PEARSON EDEXCEL GCSE COMBINED SCIENCE (HIGHER) · 1SC0

CHEMISTRY



EXAM QUESTION PACK

TOPIC 1: KEY CONCEPTS IN CHEMISTRY: COVALENT BONDING (PAPER 2)

SCORE	PERCENTAGE
/93	%

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Q1.

This question is about the properties of different substances.

Silicon tetrachloride is a simple molecular covalent compound.

(i) A molecule of silicon tetrachloride is composed of a silicon atom and four chlorine atoms.

- a silicon atom has 4 outer electrons
- a chlorine atom has 7 outer electrons

Draw a dot and cross diagram of a molecule of silicon tetrachloride, $SiCl_4$.

Show outer electrons only.

(2)

(ii) Explain why simple molecular covalent compounds such as silicon tetrachloride have low melting and boiling points.

(2)

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(Total for question = 4 marks)

(**QU05a 1SC0/1CH, June 2024**)

Q2.

(a) Complete the sentence by putting a cross (☒) in the box next to your answer.

The particles in atoms are electrons, neutrons and protons.

The mass of an electron is

(1)

☒ **A** greater than the mass of a neutron

☒ **B** the same as the mass of a proton

☒ **C** smaller than the mass of a proton

☒ **D** the same as the mass of a neutron

(b) The atomic number of oxygen is 8.

The mass number of an atom of oxygen is 17.

Describe the number and type of particles in the nucleus of this atom.

(2)

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(c) Sulfur and oxygen are both in group 6 of the periodic table.

Explain, in terms of their electronic configurations, why they are both in group 6.

(2)

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(d) An atom of phosphorus contains 15 electrons.

Describe how these 15 electrons are arranged in a phosphorus atom.

(2)

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(e) Phosphorus oxide is a compound that contains covalent bonds.

(i) Describe what is meant by a **covalent bond.**

(2)

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(ii) The formula of a molecule of phosphorus oxide is P_4O_{10}

Give the empirical formula of this oxide.

(1)

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(Total for Question = 10 marks)

(**Q46 1SC0/1CH, June 2013**)

Q3.

(a) Complete the sentence by putting a cross (☒) in the box next to your answer.

The particles in atoms are electrons, neutrons and protons.

The mass of an electron is

(1)

☒ **A** greater than the mass of a neutron

☒ **B** the same as the mass of a proton

☒ **C** smaller than the mass of a proton

☒ **D** the same as the mass of a neutron

(b) The atomic number of oxygen is 8.

The mass number of an atom of oxygen is 17.

Describe the number and type of particles in the nucleus of this atom.

(2)

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(c) Sulfur and oxygen are both in group 6 of the periodic table.

Explain, in terms of their electronic configurations, why they are both in group 6.

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(d) An atom of phosphorus contains 15 electrons.

Describe how these 15 electrons are arranged in a phosphorus atom.

(2)

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(e) Phosphorus oxide is a compound that contains covalent bonds.

(i) Describe what is meant by a **covalent bond.**

(2)

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(ii) The formula of a molecule of phosphorus oxide is P_4O_{10}

Give the empirical formula of this oxide.

(1)

.....

(Total for Question = 10 marks)

(**Q43 1SC0/2CH, June 2013**)

Q4.

Chlorine exists as diatomic molecules.

In a molecule, two chlorine atoms are joined by a covalent bond.

(i) Describe what is meant by a **covalent bond**.

(2)

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(ii) Explain why chlorine is a gas, rather than a liquid, at room temperature.

(2)

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(Total for question = 4 marks)

(**Q22 1SC0/2CF, June 2018**)

Q5.

Chlorine exists as diatomic molecules.

In a molecule, two chlorine atoms are joined by a covalent bond.

(i) Describe what is meant by a **covalent bond**.

(2)

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(ii) Explain why chlorine is a gas, rather than a liquid, at room temperature.

(2)

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(Total for question = 4 marks)

(**Q06 1SC0/2CH, June 2018**)

Q6.

Chlorine and carbon

(a) Chlorine has an atomic number of 17.
Chlorine-35 and chlorine-37 are two isotopes of chlorine.

(i) Complete the table to show the numbers of protons, neutrons and electrons in each of the isotopes.

(2)

	chlorine-35	chlorine-37
number of protons		
number of neutrons		
number of electrons		

(ii) A normal sample of chlorine contains only chlorine-35 and chlorine-37 atoms.

Explain why the relative atomic mass of chlorine is 35.5

(2)

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(b) Tetrachloromethane is a simple molecular, covalent compound. The formula of its molecule is CCl_4.

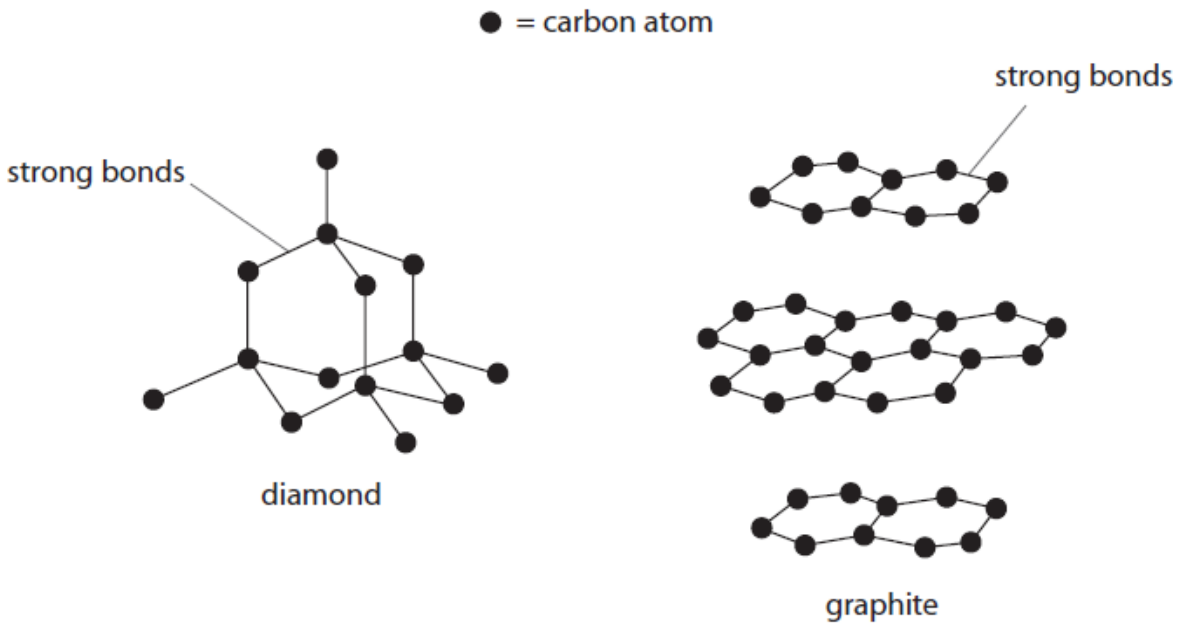
There are four electrons in the outer shell of a carbon atom.
There are seven electrons in the outer shell of a chlorine atom.

Draw a dot and cross diagram to show the bonding in a molecule of tetrachloromethane, CCl_4.

Show outer shell electrons only.

(2)

*(c) The diagrams show the arrangements of carbon atoms in diamond and in graphite.



Compare a use of diamond with a use of graphite, explaining each use in terms of the bonding

and structure. In your answer you should use information from the diagrams.

(6)

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(Total for question = 12 marks)

(**Q06 1SC0/1CH, June 2014**)

Q7.

Chlorine and carbon

(a) Chlorine has an atomic number of 17.
Chlorine-35 and chlorine-37 are two isotopes of chlorine.

(i) Complete the table to show the numbers of protons, neutrons and electrons in each of the isotopes.

(2)

	chlorine-35	chlorine-37
number of protons		
number of neutrons		
number of electrons		

(ii) A normal sample of chlorine contains only chlorine-35 and chlorine-37 atoms.

Explain why the relative atomic mass of chlorine is 35.5

(2)

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(b) Tetrachloromethane is a simple molecular, covalent compound. The formula of its molecule is CCl_4.

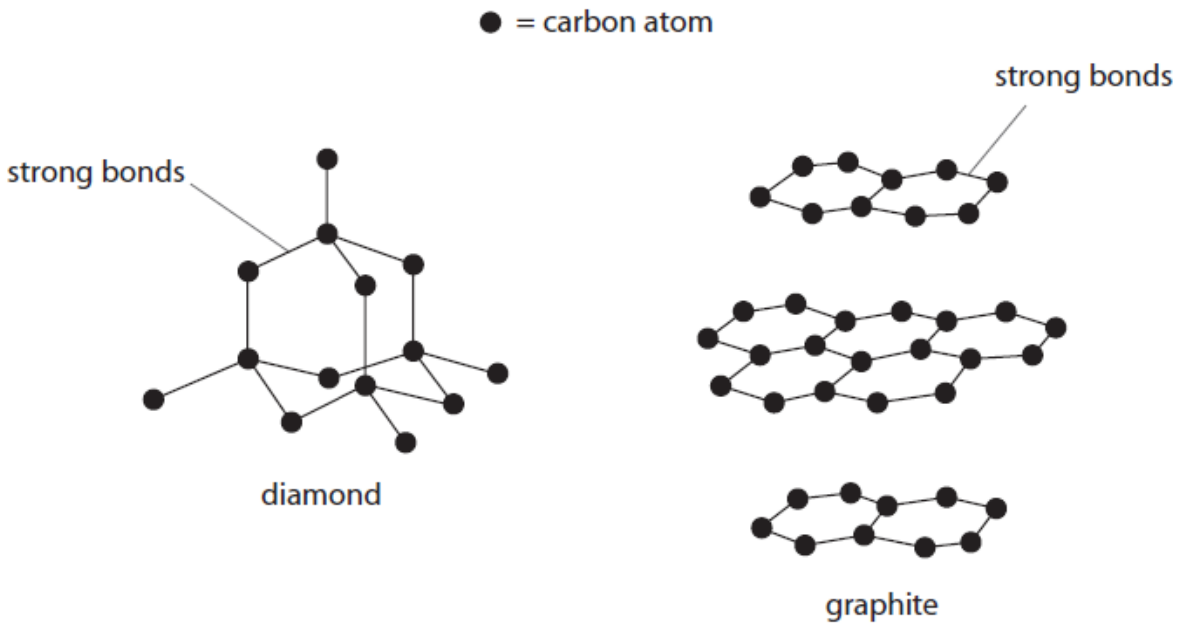
There are four electrons in the outer shell of a carbon atom.
There are seven electrons in the outer shell of a chlorine atom.

Draw a dot and cross diagram to show the bonding in a molecule of tetrachloromethane, CCl_4.

Show outer shell electrons only.

(2)

*(c) The diagrams show the arrangements of carbon atoms in diamond and in graphite.



Compare a use of diamond with a use of graphite, explaining each use in terms of the bonding

and structure. In your answer you should use information from the diagrams.

(6)

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(Total for question = 12 marks)

(**Q05 1SC0/2CH, June 2014**)

Q8.

Figure 6 shows the electron arrangement for an atom of hydrogen and an atom of oxygen.

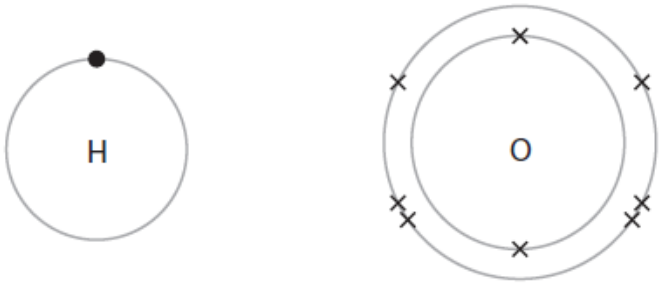


Figure 6

Complete the dot and cross diagram in Figure 7 for a molecule of water, H_2O.

Draw outer shell electrons only.

(2)

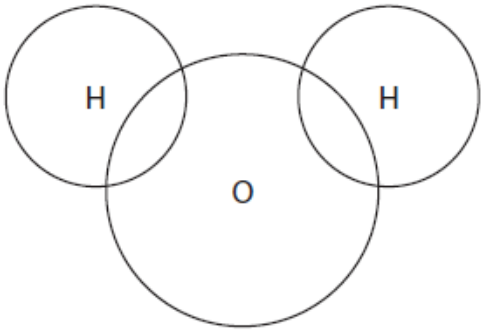


Figure 7

(Total for question = 2 marks)

(**Q04c 1SC0/2CF, Nov 2021**)

Q9.

Figure 1 shows the structure of a molecule of each of four compounds, **A**, **B**, **C** and **D**.

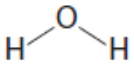
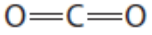
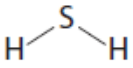
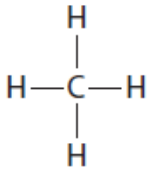
compound A	compound B	compound C	compound D
			

Figure 1

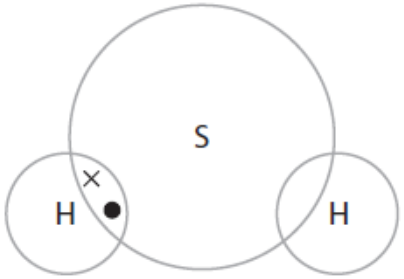
Figure 2 shows information about the number of electrons in the outer shell of each of the different atoms in a molecule of compound **C.**

symbol of element	number of electrons in outer shell of the atom
H	1
S	6

Figure 2

Use the information in Figure 2 to complete the dot and cross diagram for a molecule of compound **C.**

(2)



(Total for question = 2 marks)

(**QU01c 1SC0/2CF, June 2023**)

Q10.

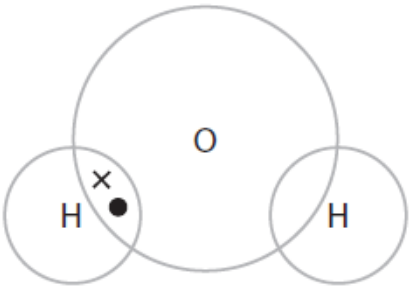
An oxygen atom has six electrons in its outer shell.

A hydrogen atom has one electron in its outer shell.

Complete the dot and cross diagram of a molecule of water, H_2O.

Show outer shell electrons only.

(2)



(Total for question = 2 marks)

(**Q05e 1SC0/1CF, June 2019**)

Q11.

Sodium reacts with chlorine to form sodium chloride, which contains ionic bonds.

Hydrogen reacts with chlorine to form hydrogen chloride, which contains covalent bonds.

Figure 6 shows dot and cross diagrams of these compounds.

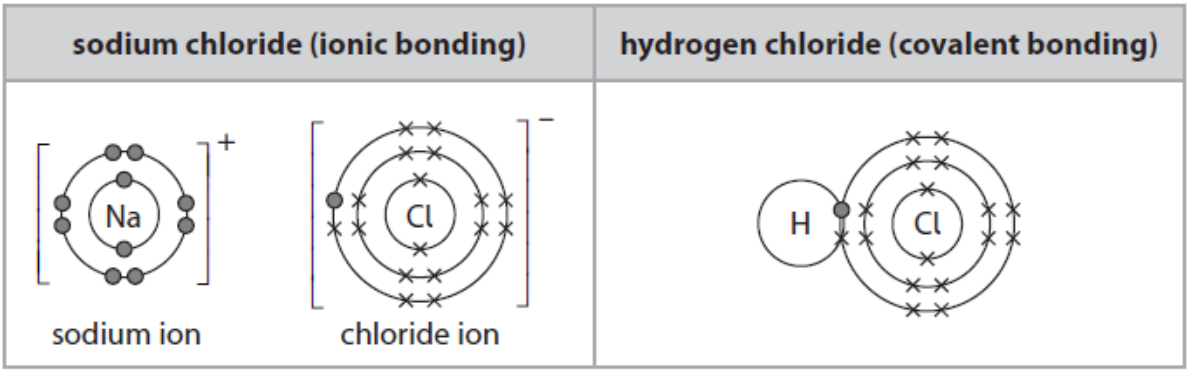


Figure 6

Describe the differences between an ionic bond and a covalent bond.

(4)

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(Total for question = 4 marks)

(**Q04d 1SC0/1CF, June 2023**)

Q12.

* A molecule of methane can be represented in several different ways as shown in Figure 5. These representations have been labelled A–E to assist you in your answer.

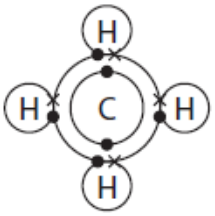
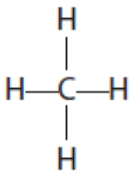
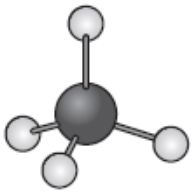
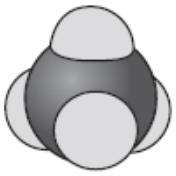
A	B	C	D	E
CH_4				

Figure 5

Describe what information can be obtained from each representation including the limitations of these representations of methane.

(6)

(Total for question = 6 marks)

(**QU05d 1SC0/1CH, June 2022**)

Q13.

Fluorine has an electronic configuration 2.7.

Fluorine gas exists as diatomic molecules.

In each molecule of fluorine, the two fluorine atoms are joined by a covalent bond.

Draw a dot and cross diagram to show the electrons in a molecule of fluorine, F_2.

Show outer electrons only.

(2)

(Total for question = 2 marks)

(**Q05b 1SC0/2CF/S2, SAM**)

Q14.

Fluorine has an electronic configuration 2.7.

Fluorine gas exists as diatomic molecules.
In each molecule of fluorine, the two fluorine atoms are joined by a covalent bond.

Draw a dot and cross diagram to show the electrons in a molecule of fluorine, F_2.

Show outer electrons only.

(2)

(Total for question = 2 marks)

(**Q01b 1SC0/2CH/S2, SAM**)

Q15.

Covalent substances can be simple molecular covalent or giant covalent.

Oxygen, O_2, is also a simple molecular, covalent substance.

Draw a dot and cross diagram for the molecule of oxygen.

(2)

(Total for question = 2 marks)

(**Q15 1SC0/1CH, June 2018**)

Q16.

The electronic configuration of carbon is 2.4
The electronic configuration of oxygen is 2.6

Draw a dot and cross diagram for a molecule of carbon dioxide.

Show outer electrons only.

(2)

(Total for question = 2 marks)

(**Q02c 1SC0/1CH, Nov 2020**)

Q17.

Crude oil is a mixture of hydrocarbons.

When hydrocarbons undergo combustion, water is produced.

Draw a dot and cross diagram of a molecule of water.

(Total for question = 2 marks)

(**QU06b 1SC0/2CF, June 2025**)

Q18.

Crude oil is a mixture of hydrocarbons.

When hydrocarbons undergo combustion, water is produced.

Draw a dot and cross diagram of a molecule of water.

(Total for question = 2 marks)

(**QU02b 1SC0/2CH, June 2025**)

Q19.

Hydrogen reacts with chlorine to form hydrogen chloride.

$$H—H + Cl—Cl \rightarrow 2H—Cl$$

The symbol – is used to show a covalent bond.

The electronic configuration of hydrogen is 1.
The electronic configuration of chlorine is 2.8.7.

Draw the dot-and-cross diagram for the molecule of hydrogen chloride.
Show outer electrons only.

(2)

(Total for question = 2 marks)

(**Q02d 1SC0/2CF, SAM 2016**)

Q20.

Figure 1 shows the structure of a molecule of each of four compounds, **A**, **B**, **C** and **D**.

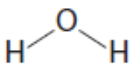
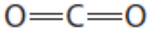
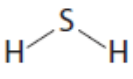
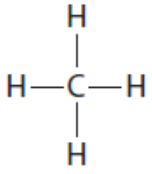
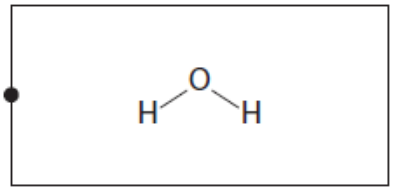
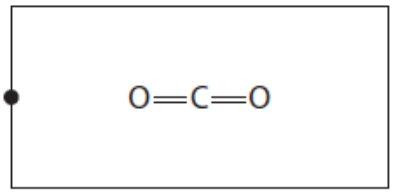
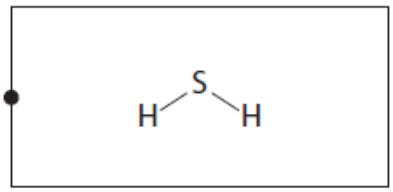
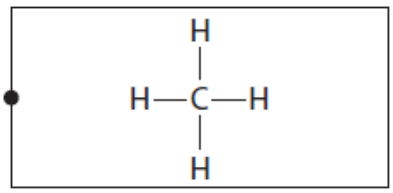
compound A	compound B	compound C	compound D
			

Figure 1

The names of two of the compounds in Figure 1 are shown below.

Draw one straight line from each name to the structure of a molecule of that compound.

(2)

name of compound	structure of molecule
carbon dioxide	
methane	
	
	

(Total for question = 2 marks)

(**QU01b 1SC0/2CF, June 2023**)

Q21.

Figure 5 shows the percentage of three gases, **X**, **Y** and **Z**, in the Earth's early atmosphere.

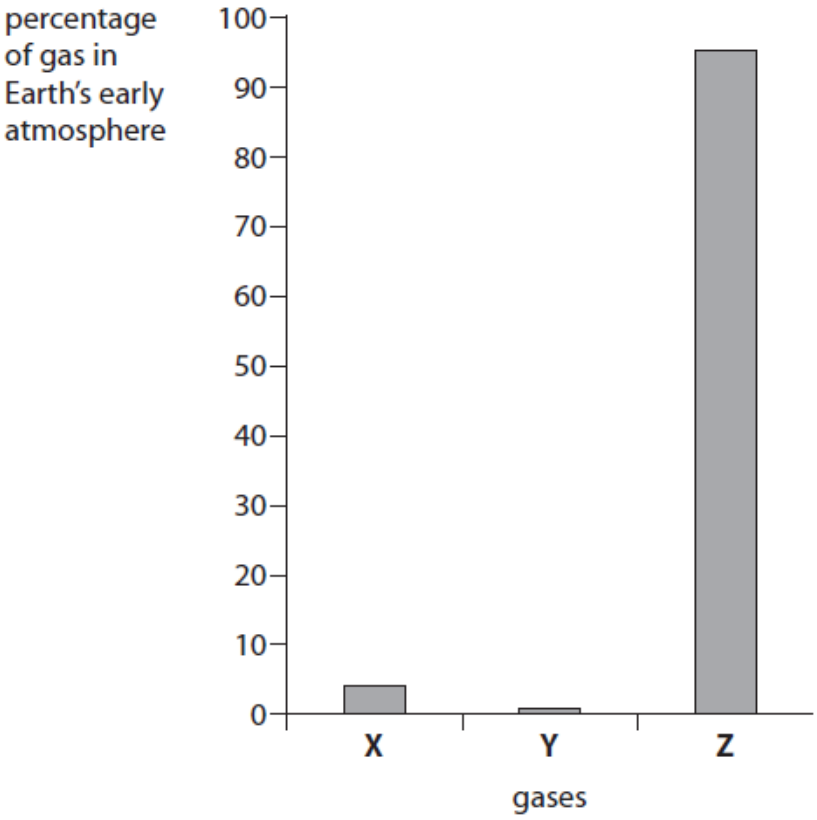


Figure 5

It is thought that small quantities of hydrogen sulfide, H_2S, were also in the Earth's early atmosphere.

Draw the dot and cross diagram for a molecule of hydrogen sulfide.

Show outer electrons only.

(2)

(Total for question = 2 marks)

(**QU03b 1SC0/2CH, June 2023**)

Q22.

Nitrogen and oxygen are present in the air.

(a) In industry, nitrogen and oxygen are obtained from air.

(i) Give the name of the process used.

(1)

.....

(ii) State why the air is cooled before the start of the process.

(1)

.....

.....

(b) Complete the sentence by putting a cross (☒) in the box next to your answer.

Oxygen has a low boiling point because there are

(1)

☒ **A** weak covalent bonds between the oxygen atoms

☒ **B** weak covalent bonds between the oxygen molecules

☒ **C** weak forces of attraction between the oxygen atoms

☒ **D** weak forces of attraction between the oxygen molecules

(c) Another gas present in air is carbon dioxide, CO_2.
There are covalent bonds between the atoms in a molecule of carbon dioxide.

(i) Describe what is meant by a**covalent bond.**

(2)

.....

.....

.....

(ii) The electronic configuration of oxygen (atomic number 8) is 2.6.

Give the electronic configuration of carbon (atomic number 6).

(1)

.....

(iii) Draw a dot and cross diagram of a molecule of carbon dioxide.

Show outer electrons only.

(2)

(Total for Question = 8 marks)

(**Q12 1SC0/1CH, June 2013**)

Q23.

Nitrogen and oxygen are present in the air.

(a) In industry, nitrogen and oxygen are obtained from air.

(i) Give the name of the process used.

(1)

.....

(ii) State why the air is cooled before the start of the process.

(1)

.....

.....

(b) Complete the sentence by putting a cross (☒) in the box next to your answer.

Oxygen has a low boiling point because there are

(1)

☒ **A** weak covalent bonds between the oxygen atoms

☒ **B** weak covalent bonds between the oxygen molecules

☒ **C** weak forces of attraction between the oxygen atoms

☒ **D** weak forces of attraction between the oxygen molecules

(c) Another gas present in air is carbon dioxide, CO_2.
There are covalent bonds between the atoms in a molecule of carbon dioxide.

(i) Describe what is meant by a**covalent bond.**

(2)

.....

.....

.....

(ii) The electronic configuration of oxygen (atomic number 8) is 2.6.

Give the electronic configuration of carbon (atomic number 6).

(1)

.....

(iii) Draw a dot and cross diagram of a molecule of carbon dioxide.

Show outer electrons only.

(2)

(Total for Question = 8 marks)

(**Q02 1SC0/2CH, June 2013**)

Q24.

Figure 1 shows the structure of a molecule of each of four compounds, **A**, **B**, **C** and **D**.

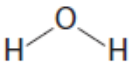
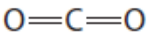
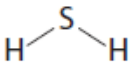
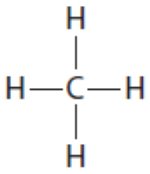
compound A	compound B	compound C	compound D
			

Figure 1

The formula of a molecule of compound **A** is H_2O.

Give the formula of a molecule of compound **D**.

(1)

.....

(Total for question = 1 mark)

(**QU01a 1SC0/2CF, June 2023**)

Q25.

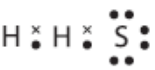
Hydrogen sulphide, H_2S, is a simple molecular, covalent compound.

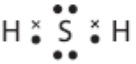
(i) A hydrogen atom has one electron in its outer shell.

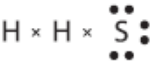
A sulfur atom has six electrons in its outer shell.

Which of the following is the dot and cross diagram of a molecule of hydrogen sulfide?

(1)

☒ **A** 

☒ **B** 

☒ **C** 

☒ **D** 

(ii) Which row in Figure 5 shows the properties of a simple molecular, covalent compound such as hydrogen sulfide?

(1)

	melting point	boiling point	conduction of electricity
☒ **A**	high	high	poor conductor
☒ **B**	high	high	good conductor only when liquid
☒ **C**	low	low	poor conductor
☒ **D**	high	high	good conductor

Figure 5

(Total for question = 2 marks)

(**Q04c 1SC0/1CF, SAM**)

Q26.

Hydrogen sulphide, H_2S, is a simple molecular, covalent compound.

(i) A hydrogen atom has one electron in its outer shell.

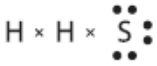
A sulfur atom has six electrons in its outer shell.

Which of the following is the dot and cross diagram of a molecule of hydrogen sulfide?

(1)

☒ **A** 

☒ **B** 

☒ **C** 

☒ **D** 

(ii) Which row in Figure 1 shows the properties of a simple molecular, covalent compound such as hydrogen sulfide?

(1)

	melting point	boiling point	conduction of electricity
☒ A	high	high	poor conductor
☒ B	high	high	good conductor only when liquid
☒ C	low	low	poor conductor
☒ D	high	high	good conductor

Figure 1

(Total for question = 2 marks)

(**Q01a 1SC0/1CH, SAM**)

Q27.

Nitrogen and oxygen are present in the air.

Another gas present in air is carbon dioxide, CO_2.
There are covalent bonds between the atoms in a molecule of carbon dioxide.

(i) Describe what is meant by a**covalent bond.**

(2)

.....

.....

.....

(ii) The electronic configuration of oxygen (atomic number 8) is 2.6.

Give the electronic configuration of carbon (atomic number 6).

(1)

.....

(iii) Draw a dot and cross diagram of a molecule of carbon dioxide.

Show outer electrons only.

(2)

(**Q20 1SC0/1CH, June 2013**)

Q28.

Nitrogen and oxygen are present in the air.

Another gas present in air is carbon dioxide, CO_2.
There are covalent bonds between the atoms in a molecule of carbon dioxide.

(i) Describe what is meant by a**covalent bond.**

(2)

.....

.....

.....

(ii) The electronic configuration of oxygen (atomic number 8) is 2.6.

Give the electronic configuration of carbon (atomic number 6).

(1)

.....

(iii) Draw a dot and cross diagram of a molecule of carbon dioxide.

Show outer electrons only.

(2)

(**Q11 1SC0/2CH, June 2013**)

Q29.

The freezing point of water is 0°C.

What is the structure of water?

(1)

☒ **A** ionic

☒ **B** simple molecular (covalent)

☒ **C** giant covalent

☒ **D** metallic

(Total for question = 1 mark)

(**Q01cii 1SC0/1CF, SAM 2016**)

Q30.

Phosphorus oxide is a compound that contains covalent bonds.

(i) Describe what is meant by a **covalent bond.**

(2)

.....

.....

.....

.....

(ii) The formula of a molecule of phosphorus oxide is P_4O_{10}

Give the empirical formula of this oxide.

(1)

.....

(**Q21 1SC0/1CF, June 2013**)

Q31.

Phosphorus oxide is a compound that contains covalent bonds.

(i) Describe what is meant by a **covalent bond.**

(2)

.....

.....

.....

.....

(ii) The formula of a molecule of phosphorus oxide is P_4O_{10}

Give the empirical formula of this oxide.

(1)

.....

(**Q17 1SC0/2CF, June 2013**)

Q32.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Chlorine is an element in group 7 of the periodic table.

Chlorine reacts with sodium to form sodium chloride.

(i) Write the word equation for this reaction.

(2)

..... →
.....

(ii) Chlorine, Cl_2, is made of simple molecules.

Describe what is meant by the term **molecule**.

(2)

.....

.....

.....

.....

(iii) Sodium, like all metals, conducts electricity.

Explain how sodium conducts electricity.

(2)

.....

.....

.....

.....

(iv) Sodium chloride contains sodium ions, Na^+, and chloride ions, Cl^- .

Use this information to state the formula of sodium chloride.

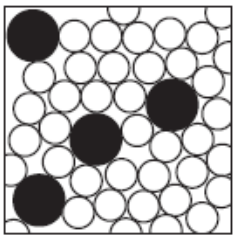
(1)

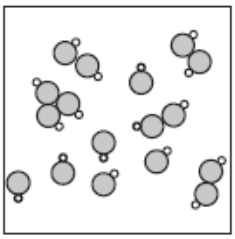
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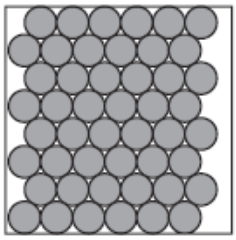
(v) Sodium chloride is made of a giant structure of ions.

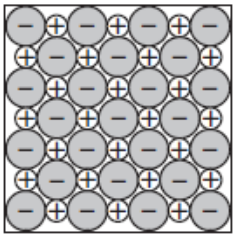
Which diagram shows the arrangement of particles in sodium chloride?

(1)

☐ A 

☐ C 

☐ B 

☐ D 

(vi) Sodium chloride solution conducts electricity.

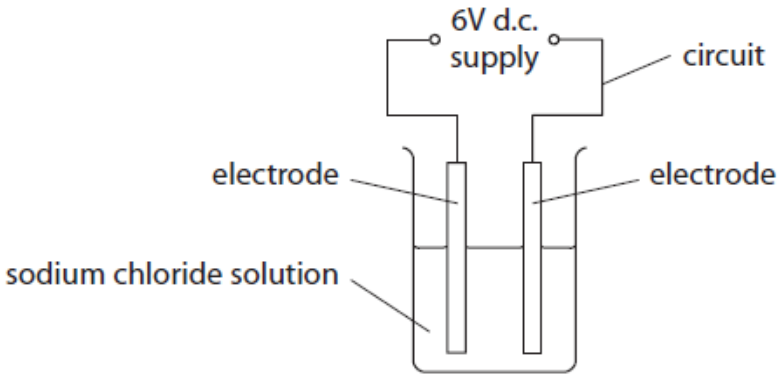


Figure 8

State what can be put into the circuit in Figure 8 to show that a current is flowing.

(1)

.....

(Total for question = 9 marks)

(**QU04b 1SC0/2CF, June 2023**)

Q33.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Sodium reacts with hydrochloric acid to form sodium chloride and hydrogen.

(i) Write the word equation for this reaction.

(2)

..... → .....

(ii) The hazard symbol shown in Figure 1 is used on containers of sodium.



Figure 1

What is the meaning of this hazard symbol?

(1)

☒ **A** corrosive

☒ **B** flammable

☒ **C** oxidising

☒ **D** toxic

(iii) Hydrogen has one electron in its electron shell.
Figure 2 shows the incomplete dot and cross diagram of a hydrogen molecule.

Complete Figure 2 to show the electrons in the covalent bond between the two atoms of hydrogen.

(1)

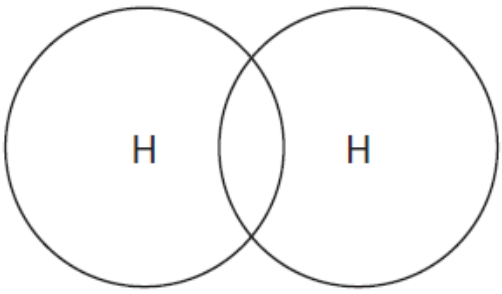


Figure 2

(Total for question = 4 marks)

(**Q01b 1SC0/1CF, Nov 2020**)

Q34.

Chlorine reacts with hydrogen to form hydrogen chloride.

(i) Write the word equation for this reaction.

(1)

..... → .....

(ii) Hydrogen chloride dissolves in water to form an acidic solution.

State what is **seen** when blue litmus paper is placed into this solution.

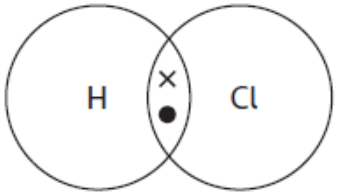
(1)

.....

(iii) A chlorine atom has seven electrons in its outer shell.
A hydrogen atom has one electron in its outer shell.

Complete the dot and cross diagram of a molecule of hydrogen chloride.
Show outer shell electrons only.

(1)



(iv) Name the type of bonding in a molecule of hydrogen chloride.

(1)

.....

(Total for question = 4 marks)

(**Q03b 1SC0/2CF, Nov 2020**)