

Shells, groups and the periodic table

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

Name: _____ Date: _____ Class: _____

These problems train you to write electron arrangements for the first 20 elements, to read group and period from them, and to explain the history of the periodic table with data. They move from direct recall to interpretation of graphs and diagrams. Use them for GCSE, IGCSE, O Level, CBSE Class 9-10 and NGSS high school chemistry. Keep a periodic table beside you for atomic numbers.

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

Problem 1 Write the arrangements (easy)

Write the electron arrangement of each atom, using the atomic number in brackets.

1. Magnesium (12)
2. Fluorine (9)
3. Potassium (19)
4. Boron (5)

Problem 2 Group and period (easy)

Each arrangement belongs to a neutral atom. State its group and its period.

1. 2,8,3
2. 2,6
3. 2,4
4. 2,8,8

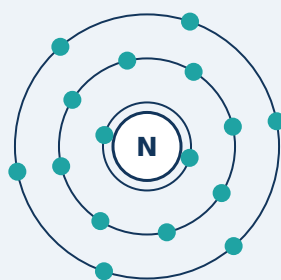
Problem 3 Shell capacity (easy)

1. State the maximum number of electrons in each of the first three shells for the first 20 elements.
2. Explain why helium and neon are both described as having full outer shells.

Problem 4 Reading a shell diagram (easy)

Atom X is a neutral atom shown below.

1. Write its electron arrangement.
2. State how many protons it has.
3. Identify the element, given that atomic number 16 is sulfur.
4. State its group and period.



neutral atom
dots = electrons

Atom X.

Problem 5 Complete the table (easy)

Complete the table.

Element	Atomic number	Arrangement	Group	Period
Beryllium	4	?	?	?
Nitrogen	7	?	?	?
Chlorine	17	?	?	?
Calcium	20	?	?	?

Problem 6 Same group, same behaviour (easy)

Five neutral atoms have these arrangements: A = 2,1; B = 2,8,5; C = 2,8,1; D = 2,5; E = 2,8,8.

1. Name the pairs of atoms that are in the same group.
2. State which atom is a noble gas.
3. State which atoms have three shells.

Problem 7 Deduce the element (medium)

Use the periodic table to name each element.

1. It has three shells and five outer electrons.
2. It has four shells and two outer electrons.
3. It is in period 2 and Group 7.

For each, give the electron arrangement and the atomic number.

Problem 8 Mendeleev's prediction (medium)

Mendeleev predicted a density of 5.5 g/cm³ and a relative atomic mass of 72 for eka-silicon. Germanium has a density of 5.32 g/cm³ and a relative atomic mass of 72.6.

1. Calculate the percentage difference in density, using the measured value as the base.

2. Calculate the percentage difference in relative atomic mass.
3. Explain why such close agreement convinced scientists.

Problem 9 Tellurium and iodine (medium)

Tellurium has a relative atomic mass of 127.6 and iodine has 126.9. Mendeleev put iodine after tellurium.

1. Calculate the difference in relative atomic mass.
2. Explain why he reversed the order of mass.
3. State what Moseley's atomic numbers 52 for tellurium and 53 for iodine show.

Problem 10 Metal or non-metal? (medium)

Element P is shiny, malleable and conducts electricity, and its atoms are 2,8,2. Element Q is dull yellow, brittle and does not conduct, and its atoms are 2,8,6.

1. Classify each as a metal or a non-metal.
2. State whether each tends to lose or gain electrons.
3. Name the element in each case (atomic numbers 12 and 16).

Problem 11 Spot the errors (medium)

Bilal in Lahore made three statements. Find and correct each mistake.

1. "Chlorine is 2,8,8,1."
2. "Sodium is in period 1 because it is in Group 1."
3. "Elements in the same period have the same number of outer electrons."

Problem 12 Unreactive noble gases (medium)

Helium is 2, neon is 2,8 and argon is 2,8,8.

1. State what these arrangements have in common.
2. Explain why noble gases hardly react.
3. State why helium is placed with them although it has only 2 outer electrons.

Problem 13 Locate the elements (medium)

Elements A to F are marked on the grid below (they are not real symbols).

1. Name the two elements in the same group.
2. Identify the noble gas.
3. Write the electron arrangements of C, E and F.

Group Period	1	2	3	4	5	6	7	0
1								
2	A							D
3	B		F				C	
4		E						

Positions of elements A to F.

Problem 14 Atomic number from arrangement (medium)

Add the electrons to find the atomic number and name each element.

- 2,8,4
- 2,8,8,1
- 2,3
- 2,8,2

Problem 15 Same arrangement, different species (medium)

Count the electrons in each species and write its arrangement: Na^+ (atomic number 11), F^- (9), Mg^{2+} (12), Cl^- (17).

State which noble gas each matches.

Problem 16 Unknown atom with 15 electrons (hard)

A neutral atom has 15 electrons.

- Write its arrangement.
- State its group and period.
- Suggest whether it is a metal and how many electrons it would gain to reach a full shell.

Problem 17 Argon and potassium (hard)

Argon has a relative atomic mass of 39.9 and atomic number 18. Potassium has 39.1 and atomic number 19.

- Predict the order if the elements are ranked by mass alone.
- Give the order if ranked by atomic number.
- Use the properties of the two elements to explain which order matches the groups.

Problem 18 Newlands' octaves (hard)

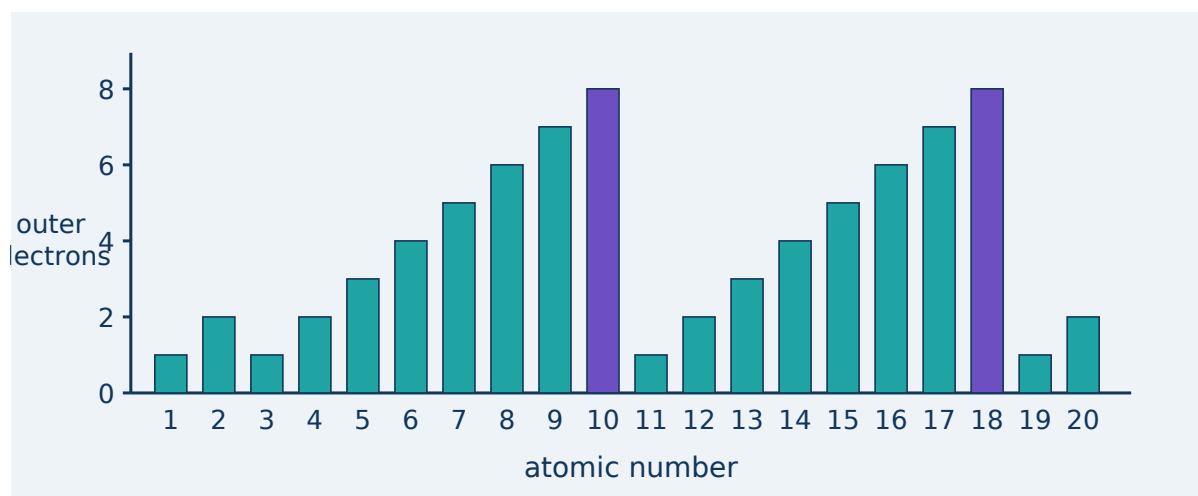
Newlands listed elements by mass: lithium 7, beryllium 9, boron 11, carbon 12, nitrogen 14, oxygen 16, fluorine 19, sodium 23.

1. Count eight places from lithium and state which element you reach.
2. Compare the arrangements of lithium and that element.
3. Explain why the pattern repeats after eight elements.
4. Suggest why the pattern failed beyond calcium.

Problem 19 Outer electrons graph (hard)

The graph shows outer electrons against atomic number for elements 1 to 20.

1. Read the number of outer electrons for atomic numbers 9, 13 and 18.
2. List the atomic numbers with the same group as atomic number 3.
3. Explain why the graph restarts at 1 for atomic numbers 3, 11 and 19.
4. Explain why atomic number 2 has only 2 outer electrons.



Outer electrons against atomic number.

Problem 20 Evaluate the evidence (hard)

In 1870 a sceptical chemist in Paris said that Mendeleev's gaps were just guesses.

Germanium was found in 1886 with relative atomic mass 72.6, density 5.32 g/cm³ and oxide GeO₂, against predictions of 72, 5.5 g/cm³ and XO₂.

1. Evaluate how strongly the discovery supports the table.
2. State one limitation that remained until atomic numbers were understood.