REVISE PEARSON EDEXCEL GCSE (9–1)

Chemistry

GRADES 7–9 Revision & Practice

NAIL IT!

Pearson

REVISE PEARSON EDEXCEL GCSE (9–1)

Chemistry

GRADES 7–9 Revision & Practice

NAIL IT!

Series consultant: Harry Smith
Author: Sue Robilliard

Pearson

Contents

Use this quick quiz to check that you are confident with the core skills and knowledge you need for the Pearson Edexcel GCSE (9–1) Chemistry Higher exam or Combined Science Higher exam.

Check your understanding with solutions to all the exam-style questions.

A small bit of small print

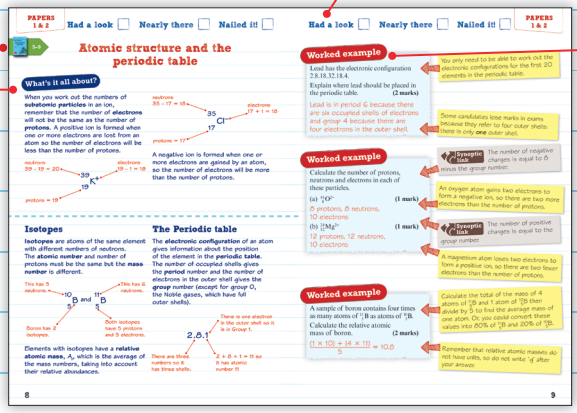
Pearson Edexcel publishes Sample Assessment Material and the Specification on its website. This is the official content and this book should be used in conjunction with it. The questions in the *Exam practice* sections have been written to help you revise topics and practise answering exam questions. Remember – the real exam questions may not look like this.

Welcome to Nail it!

This book provides revision and practice to help you nail down a top grade in your Pearson Edexcel GCSE (9–1) Chemistry Higher exam or Combined Science Higher exam. Designed for students aiming for a grade 7, 8 or 9, it is packed with exam tips, support for tricky topics and exam-style practice questions to make sure you are ready to tackle the toughest questions and achieve top marks.

For more help with these topics, check out these pages in the Revise Pearson Edexcel GCSE (9–1) Chemistry Higher Revision Guide. To check out pages in the Revise Pearson Edexcel GCSE (9-1) Combined Science Revision Guide see the table on page 77.

Track your progress by ticking these boxes.

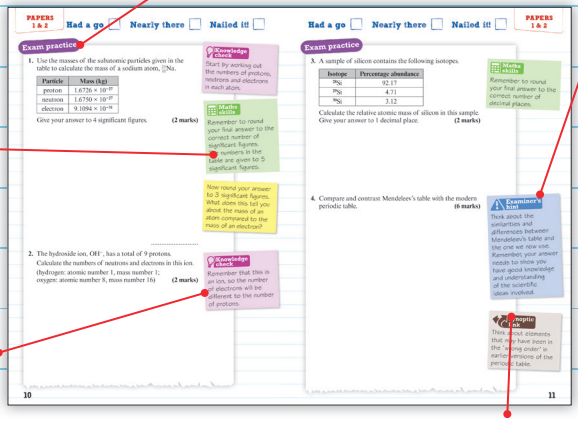


Worked example exam-style questions show you exactly how to tackle tricky questions and set out your working.

Revise the key facts and formulae for this topic.

Check that you are on track for a top grade with these exam-style questions. There are answers at the back of the book.

Examiner's hints give top tips for exam success.



Reminders of any maths skills needed to answer a question.

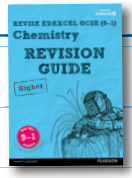
Knowledge check hints give reminders of key information and core skills. You need to be confident with these to help you achieve that top grade.

Support in bringing in knowledge from other topics to enhance your answer is given in the synoptic links.

Knowledge check

If you're aiming for a top grade, you need to be confident with core skills and knowledge, such as knowing about atomic structure, being able to balance equations and carry out mole calculations. Take this quick quiz to find out which skills you might need to brush up on before tackling the trickier topics. Answers are on page 70.

Revise core skills



Use the **Revise Pearson Edexcel GCSE (9–1) Chemistry Revision Guide** if you need to revise any of the core skills.
The green arrow tell you which page in the Guide to look at for more help with each of the topics covered in the quiz.

2 **1.** Hydrogen and oxygen react to form water. What is the balanced equation for this reaction?

- ☐ **A** $2H + O \rightarrow H_2O$
- ☐ **B** $H_2 + O \rightarrow H_2O$
- ☐ **C** $H_2 + O_2 \rightarrow 2H_2O$
- ☐ **D** $2H_2 + O_2 \rightarrow 2H_2O$

3 **2.** Silver nitrate solution reacts with sodium iodide solution to form a precipitate of silver iodide and sodium nitrate solution. What is the **ionic** equation for this reaction?

- ☐ **A** $AgNO_3(aq) + NaI(aq) \rightarrow AgI(s) + NaNO_3(aq)$
- ☐ **B** $Ag^+(aq) + NaI(aq) \rightarrow AgI(s) + Na^+(aq)$
- ☐ **C** $Ag^+(aq) + I^-(aq) \rightarrow AgI(s)$
- ☐ **D** $Na^+(aq) + NO_3^-(aq) \rightarrow NaNO_3(aq)$

7 **3.** Complete this sentence.
The elements in the periodic table are arranged in order of increasing

.....

10 **4.** How many electrons are there in the aluminium ion $^{27}_{13}Al^{3+}$?

- ☐ **A** 10
- ☐ **B** 16
- ☐ **C** 24
- ☐ **D** 30

11 **5.** What is the name of the compound with the formula $KClO_3$?

.....

12 **6.** When do ionic compounds conduct electricity?

- ☐ **A** in aqueous solution only
- ☐ **B** in the solid state only
- ☐ **C** in aqueous solution and when molten
- ☐ **D** in the solid state and when molten

13 **7.** Carbon is in group 4 of the periodic table. How many covalent bonds can carbon atoms form?

- ☐ **A** 1
- ☐ **B** 2
- ☐ **C** 3
- ☐ **D** 4

14 **8.** Which of these is a simple molecular substance?

- ☐ **A** copper
- ☐ **B** diamond
- ☐ **C** salt
- ☐ **D** water

15 **9.** Which particles move through the structure when graphite conducts electricity?

- ☐ **A** atoms
- ☐ **B** electrons
- ☐ **C** ions
- ☐ **D** molecules

19 **10.** What is the relative formula mass of sulfuric acid, H_2SO_4?
(A_r: H = 1, O = 16, S = 32)

.....

20 **11.** The molecular formula of a compound is $C_2H_4O_2$. What is the empirical formula of this compound?

.....

23 **12.** A solution is made by dissolving 5.0 g of potassium hydroxide in 100 cm^3 of water.
What is the concentration of the solution formed in g/dm^3?

- ☐ **A** 0.50
- ☐ **B** 20
- ☐ **C** 50
- ☐ **D** 200

24 **13.** What is the amount, in mol, of methane molecules in 96 g of methane, CH_4?
(A_r: H = 1, C = 12)

- ☐ **A** 0.167
- ☐ **B** 2
- ☐ **C** 4
- ☐ **D** 6

24 **14.** How many **atoms** are there in 0.5 mol of nitrogen gas, N_2?
(Avogadro's constant = 6.02×10^{23})

- ☐ **A** 3.01×10^{23}
- ☐ **B** 6.02×10^{23}
- ☐ **C** 1.204×10^{24}
- ☐ **D** 2.408×10^{24}

34 **15.** Which ions are present in aqueous solutions of all acids?

- ☐ **A** Cl^-
- ☐ **B** H^+
- ☐ **C** Na^+
- ☐ **D** SO_4^{2-}

35 **16.** The concentration of an aqueous solution of an acid is decreased by a factor of 100. What is the change in pH of the solution?

- ☐ **A** decrease by 1
- ☐ **B** decrease by 2
- ☐ **C** increase by 1
- ☐ **D** increase by 2

36 **17.** Which of these reacts with dilute sulfuric acid to form magnesium sulfate and hydrogen?

- ☐ **A** magnesium
- ☐ **B** magnesium carbonate
- ☐ **C** magnesium hydroxide
- ☐ **D** magnesium oxide

40 **18.** Which of these is an insoluble salt?

- ☐ **A** ammonium nitrate
- ☐ **B** barium sulfate
- ☐ **C** potassium chloride
- ☐ **D** sodium carbonate

42 **19.** What is produced at the **cathode** during the electrolysis of molten zinc chloride?

- ☐ **A** chlorine
- ☐ **B** hydrogen
- ☐ **C** oxygen
- ☐ **D** zinc

43 **20.** What is produced at the **anode** during the electrolysis of an aqueous solution of sodium sulfate?

- ☐ **A** hydrogen
- ☐ **B** oxygen
- ☐ **C** sodium
- ☐ **D** sulfur

48 **21.** Four metals are arranged in order of decreasing reactivity from left to right: potassium, calcium, zinc, silver.
Which atoms form cations most easily?

- ☐ **A** potassium atoms
- ☐ **B** calcium atoms
- ☐ **C** zinc atoms
- ☐ **D** silver atoms

49 **22.** Zinc is formed when zinc oxide is heated with carbon.
$ZnO + C \rightarrow Zn + CO$
Which substance is reduced in this reaction?

- ☐ **A** ZnO
- ☐ **B** C
- ☐ **C** Zn
- ☐ **D** CO

55 **23.** Which of these is a typical property of a transition metal?

- ☐ **A** can act as a catalyst
- ☐ **B** forms white or colourless compounds
- ☐ **C** has a low density
- ☐ **D** has a low melting point

59 **24.** During an accurate titration, 25.0 cm^3 of sodium hydroxide solution reacted with 22.6 cm^3 of hydrochloric acid. Which of these should be used to measure the volume of sodium hydroxide solution?

- ☐ **A** burette
- ☐ **B** conical flask
- ☐ **C** measuring cylinder
- ☐ **D** pipette

59 **25.** A student obtained the following titres during a titration: 22.3 cm^3, 21.9 cm^3, 21.5 cm^3, 21.6 cm^3. What is the mean of the concordant titres?

- ☐ **A** 21.55 cm^3
- ☐ **B** 21.67 cm^3
- ☐ **C** 21.83 cm^3
- ☐ **D** 22.10 cm^3

60 **26.** What mass of sodium hydroxide, NaOH, is needed to make 100 cm^3 of a solution with a concentration of 0.100 mol/dm^3? (M_r of NaOH = 40)

- ☐ **A** 0.4 g
- ☐ **B** 4.0 g
- ☐ **C** 40 g
- ☐ **D** 400 g

61 **27.** What is the amount, in mol, of hydrochloric acid in 25.0 cm^3 of a solution of hydrochloric acid with a concentration of 0.200 mol/dm^3?

.....

62 **28.** The theoretical yield of iron produced in a reaction is 5.6 g. The actual yield of iron formed is 3.5 g. What is the percentage yield of iron in this reaction?

.....

68

29 Methanol, CH_3OH, is manufactured by this reaction

$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$

The forward reaction is exothermic. What are the effects of increasing the temperature on this equilibrium?

- ☐ **A** rate of reaction decreases and less methanol is formed
- ☐ **B** rate of reaction decreases and more methanol is formed
- ☐ **C** rate of reaction increases and less methanol is formed
- ☐ **D** rate of reaction increases and more methanol is formed

78

30. Chlorine displaces bromine from aqueous potassium bromide. The half equations for this reaction are

$Cl_2(aq) + 2e^- \rightarrow 2Cl^-(aq)$

$2Br^-(aq) \rightarrow Br_2(aq) + 2e^-$

Which species is oxidised?

- ☐ **A** Cl_2
- ☐ **B** Cl^-
- ☐ **C** Br^-
- ☐ **D** Br_2

78

31. Complete the sentence.

The .....the rate of reaction,

the lower the ..... time.

82

32. Which of these is always endothermic?

- ☐ **A** displacement
- ☐ **B** dissolving
- ☐ **C** neutralisation
- ☐ **D** thermal decomposition

99

33. Which of these formulae represents a hydrocarbon?

- ☐ **A** C_3H_8
- ☐ **B** CH_2Cl_2
- ☐ **C** C_2H_6O
- ☐ **D** $NaHCO_3$

102

34. Which of these functional groups is needed to form an addition polymer?

- ☐ **A** alcohols and carboxylic acids
- ☐ **B** alcohols only
- ☐ **C** alkanes and alkenes
- ☐ **D** alkenes only

108

35. Which of these carboxylic acids will react with magnesium to form magnesium propanoate?

- ☐ **A** HCOOH
- ☐ **B** CH_3COOH
- ☐ **C** CH_3CH_2COOH
- ☐ **D** $CH_3CH_2CH_2COOH$

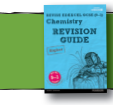
96

36. A compound reacts with aqueous sodium hydroxide when heated and releases a gas that turns damp red litmus blue.Which of these ions could be present in the compound?

- ☐ **A** N^{3-}
- ☐ **B** Na^+
- ☐ **C** NH_4^+
- ☐ **D** NO_3^-

CORE

Had a look ☐ Nearly there ☐ Nailed it! ☐



1–3, 11

Formulae and equations

What's it all about?

Balancing formulae

In the formula of an ionic compound, the charges must be balanced. An ammonium ion is NH_4^+ and a sulfate ion is SO_4^{2-}. The formula for ammonium sulfate is:

Brackets are needed when there is more than one compound ion in a formula.

$(NH_4)_2SO_4$

2 ammonium ions with 1 positive charge each balance the 2 negative charges on the sulfate ion.

A compound ion contains more than one atom, for example:
NH_4^+, OH^-, NO_3^-, CO_3^{2-}, SO_4^{2-}

Balancing equations

All equations must be balanced so they have the same number of atoms of each kind on each side.

$H_2 + O_2 \rightarrow H_2O$

This equation is not balanced as there are 2 hydrogen atoms and 2 oxygen atoms on the left and 2 hydrogen atoms and 1 oxygen atom on the right.

$2H_2 + O_2 \rightarrow 2H_2O$

Add a 2 in front of H_2O to give 2 oxygen atoms on the right. A 2 is now needed in front of H_2 to balance the hydrogen.

All ionic equations must be balanced in terms of the numbers of atoms or ions of each element **and** their charges.

$Cu + Ag^+ \rightarrow Ag + Cu^{2+}$

This ionic equation is balanced in terms of particles as there is 1 copper particle on each side and 1 silver particle on each side of the equation.

It is not balanced in terms of charges as there is only 1 positive charge on the left but 2 on the right.

The correct balanced equation is

$Cu + 2Ag^+ \rightarrow 2Ag + Cu^{2+}$

There are now two positive charges on each side of the equation.

Worked example

Balance this equation.

$C_4H_{10} + O_2 \rightarrow CO_2 + H_2O$ **(1 mark)**

$C_4H_{10} + 6\frac{1}{2}O_2 \rightarrow 4CO_2 + 5H_2O$

Start by balancing the carbon atoms, then the hydrogen atoms and finally the oxygen atoms. It is acceptable to balance equations like this using $\frac{1}{2}$.

Worked example

Balance this ionic equation.

$Br_2 + I^- \rightarrow Br^- + I_2$ **(1 mark)**

$Br_2 + 2I^- \rightarrow 2Br^- + I_2$

This equation is balanced in terms of charges but not in terms of atoms.

Exam practice

1. The symbols of some ions are:

Na^+	Mg^{2+}	Al^{3+}	NO_3^-	OH^-	SO_4^{2-}

Write the formulae for the following compounds:

(a) sodium sulfate ..... **(1 mark)**

(b) magnesium hydroxide ..... **(1 mark)**

(c) aluminium nitrate ..... **(1 mark)**

Use the formulae of the ions you are given.

Knowledge check

Remember to use brackets if you need more than one of any compound ion.

Examiner's hint

The total numbers of positive charges and negative charges must be the same.

2. Balance these equations by inserting numbers where appropriate.

(a) .....Na + ... H_2O → .....NaOH + ...H_2 **(1 mark)**

(b) .....Fe + ...Cl_2 → $FeCl_3$ **(1 mark)**

(c) .....C_2H_6 + ...O_2 → .....CO_2 + ...H_2O **(1 mark)**

You do not need to insert the number 1 when balancing equations.

It is acceptable to balance equations like this using $\frac{1}{2}$.

3. Magnesium reacts with dilute nitric acid to form a solution of magnesium nitrate and hydrogen.

Write the balanced equation for this reaction. Include state symbols. **(3 marks)**

The formulae of the ions in question 1 will help you to work out the formula of magnesium nitrate.

4. Complete and balance these ionic equations.

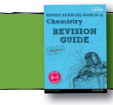
(a) .....Cl_2 + ...Br^- → .....Cl^- + ...Br_2 **(1 mark)**

(b) .....Al^{3+} + ... → .....$Al(OH)_3$ **(2 marks)**

(c) .....Pb^{2+} + ... → .....PbI_2 **(2 marks)**

Remember to check that the particles and the charges are balanced.

Had a look ☐ Nearly there ☐ Nailed it! ☐

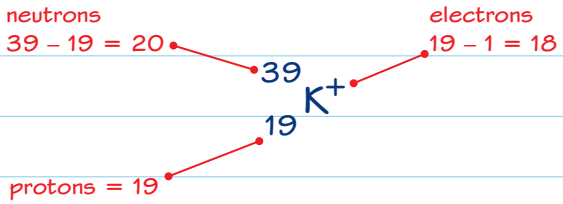


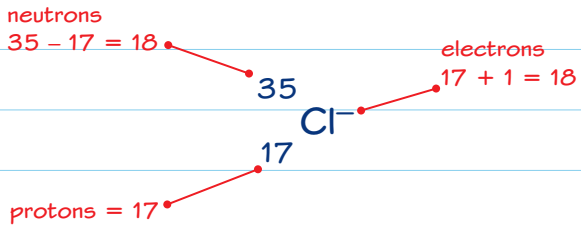
5–9

Atomic structure and the periodic table

What's it all about?

When you work out the numbers of **subatomic particles** in an ion, remember that the number of **electrons** will not be the same as the number of **protons**. A positive ion is formed when one or more electrons are lost from an atom so the number of electrons will be less than the number of protons.

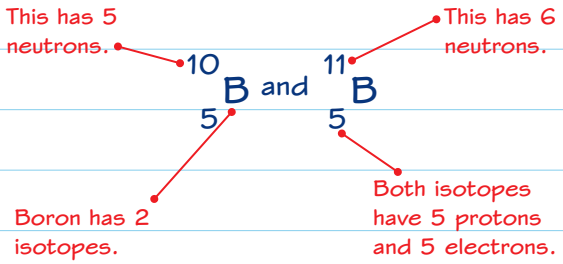




A negative ion is formed when one or more electrons are gained by an atom, so the number of electrons will be more than the number of protons.

Isotopes

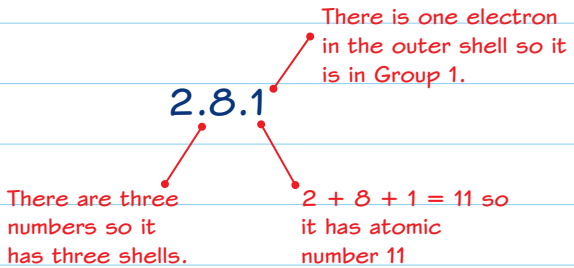
Isotopes are atoms of the same element with different numbers of neutrons. The **atomic number** and number of protons must be the same but the **mass number** is different.



Elements with isotopes have a **relative atomic mass**, A_r, which is the average of the mass numbers, taking into account their relative abundances.

The Periodic table

The **electronic configuration** of an atom gives information about the position of the element in the **periodic table**. The number of occupied shells gives the **period** number and the number of electrons in the outer shell gives the **group** number (except for group 0, the Noble gases, which have full outer shells).



Worked example

Lead has the electronic configuration 2.8.18.32.18.4.

Explain where lead should be placed in the periodic table. **(2 marks)**

Lead is in period 6 because there are six occupied shells of electrons and group 4 because there are four electrons in the outer shell.

You only need to be able to work out the electronic configurations for the first 20 elements in the periodic table.

Some candidates lose marks in exams because they refer to four outer shells: there is only **one** outer shell.

Worked example

Calculate the number of protons, neutrons and electrons in each of these particles.

(a) $^{16}_{8}O^{2-}$ **(1 mark)**

8 protons, 8 neutrons, 10 electrons

(b) $^{24}_{12}Mg^{2+}$ **(1 mark)**

12 protons, 12 neutrons, 10 electrons

Synoptic link The number of negative charges is equal to 8 minus the group number.

An oxygen atom gains two electrons to form a negative ion, so there are two more electrons than the number of protons.

Synoptic link The number of positive charges is equal to the group number.

A magnesium atom loses two electrons to form a positive ion, so there are two fewer electrons than the number of protons.

Worked example

A sample of boron contains four times as many atoms of $^{11}_{5}B$ as atoms of $^{10}_{5}B$.

Calculate the relative atomic mass of boron. **(2 marks)**

$$\frac{(1 \times 10) + (4 \times 11)}{5} = 10.8$$

Calculate the total of the mass of 4 atoms of $^{11}_{5}B$ and 1 atom of $^{10}_{5}B$ then divide by 5 to find the average mass of one atom. Or, you could convert these values into 80% of $^{11}_{5}B$ and 20% of $^{10}_{5}B$.

Remember that relative atomic masses do not have units, so do not write 'g' after your answer.

Had a go ☐ Nearly there ☐ Nailed it! ☐

Exam practice

1. Use the masses of the subatomic particles given in the table to calculate the mass of a sodium atom, $^{23}_{11}Na$.

Particle	Mass (kg)
proton	1.6726×10^{-27}
neutron	1.6750×10^{-27}
electron	9.1094×10^{-31}

Give your answer to 4 significant figures. **(2 marks)**

Knowledge check

Start by working out the numbers of protons, neutrons and electrons in each atom.

Maths skills

Remember to round your final answer to the correct number of significant figures. The numbers in the table are given to 5 significant figures.

Now round your answer to 3 significant figures. What does this tell you about the mass of an atom compared to the mass of an electron?

.....

2. The hydroxide ion, OH^-, has a total of 9 protons.

Calculate the numbers of neutrons and electrons in this ion.

(hydrogen: atomic number 1, mass number 1;
oxygen: atomic number 8, mass number 16) **(2 marks)**

Knowledge check

Remember that this is an ion, so the number of electrons will be different to the number of protons.

Exam practice

3. A sample of silicon contains the following isotopes.

Isotope	Percentage abundance
^{28}Si	92.17
^{29}Si	4.71
^{30}Si	3.12

Calculate the relative atomic mass of silicon in this sample. Give your answer to 1 decimal place. **(2 marks)**

Maths skills

Remember to round your final answer to the correct number of decimal places.

4. Compare and contrast Mendeleev's table with the modern periodic table. **(6 marks)**

Examiner's hint

Think about the similarities and differences between Mendeleev's table and the one we now use. Remember, your answer needs to show you have good knowledge and understanding of the scientific ideas involved.

Synoptic link

Think about elements that may have been in the 'wrong order' in earlier versions of the periodic table.

Had a look ☐ Nearly there ☐ Nailed it! ☐

10, 11, 13, 17

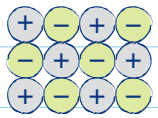
Bonding

What's it all about?

Bonding is the strong electrostatic forces of attraction between oppositely charged particles. The **outer** electrons of atoms are rearranged and usually obtain the same electron configuration as the nearest noble gas. They do this by gaining, losing or sharing electrons.

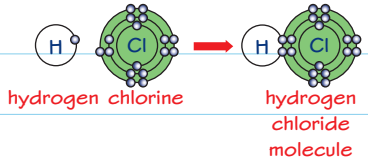
Types of bonding

Ionic bonding:



- takes place between metals and non-metals
- involves the transfer of electrons from the metal to the non-metal - metals form cations (positive ions) and non-metals usually form anions (negative ions)
- is the strong electrostatic attraction between oppositely charged ions

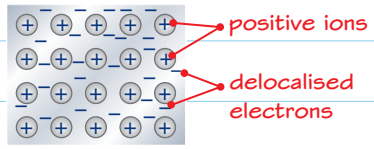
Covalent bonding:



- takes place between non-metals
- involves the sharing of pairs of electrons to form a molecule
- is the strong electrostatic attraction between two nuclei and the shared pair of electrons

The resulting particle is a molecule.

Metallic bonding:



- takes place in metals
- involves positive ions in a sea of electrons
- is the strong electrostatic attraction between metal ions and delocalised electrons

The electrons are free to move between the positive ions.

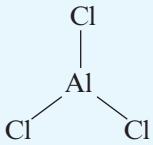
Metals form cations (positive ions) and non-metals usually form anions (negative ions). Hydrogen is a non-metal but forms an H^+ ion.

Ionic and covalent bonding

Similarities	Differences
• Both types of bonding involve the rearrangement of the outer electrons of atoms.	• Ionic bonding takes place when electrons are gained and lost. Anions and cations are formed.
• They are both strong. • Atoms or ions usually have 8 electrons in their outer shell once they have bonded.	• Covalent bonding takes place when pairs of electrons are shared. Neutral molecules are formed.

Worked example

Aluminium chloride consists of covalent molecules that can be represented by this structure:



(a) Write the electronic configurations of aluminium and chlorine. **(2 marks)**

Aluminium is 2.8.3 and chlorine is 2.8.7.

Look at a copy of the periodic table to find the atomic numbers.

(b) Draw a dot-and-cross diagram to represent aluminium chloride. Show the outer shell electrons only. **(1 mark)**

Aluminium has 13 electrons and chlorine has 17 electrons.

You could also draw the electrons in overlapping circles. Don't forget to include the 3 non-bonding pairs of electrons on each chlorine atom.

(c) State **two** features that are unusual about this molecule. **(2 marks)**

Metals and non-metals react together to form ionic compounds but this is a covalent molecule.

There are only 6 electrons in the outer shell of aluminium in aluminium chloride but a complete outer shell holds 8 electrons.

Don't be tempted to add 2 more electrons to the outer shell of aluminium.

Had a go ☐ Nearly there ☐ Nailed it! ☐

Exam practice

1. Sodium oxide is an ionic compound.

Describe, in terms of electron transfer, how sodium atoms react with oxygen atoms to form sodium oxide.

You may include diagrams in your answer. **(4 marks)**

Examiner's hint

Use the information given in the question. Sodium oxide is an ionic compound so you should not mention sharing electrons.

Knowledge check

Metals form positive ions and non-metals form negative ions.

Synoptic link

Start with the electronic configurations of sodium and oxygen – use the periodic table to work out how many electrons they each have.

Diagrams are not essential but may help you to organise your answer. You could include dot-and-cross diagrams to show the electronic configurations of the atoms and the ions. Don't forget to include the charges on the ions.

Exam practice

2. Magnesium is a metal and chlorine is a non-metal.

Compare and contrast the bonding in magnesium with that in chlorine gas.

You may include diagrams in your answer. **(6 marks)**

Examiner's hint

'Compare and contrast' means that you need to include similarities and differences. You need to include at least one similarity and at least one difference in your answer.

Knowledge check

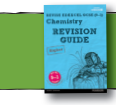
Think about the types of bonding in magnesium and chlorine gas. If you cannot remember the particles in chlorine gas, revise group 7.

Synoptic link

Don't just describe the bonding in magnesium and then the bonding in chlorine. It isn't wrong to include these, but you also need to think about the similarities and the differences between them and make these clear in your answer.

It is often helpful to include diagrams when describing the bonding in a substance.

Had a look ☐ Nearly there ☐ Nailed it! ☐

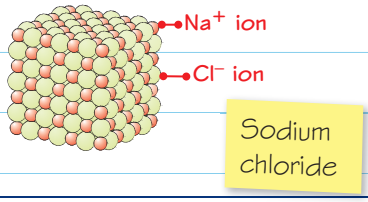


12, 14–18, 25, 111, 112

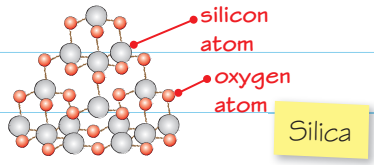
Structure, bonding and properties

What's it all about?

Giant lattice structures

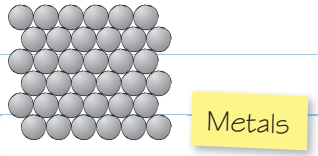


Sodium chloride is an example of an **ionic compound**. There are strong electrostatic forces of attraction between oppositely charged ions.



Silica is an example of a **giant molecular** substance.

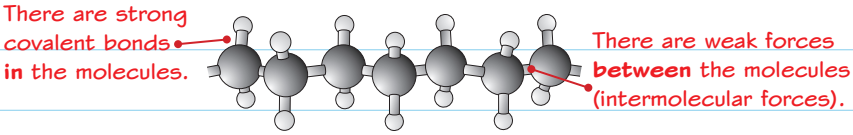
There are strong covalent bonds between the atoms.



Metals have strong electrostatic forces of attraction between positive ions and delocalised electrons.

Simple molecular

Poly(ethene) is an example of a simple molecular substance.



Physical properties

The physical properties of a substance depend on bonding and structure. The uses of a material depend on its properties.

Physical property	Explanation
High melting point or boiling point	A lot of energy is needed to overcome the forces between the particles to separate them. Ionic compounds, giant molecular substances and most metals have high melting and boiling points.
Conducts electricity	Ionic compounds conduct electricity when molten or dissolved in water as their ions can move. Metals and graphite conduct electricity, as delocalised electrons can move.
Soluble in water	Many ionic compounds and a few simple molecular substances are soluble in water because particles form strong forces with water molecules. Metals and giant molecular substances are not soluble in water.

Worked example

Potassium chloride and carbon dioxide have very different properties.

Potassium chloride is an ionic compound. It is a crystalline solid with a high melting point and conducts electricity when molten or in aqueous solution.

Carbon dioxide is a covalent compound. It is a gas at room temperature and does not conduct electricity.

Explain these properties of potassium chloride and carbon dioxide in terms of the particles present and the forces between them. **(6 marks)**

Potassium chloride contains ions / K^+ and Cl^-. It has a high melting point because it has a giant structure with strong (electrostatic) forces of attraction between the ions so a lot of energy is needed to separate the oppositely charged ions. It conducts electricity when molten or in aqueous solution because the ions are free to move.

Carbon dioxide contains molecules so little energy is needed to separate the molecules. It has a low melting point because it is a simple molecular substance with weak forces between the molecules. It does not conduct electricity as it does not contain any charged particles (that are free to move from place to place).

Examiner's hint

You do not need to include any other properties, just write about melting points and conduction of electricity.

You do not need to explain how these particles are formed from the atoms.

Remember that **ions** move in an ionic compound, not electrons.

Remember that covalent bonds are **not** broken when a simple molecular substance melts or boils.

Had a go ☐ Nearly there ☐ Nailed it! ☐

Exam practice

1. Explain why solid magnesium sulfate does not conduct electricity but an aqueous solution of magnesium sulfate is a good conductor of electricity. **(2 marks)**

Examiner's hint

Take care to include the correct particles in your answer.

2. Graphite and ceramics have very high melting points. However, graphite is a good conductor of electricity but ceramics are poor conductors when solid.

Discuss these two properties, in terms of structure and bonding. **(4 marks)**

Examiner's hint

You need to explain the similarities and differences in their structure and bonding and relate these to the properties.

Knowledge check

Revise the structure and bonding in graphite.

Synoptic link

You are not expected to know a lot about ceramics but apply your knowledge of the properties to predict the likely structure.

Exam practice

3. Some physical properties of three substances, **A**, **B** and **C** are given in the table.

Property	A	B	C
Melting point in °C	650	801	42
Conducts electricity	good conductor when solid	poor conductor when solid good conductor when molten	poor conductor when solid and molten

Identify the types of bonding and structure in **A**, **B** and **C**.

Justify your answers. **(6 marks)**

The melting point of graphite is over 3500 °C.

Knowledge check

The bonding is ionic, covalent or metallic. The structure is giant or simple molecular.

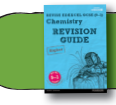
Synoptic link

Use the relative melting points to consider the strength of the bonds or forces between particles. Then use the conduction to consider the particles.

You must give reasons for your answers and you must also present these reasons clearly and in a logical structure.

PAPER 1

Had a look ☐ Nearly there ☐ Nailed it! ☐



34–41

Acids, bases and salts

What's it all about?

Bases

Bases react with an acid to form a salt and water. Metal oxides and metal hydroxides are bases.

An **alkali** is a base that is soluble in water, e.g. sodium hydroxide (NaOH) and potassium hydroxide (KOH).

The pH depends on the concentration of the solution and the strength of the acid or alkali.

Acids and alkalis

ACIDS
Acids produce H^+ ions in an aqueous solution. The pH of aqueous solution is <7. The higher the concentration of $H^+(aq)$ ions, the **lower** the pH.

NEUTRAL

ALKALIS
Alkalis produce OH^- ions in an aqueous solution. The pH of aqueous solution is >7. The higher the concentration of $OH^-(aq)$ ions, the **higher** the pH.

Leave out the symbols of the ions in solution that do not change.

Strong acids

A **strong acid** completely dissociates into ions in aqueous solution. Hydrochloric acid (HCl), nitric acid (HNO_3) and sulfuric acid (H_2SO_4) are strong acids. A **weak acid** only slightly dissociates into ions in aqueous solution. Ethanoic acid (CH_3COOH) is a weak acid.

Ionic equations for reactions of acids

$2H^+(aq) + Mg(s) \rightarrow Mg^{2+}(aq) + H_2(g)$

$2H^+(aq) + CuO(s) \rightarrow Cu^{2+}(aq) + H_2O(l)$

$H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$

$2H^+(aq) + CuCO_3(s) \rightarrow Cu^{2+}(aq) + CO_2(g) + H_2O(l)$

Salts

A **salt** is formed when the hydrogen ions in an acid are replaced with metal ions. For example, nitric acid forms nitrates and ethanoic acid forms ethanoates. Soluble salts can be made by reacting an acid with a base, an alkali or a carbonate. Some moderately reactive metals, such as magnesium, also react with acids to form salts.

Insoluble salts

Insoluble salts are made by mixing together an aqueous solution containing the cation and an aqueous solution containing the anion in the required salt. For example, silver chloride can be made from silver nitrate solution and sodium chloride solution.

$Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$