1.1 States separation and atoms

Name: _____ Class: _____ Date: _____ **Total: 30 marks**

Objective

Build the skills to answer exam questions on **states of matter, separation and atomic structure** 、 : particle arrangements and changes of state, separating mixtures, chromatography, atoms, isotopes and the Periodic Table.

You must be able to:

- describe particles in solids, liquids and gases
- choose a method to separate a mixture and calculate R_f values
- work out protons, neutrons, electrons and electronic configurations
- calculate relative atomic mass from isotope abundances

1 Key knowledge and worked examples

■ Separation and atoms

idea	rule or formula
R_f value	distance moved by the spot ÷ distance moved by the solvent front
protons	atomic number
neutrons	mass number − atomic number
electron shells	fill in the order 2, 8, 8; the group is the number of outer electrons
relative atomic mass A_r	(abundance × mass number, added for each isotope) ÷100

Worked example 1: relative atomic mass. Boron is 19.9% boron-10 and 80.1% boron-11. Find A_r.

1. Known: 19.9% of 10; 80.1% of 11.
2. Rule: (abundance × mass, added) ÷100.
3. Numbers: $(19.9 \times 10 + 80.1 \times 11) \div 100 = (199 + 881.1) \div 100$.
4. Result: 10.8.

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Worked example 2: an atom. Chlorine-37 has atomic number 17. Find its protons, neutrons, electrons and configuration.

1. Known: atomic number 17; mass number 37.
2. Rule: protons = electrons = 17; neutrons = $37 - 17$.
3. Numbers: 20 neutrons; 17 electrons fill $2, 8, 7$.
4. Result: 17 **p,** 20 **n,** 17 **e,** 2.8.7 (Group 7).

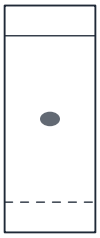
Answer shapes: for separation, name the method **and** say which property it uses (solubility, boiling point, particle size).

2 Practice

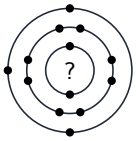
2.1 Describe the arrangement and the movement of the particles in a gas. [2]



2.2 On a chromatogram a spot moves 4.5 cm and the solvent front moves 9.0 cm. Calculate the R_f value. [2]



2.3 An atom has 13 protons. State its electronic configuration and its group. [2]



2.4 Name the method to get: salt crystals from salt solution; pure ethanol from a mixture of ethanol and water. [2]



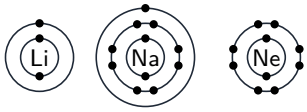
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3 Exam-style questions

3.1 Gallium is 60% gallium-69 and 40% gallium-71. Calculate the relative atomic mass of gallium. [3]

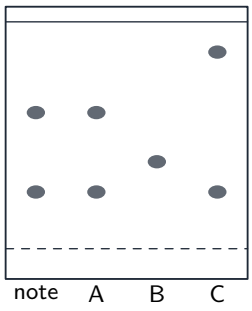
isotope	abundance
gallium-69	60%
gallium-71	40%

3.2 Explain why elements in the same group have similar chemical properties, and why Group 0 elements are unreactive. [3]



3.3 A scientist tests the black ink on a note against the inks of three pens, A, B and C. The chromatogram is shown. The solvent front moved 8.0 cm. The two spots from the note moved 2.0 cm and 4.8 cm.

(a) Calculate the R_f values of the two spots from the note, and state which pen matches. [3]



(b) Describe how the scientist should set up this chromatography experiment. [4]

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(c) Explain why the start line is drawn in pencil, not in ink. [3]

(d) The scientist wants pure water from a solution of the ink. Describe how to obtain pure water from the solution, and how to show that the water is pure. [6]

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