

How ions bond: transfer and lattices

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

Name: _____ Date: _____ Class: _____

These problems train you to find ion charges from the periodic table, to describe electron transfer, to work out formulae by balancing charge, and to explain the properties of ionic compounds. They begin with recall and finish with explanation, prediction and evaluation. Use them for GCSE, IGCSE, O Level, CBSE Class 9-10 and NGSS high school chemistry. A periodic table helps with group numbers.

Level: Chemistry grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · **Curriculum:** HS-PS1-3, GCSE C2

Problem 1 Words for ions (easy)

1. Define the term ion.
2. State what a cation is and what an anion is.
3. State whether metals or non-metals usually form cations.

Problem 2 Charges from the group (easy)

Use the group number to give the charge on the ion of each element.

1. Lithium (Group 1)
2. Magnesium (Group 2)
3. Aluminium (Group 3)
4. Oxygen (Group 6)
5. Fluorine (Group 7)

Problem 3 Sodium becomes an ion (easy)

A sodium atom has 11 protons and 11 electrons.

1. State how many electrons it loses to become Na^+ .
2. State the number of protons and electrons in Na^+ .
3. Write the electron arrangement of Na^+ .

Problem 4 Reading a lattice (easy)

The diagram shows part of an ionic crystal.

1. Count the large ions and the small ions.
2. State the simplest ratio of large to small ions.
3. Explain why each ion in the lattice is surrounded by ions of the opposite charge.



Two-dimensional slice of an ionic crystal.

Problem 5 Names and formulas (easy)

Name each compound and write its formula.

1. Lithium + fluorine
2. Magnesium + oxygen
3. Potassium + bromine
4. Calcium + chlorine

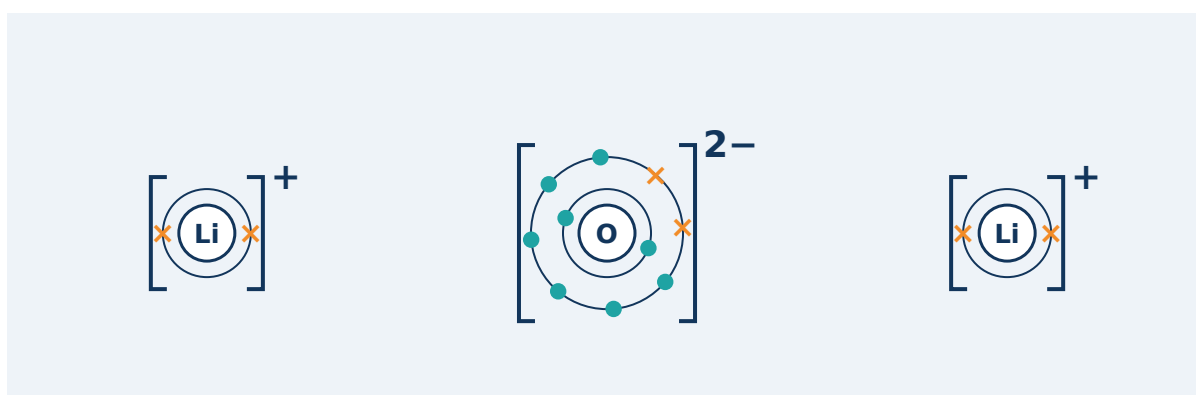
Problem 6 Three properties (easy)

State three properties of ionic compounds.

Problem 7 Lithium oxide diagram (medium)

The diagram shows lithium oxide.

1. State how many electrons each lithium atom transfers.
2. Explain why two lithium ions are needed for one oxide ion.
3. Write the formula of lithium oxide.
4. State the electron arrangement of each ion.



Lithium oxide.

Problem 8 Formulae from charges (medium)

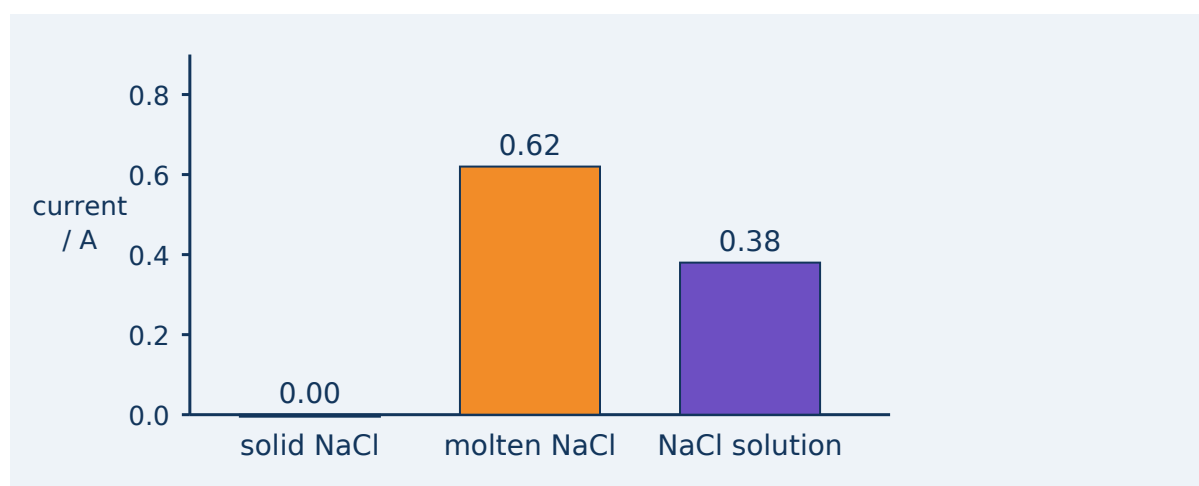
Work out the formula of each compound.

1. Calcium (Ca^{2+}) and chloride (Cl^-)
2. Aluminium (Al^{3+}) and chloride (Cl^-)
3. Sodium (Na^+) and sulfide (S^{2-})
4. Magnesium (Mg^{2+}) and nitride (N^{3-})
5. Aluminium (Al^{3+}) and sulfide (S^{2-})

Problem 9 When does salt conduct? (medium)

A student in Lagos measures the current through sodium chloride at 4.5 V.

1. Read the current for each state from the chart.
2. Explain the result for the solid.
3. Explain the results for the molten and dissolved salt.



Current through sodium chloride in three states.

Problem 10 Comparing melting points (medium)

Melting points: sodium chloride 801 °C, lithium fluoride 845 °C, calcium oxide 2613 °C, magnesium oxide 2852 °C.

1. Put the compounds in order, highest first.
2. Explain why magnesium oxide melts at a much higher temperature than sodium chloride.

Problem 11 Why crystals shatter (medium)

Wanjiru taps a crystal of salt with a hammer in Nairobi and it breaks into pieces rather than bending.

1. Name the property shown.
2. Explain it using ions.

Problem 12 Spot the errors (medium)

Find and correct the mistake in each statement.

1. "A molecule of sodium chloride contains one sodium and one chlorine atom."
2. "Solid ionic compounds conduct because electrons move."
3. "Magnesium atoms gain two electrons to form Mg^{2+} ."

Problem 13 Counting ions in a crystal (medium)

A tiny crystal of calcium fluoride, CaF_2 , contains 1.2×10^6 calcium ions.

1. Calculate the number of fluoride ions.
2. Calculate the total number of ions.
3. Show that the crystal is electrically neutral.

Problem 14 Electron arrangements of ions (medium)

Write the electron arrangement of each species and name the noble gas it matches.

1. Mg (12 electrons) and Mg^{2+}
2. O (8 electrons) and O^{2-}

Problem 15 Forming calcium fluoride (medium)

Calcium has the arrangement 2,8,8,2 and fluorine is 2,7.

1. Describe the electron transfer when they react.
2. Explain why the formula is CaF_2 .
3. State the arrangements of the two ions.

Problem 16 Predict formulae (hard)

Element R is in Group 3 and element S is in Group 7. Element T is in Group 1 and element U is in Group 6. Element V is in Group 2 and nitrogen forms N^{3-} .

1. Predict the formula of the compound of R and S.
2. Predict the formula of the compound of T and U.
3. Predict the formula of the compound of V and nitrogen.
4. Show by charge the check for each.

Problem 17 Dissolving salt (hard)

Sodium chloride has a solubility of 36 g per 100 g of water at 20 °C.

1. Calculate the maximum mass that dissolves in 50 g of water.
2. A cook adds 25 g of salt to 50 g of water. Calculate the mass that stays undissolved.
3. Explain how water dissolves an ionic solid.

Problem 18 Ranking melting points (hard)

Potassium chloride melts at 770 °C, sodium chloride at 801 °C and magnesium oxide at

2852 °C.

1. Rank the compounds from lowest to highest melting point.
2. Explain why potassium chloride has a slightly lower melting point than sodium chloride, given that K^+ has an extra shell of electrons.
3. Explain why magnesium oxide is much higher.

Problem 19 Identify three white solids (hard)

Three white solids are table salt, sugar and chalk (calcium carbonate, which does not dissolve in water). Plan tests to tell them apart.

1. Describe the tests and the observations for each solid.
2. State which solid is ionic and explain what the conductivity test shows.

Problem 20 Limits of the diagram (hard)

A student draws one sodium ion beside one chloride ion with brackets and charges, and says that the diagram shows a molecule of sodium chloride.

1. Explain two things the dot-and-cross diagram shows well.
2. Explain two things it cannot show.