

Shells, groups and the periodic table

Chemistry grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · Lab

Name: _____ Date: _____ Class: _____

Can a set of cards show the repeating pattern that Mendeleev saw? You will sort ten element cards by relative atomic mass, find which cards line up in columns, and connect the pattern to electron arrangements.

Level: Chemistry grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · **Curriculum:** HS-PS1-1, HS-PS1-2

Aim

To discover a repeating pattern by sorting ten element cards by relative atomic mass, and to see how this matches electron arrangements.

Equipment

- Ten cards cut from paper, each showing a symbol, relative atomic mass and chloride formula
- Pencil and ruler
- A periodic table

Safety

Safety

Take care with scissors: cut away from your body and put them down after use. Keep the table clear so nothing falls on the floor.

Method

1. Write each card: Li 6.9 LiCl; Be 9.0 BeCl₂; B 10.8 BCl₃; C 12.0 CCl₄; Na 23.0 NaCl; Mg 24.3 MgCl₂; Al 27.0 AlCl₃; Si 28.1 SiCl₄; K 39.1 KCl; Ca 40.1 CaCl₂.
2. Put the cards in order of increasing relative atomic mass in one line.
3. Count the chlorine atoms in each formula and note where the number returns to 1.
4. Start a new row each time the number returns to 1, so that cards line up in columns.
5. Look up each element in the periodic table and write its electron arrangement beside its card.

	Group 1	Group 2	Group 3	Group 4
1	Li 6.9	Be 9.0	B 10.8	C 12.0
2	Na 23.0	Mg 24.3	Al 27.0	Si 28.1
3	K 39.1	Ca 40.1		

Cards laid out in rows by increasing mass, with similar cards in columns.

Results

Card	Relative atomic mass	Chloride formula	Cl atoms per atom	Electron arrangement
Li	6.9	LiCl	1	2,1
Be	9.0	BeCl ₂	2	2,2
B	10.8	BCl ₃	3	2,3
C	12.0	CCl ₄	4	2,4
Na	23.0	NaCl	1	2,8,1
Mg	24.3	MgCl ₂	2	2,8,2
Al	27.0	AlCl ₃	3	2,8,3
Si	28.1	SiCl ₄	4	2,8,4
K	39.1	KCl	1	2,8,8,1
Ca	40.1	CaCl ₂	2	2,8,8,2

Analysis questions

Question 1 Describe the pattern

Describe the pattern in the number of chlorine atoms as you move along the sorted line of cards.

Question 2 Find the columns

State which cards line up in each column when you start a new row at each return to 1.

Question 3 Link to electrons

Compare the number of chlorine atoms with the number of outer electrons for each card.
Predict the formula of the chloride of an element with arrangement 2,8,8,3.

Question 4 Explain the mass gaps

Calculate the jump in relative atomic mass from C to Na and from Si to K. Suggest how many elements are missing in each jump.

Question 5 Explain the repeat

Use electron arrangements to explain why Li, Na and K are in one column and why the pattern repeats.

Question 6 Evaluate and improve

Suggest two limitations of using only ten cards and one improvement.