

Alkali metals, halogens and noble gases

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

Name: _____ Date: _____ Class: _____

These problems train you to use the trends in Group 1, Group 7 and Group 0. You will balance equations, interpret displacement tests and charts, and carry out short mole calculations. They begin with recall and finish with prediction, calculation and experimental design. Use them for GCSE, IGCSE, O Level, CBSE Class 9-10 and NGSS high school chemistry.

Level: Chemistry grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · **Curriculum:** GCSE C1, IGCSE 9

Problem 1 Storing alkali metals (easy)

A school lab in Kampala keeps sodium in a bottle of oil.

1. State two physical properties of sodium.
2. Explain why it is stored under oil.

Problem 2 Lithium and water (easy)

Lithium is added to water containing universal indicator.

1. Name the two products.
2. State the colour of the indicator at the end.
3. Describe the test for the gas.

Problem 3 Halogens at room temperature (easy)

Complete the table for chlorine, bromine and iodine at room temperature.

Halogen	Colour	State
Chlorine	?	?
Bromine	?	?
Iodine	?	?

Problem 4 Uses of noble gases (easy)

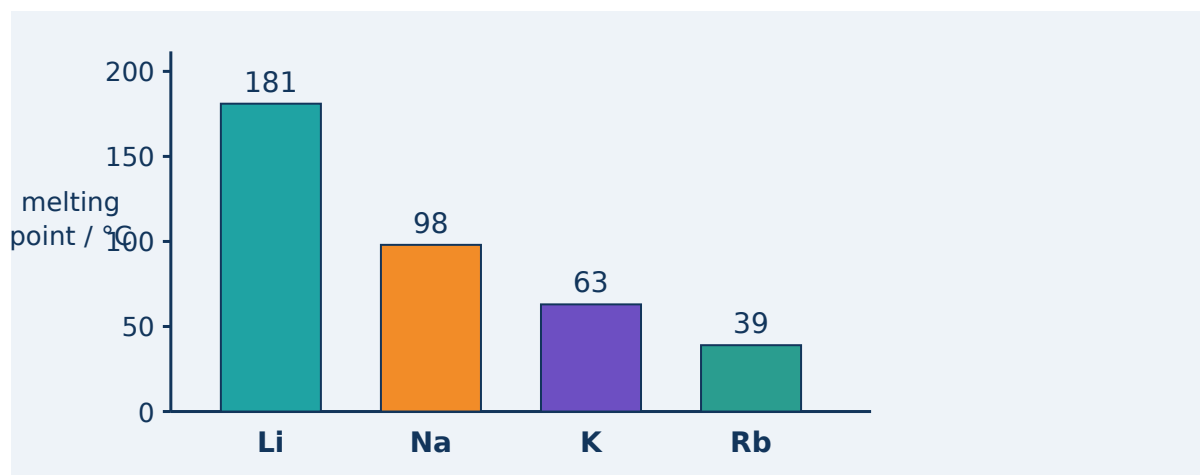
Match each gas to a use and give the reason.

1. Helium: airships
2. Neon: lighting signs
3. Argon: filament lamps

Problem 5 Melting points of alkali metals (easy)

Use the chart.

1. Read the melting point of sodium.
2. Describe the trend down the group.
3. Predict whether caesium melts above or below 39 °C.



Melting points of four alkali metals.

Problem 6 Word equations (easy)

Write word equations.

1. Sodium + water
2. Chlorine + potassium iodide
3. Lithium + chlorine

Problem 7 Balance the equations (medium)

Balance each equation.

1. $\text{Li} + \text{H}_2\text{O} \rightarrow \text{LiOH} + \text{H}_2$
2. $\text{K} + \text{Cl}_2 \rightarrow \text{KCl}$
3. $\text{Na} + \text{Br}_2 \rightarrow \text{NaBr}$
4. $\text{Rb} + \text{H}_2\text{O} \rightarrow \text{RbOH} + \text{H}_2$

Problem 8 Potassium versus sodium (medium)

Potassium is 2,8,8,1 and sodium is 2,8,1.

1. State the number of outer electrons in each.
2. Explain why potassium reacts more vigorously with water.

Problem 9 Fluorine and iodine (medium)

Fluorine is the most reactive halogen and iodine the least.

1. Explain this using the position of the outer shell.

2. State what happens to the colour of the halogens down the group.

Problem 10 Interpreting displacement tests (medium)

Three new halogens X_2 , Y_2 and Z_2 (not real symbols) were tested with solutions of their sodium salts.

Mixture	Result
$X_2 + NaY$	Colour change
$Y_2 + NaX$	No change
$Z_2 + NaY$	No change
$Y_2 + NaZ$	Colour change

1. Decide which halogen is the most reactive and which the least.
2. Write the order of reactivity.
3. Predict the result for $X_2 + NaZ$.

Problem 11 Will it react? (medium)

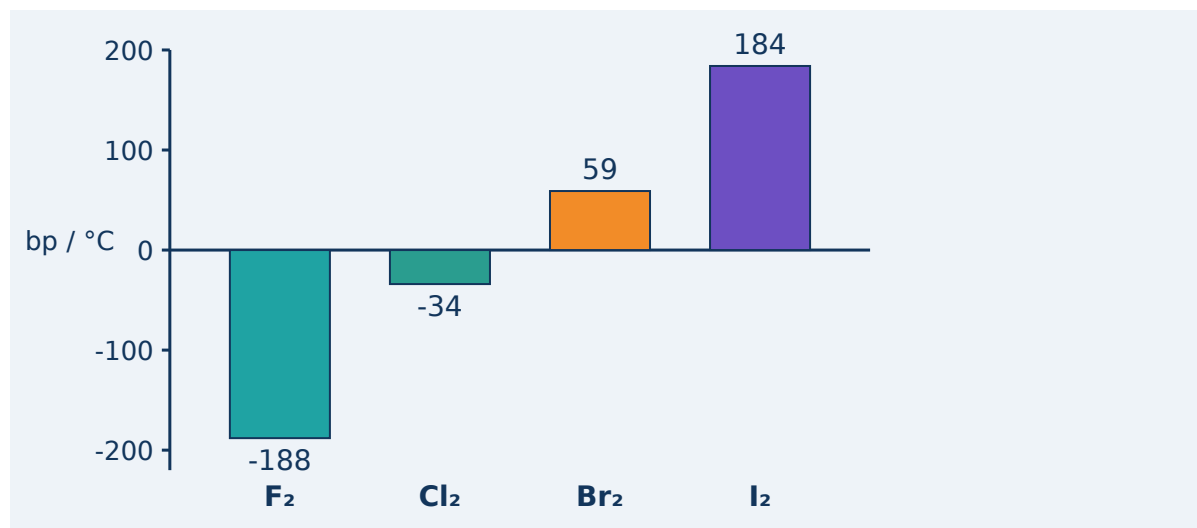
State whether each mixture reacts. Write a balanced equation if it does.

1. Chlorine + sodium iodide
2. Iodine + sodium chloride
3. Bromine + potassium iodide
4. Chlorine + potassium bromide

Problem 12 States of the halogens (medium)

The chart shows boiling points. The melting points are fluorine $-220\text{ }^{\circ}\text{C}$, chlorine $-101\text{ }^{\circ}\text{C}$, bromine $-7\text{ }^{\circ}\text{C}$ and iodine $114\text{ }^{\circ}\text{C}$.

1. State the physical state of each halogen at $25\text{ }^{\circ}\text{C}$.
2. Predict the state of astatine at $25\text{ }^{\circ}\text{C}$.



Boiling points of four halogens.

Problem 13 Hydrogen from sodium (medium)

A teacher drops 0.69 g of sodium into excess water. The equation is $2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2$. The relative atomic mass of sodium is 23 and one mole of gas occupies 24 dm³ at room temperature.

1. Calculate the moles of sodium.
2. Calculate the moles of hydrogen.
3. Calculate the volume of hydrogen in cm³.

Problem 14 Spot the errors (medium)

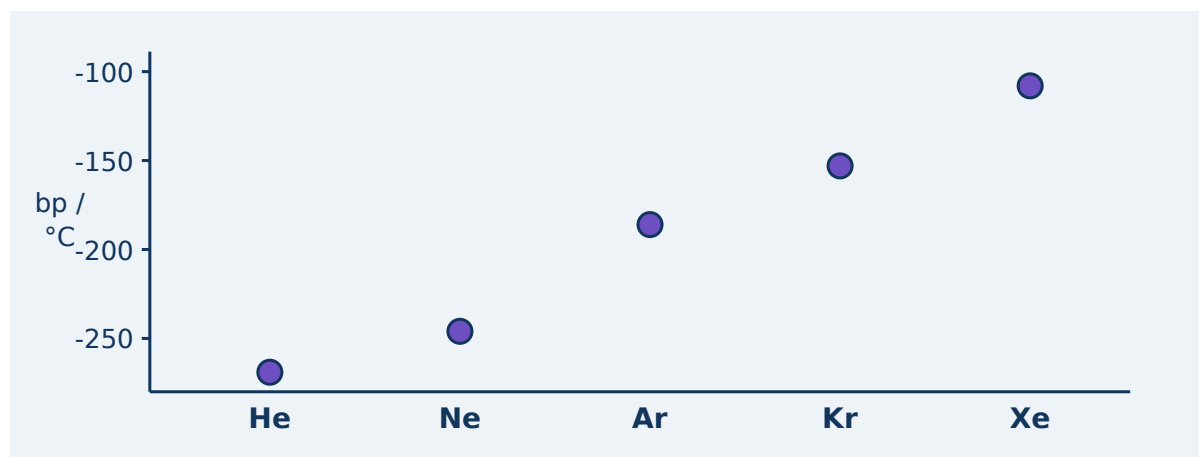
Diego in Texas wrote three statements. Find and correct each mistake.

1. "Group 1 metals get less reactive down the group."
2. "Chlorine is a red-brown liquid at room temperature."
3. "Noble gases are reactive because they have 8 outer electrons."

Problem 15 Radon boiling point (hard)

The plot shows boiling points of the noble gases (no labels on the points: they are He, Ne, Ar, Kr, Xe from left to right).

1. Read the boiling point of argon.
2. Describe the trend.
3. Estimate the boiling point of radon, the next noble gas, and justify it.



Noble gas boiling points (no labels on points).

Problem 16 Making iodine (hard)

Chlorine reacts with potassium iodide: $\text{Cl}_2 + 2\text{KI} \rightarrow 2\text{KCl} + \text{I}_2$. A student uses 3.32 g of potassium iodide (relative formula mass 166).

1. Calculate the moles of potassium iodide.
2. Calculate the mass of iodine formed (relative atomic mass 127).
3. Calculate the mass of chlorine needed (relative atomic mass 35.5).

Problem 17 Half equations (hard)

Chlorine displaces bromine: $\text{Cl}_2 + 2\text{Br}^- \rightarrow 2\text{Cl}^- + \text{Br}_2$.

1. Write the half equation for chlorine.
2. Write the half equation for bromide ions.
3. State which species is oxidised and which is reduced.

Problem 18 Predict the unknowns (hard)

Astatine is below iodine in Group 7 and francium is below caesium in Group 1.

1. Predict the colour and state of astatine, and whether it would displace iodine from potassium iodide.
2. Predict how francium would react with water compared with caesium.
3. Justify both predictions using the trends.

Problem 19 Helium airship (hard)

An airship in the UK holds 2000 m^3 of gas. At room temperature, air has a density of 1.20 kg/m^3 and helium has a density of 0.17 kg/m^3 .

1. Calculate the mass of lift each cubic metre of helium provides.
2. Calculate the total lift for the airship.
3. Explain why helium is safer than hydrogen.

Problem 20 Design an investigation (hard)

Plan an investigation to compare the reactivity of chlorine, bromine and iodine using displacement.

1. State the solutions you would need.
2. List three variables to control.
3. Describe the results that show the order.
4. Give one safety precaution.