectron spectrum of neon: one peak per subshell, height set by electron count

The photoelectron spectrum of neon: one peak – two



Successive ionisation energies reveal the shell structure through big jumps

Exercises 2.1-2.3

2.1 In water (H_2O , $M = 18$), what percent of the mass is oxygen (16)? [2]

2.2 State what an empirical formula gives. [1]

2.3 A compound has empirical mass 30 and molar mass 90. Find the multiple n . [2]

Exercises 2.1·2.3

2.1 In water (H_2O , $M = 18$), what percent of the mass is oxygen (16)? [2]

2.1

- $16/18 \times 100 \approx 89\%$
-

2.2 State what an empirical formula gives. [1]

2.2

- The simplest whole-number ratio of atoms
-

2.3 A compound has empirical mass 30 and molar mass 90. Find the multiple n . [2]

2.3

- $n = 90/30 = 3$

Exercises 2.4·3.1

2.4 After dividing by the smallest you get a ratio 1 : 1.5. State the whole-number ratio.[1]

3.1 The empirical formula of a compound gives [1]

☐

A the exact number of atoms in a molecule

B the simplest whole-number ratio of atoms

C the molar mass

D the percent composition

Exercises 2.4·3.1

2.4 After dividing by the smallest you get a ratio 1 : 1.5. State the whole-number ratio.[1]

2.4

- 2 : 3 (multiply both by 2)

3.1 The empirical formula of a compound gives [1]

☐

A the exact number of atoms in a molecule

B the simplest whole-number ratio of atoms

C the molar mass

D the percent composition

3.1 B

- the simplest whole-number ratio of atoms

Exercise 3.2

3.2 A compound is 75% carbon and 25% hydrogen by mass ($C = 12$, $H = 1$). Its empirical formula is [1]

☐

A CH

B CH₂

C CH₄

D C₂H

Exercise 3.2

3.2 A compound is 75% carbon and 25% hydrogen by mass ($C = 12$, $H = 1$). Its empirical formula is [1]

☐

A CH

B CH₂

C CH₄

D C₂H

3.2 C

- C: $75/12 = 6.25$, H: $25/1 = 25$; ratio 1 : 4, so CH₄

Exercise 3.3 (a)

3.3 A compound is 40% sulfur and 60% oxygen by mass ($S = 32$, $O = 16$).

(a) Find the empirical formula.

[3]

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[3]

(a)

- Per 100 g: $S = 40/32 = 1.25$, $O = 60/16 = 3.75$ mol; divide by 1.25: S 1, O 3;
empirical formula SO_3

Exercise 3.3 (b)

3.3 A compound is 40% sulfur and 60% oxygen by mass ($S = 32$, $O = 16$).

(b) State the method you used.

[1]

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3.3 A compound is 40% sulfur and 60% oxygen by mass ($S = 32$, $O = 16$).

(b) State the method you used.

[1]

(b)

- Convert mass percents to moles and divide by the smallest

Exercise 3.4 (a)

3.4 A compound has empirical formula CH_2 (empirical mass 14) and a molar mass of 56 g/mol.

(a) Find the multiple n .

[1]

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3.4 A compound has empirical formula CH_2 (empirical mass 14) and a molar mass of 56 g/mol.

(a) Find the multiple n .

[1]

(a)

- $n = 56/14 = 4$

Exercise 3.4 (b)

3.4 A compound has empirical formula CH_2 (empirical mass 14) and a molar mass of 56 g/mol.

(b) Write the molecular formula.

[1]

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(b) Write the molecular formula.

[1]

(b)

- C_4H_8