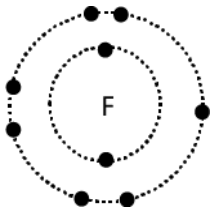
1(a).

(i) The diagram shows the arrangement of electrons in a fluorine atom.

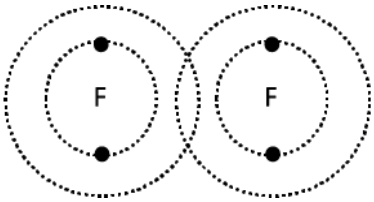
fluorine atom



A fluorine molecule contains two atoms held together by a single covalent bond.

Complete the diagram to show the arrangement of electrons in a fluorine molecule.

fluorine molecule

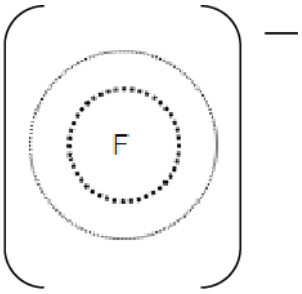


[2]

(ii) During the reaction with lithium each fluorine atom gains an electron to form a fluoride ion, F^-.

Complete the diagram to show the arrangement of electrons in a fluoride ion.

fluoride ion



[2]

(b). The table shows some information about fluorine and lithium fluoride.

Substance	Structure	Melting point (°C)
fluorine	simple covalent	– 220
lithium fluoride	giant ionic	845

Why are the melting points of fluorine and lithium fluoride different?

Put ticks (✓) in the boxes next to the **two** correct answers.

Simple covalent substances have lower melting points than giant ionic substances. ☐

Ions do not attract to each other. ☐

There are weak forces between simple covalent molecules. ☐

Ionic substances dissolve easily. ☐

[2]

2. Hydrogen gas reacts with lithium at high temperatures to make lithium hydride.

(i) At the temperatures of the reaction:

- lithium is a **liquid**
- lithium hydride is a **solid**.

Draw straight lines to join each **chemical** with its correct **state symbol at high temperature**.

chemical	state symbol at high temperature
lithium	(s)
hydrogen	(l)
lithium hydride	(g)
	(aq)

[2]

(ii) The formula for lithium hydride is LiH.

It is an ionic solid with properties similar to lithium chloride.

What properties is lithium hydride most likely to have?

Put a tick (✓) in the boxes next to the **two** correct answers.

It has a very low melting point. ☐

It is insoluble in water. ☐

The solid does not conduct electricity. ☐

The solid is made of crystals.

[2]

3(a). Chlorine reacts with metals to make metal chlorides.

The table shows some information about the chlorides of metals from different groups of the Periodic Table.

Metal	Group of the Periodic Table	Formula of metal chloride
lithium	1	LiCl
sodium	1	.....
beryllium	2	$BeCl_2$
.....	2	$MgCl_2$
aluminium	3	$AlCl_3$
silicon	4	$SiCl_4$

Complete the table by filling in the missing metal and the missing formula.

[2]

(b). Sulfur and phosphorus are non-metals.

Phosphorus is in group 5. It forms a chloride with the formula PCl_5.

Sulfur is in group 6. It forms a chloride with the formula SCl_2.

Do these chlorides fit the pattern in the table?

Explain your answer.

---

[2]

4(a). **Table 5.1** shows some data for four elements **Q, R, T** and **X**.

Element	Melting point (°C)	Boiling point (°C)	Electrical conductivity when solid	Reactivity
Q	−189	−186	none	unreactive
R	98	883	good	very reactive
T	−101	−35	none	very reactive
X	119	445	none	fairly reactive

Table 5.1

Which element in **Table 5.1** has an atom with eight electrons in its outer shell?

Explain your answer.

Element ----------

Explanation ----------

---------- **[2]**

(b). Element **T** in **Table 5.1** reacts with a metal to make a compound.

What type of structure does this compound have?

Tick (✓) **one** box.

Giant covalent ☐

Giant ionic ☐

Simple covalent ☐

[1]

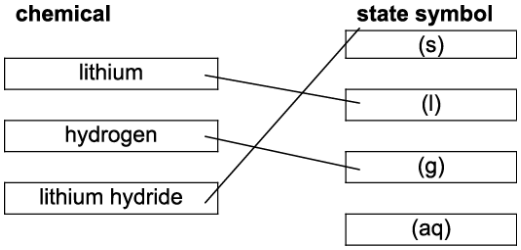
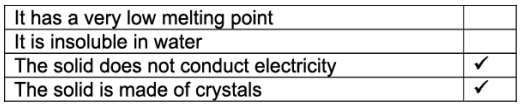
5. Magnesium oxide, MgO, is an ionic compound.

Draw a ‘dot and cross’ diagram for the ions in magnesium oxide.

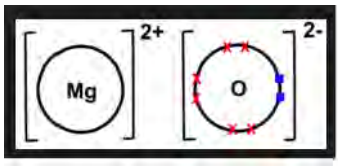
Show the outer electron shells only.

[2]

END OF QUESTION PAPER

Question			Answer/Indicative content	Marks	Guidance
1	a	i	shows 2 shared electrons between fluorine atoms ✓ shows correct number of other electrons for each atom (6) ✓	2	Accept dots or crosses or a mixture of both.
		ii	shows a total of 10 electrons ✓ in configuration 2,8 ✓	2	
	b		simple covalent substances have lower melting points than giant ionic substances ✓ there are weak forces between simple covalent molecules ✓	2	
			Total	6	
2		i		2	all correct = 2 marks 1 / 2 correct = 1 mark Examiner's Comments A disappointing number of candidates linked hydrogen incorrectly to (aq). Despite having been informed of the states of two of the chemicals, candidates still very often incorrectly linked the substances to their states.
		ii		2	Examiner's Comments Candidates most often correctly selected 'solid does not conduct electricity' but the second tick was often placed randomly.
			Total	4	

Question			Answer/Indicative content	Marks	Guidance
3	a		NaCl; magnesium;	2	**REJECT** NACl / NaCL / multiples e.g. Na_2Cl_2 **ALLOW** $NaCl_1$ **ALLOW** phonetic spelling **Examiner's Comments** Most candidates correctly identified magnesium as the missing metal in the table and many could also write the correct formula for sodium chloride. Others did not use the periodic table provided and were unable to remember the symbol for sodium and so gave SoCl as their response.
	b		P does follow pattern **AND** S does not; One from: P (does follow pattern because it) is in group 5 and has 5 Cl in molecule; S (does not follow pattern because it) is in group 6 but only has 2 / S should have 6 chlorines / S should have 4 more; Pattern shows number of chlorines matches group number;	2	**Examiner's Comments** There were some good responses that showed a clear understanding of the pattern of the formulae of the chlorides shown in the table and illustrated this understanding by reference to the chlorides of both sulfur and phosphorus. Some candidates only referred to one of the elements and others gave reasons unrelated to the pattern shown by the formulae e.g. that the elements were metals rather than non-metals.
			Total	**4**	

Question			Answer/Indicative content	Marks	Guidance
4	a		Q ✓ noble gas / Group 0 / unreactive✓	2 (AO 2.1 × 2)	Mark independently ALLOW full outer shell Examiner's Comments Most candidates could identify element Q, and many quoted lack of reactivity as the key factor. A small minority thought that eight electrons in the outer shell indicated high reactivity and suggested element T.
	b		Giant ionic ✓	1 (AO 2.1)	Examiner's Comments Few candidates, even the most able, realised that element T was likely to form an ionic compound.
			Total	3	
5			 Ions with correct electrons ✓ Charges ✓	2 (AO 1.2 × 2)	ALLOW (1) for one correct ion ALLOW eight electrons in outer shell of Mg ALLOW all oxygen electrons with same symbol IGNORE correct inner shells DO NOT ALLOW incorrect inner shells Examiner's Comments Many of the dot and cross diagrams resembled covalent compounds rather than ionic.
			Total	2	