Questions

Q1.

In Figure 8, the letters A, E, G, J, X and Z show the positions of six elements in the periodic table.
These letters are not the symbols of the atoms of these elements.

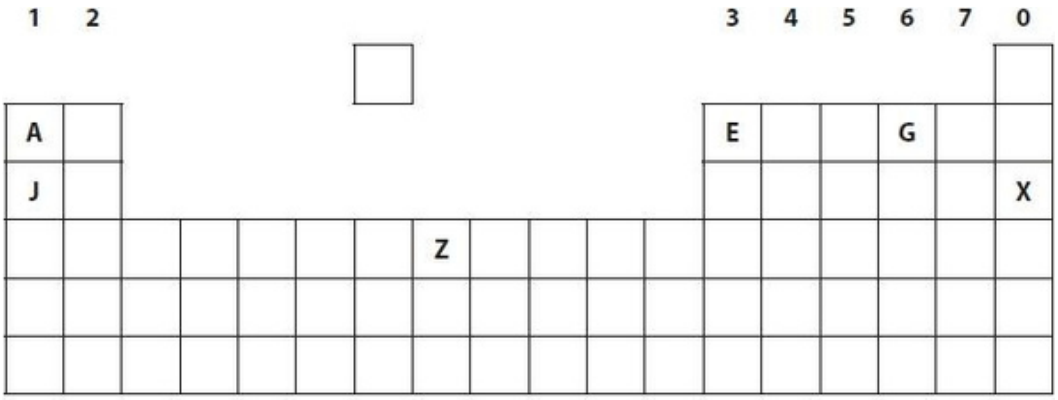


Figure 8

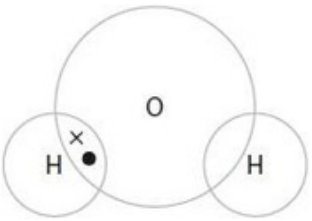
An oxygen atom has six electrons in its outer shell.

A hydrogen atom has one electron in its outer shell.

Complete the dot and cross diagram of a molecule of water, H2O.

Show outer shell electrons only.

(2)



(Total for question = 2 marks)

Q2.

* A molecule of methane can be represented in several different ways as shown in Figure 7. These representations have been labelled A–E to assist you in your answer.

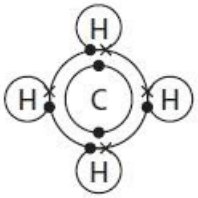
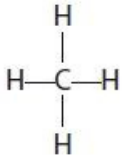
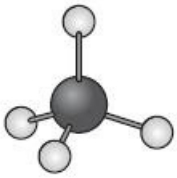
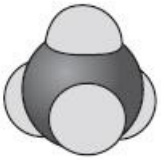
A	B	C	D	E
CH_4				

Figure 7

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

(6)

(Total for question = 6 marks)

Q3.

Diamond and graphite are both forms of carbon.

In both substances, the carbon atoms are held together by covalent bonds.

Describe what is meant by a covalent bond.

(2)

.....

.....

.....

.....

(Total for question = 2 marks)

Q4.

Covalent substances can be simple molecular covalent or giant covalent.

Oxygen, O2, is also a simple molecular, covalent substance.

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

(2)

(Total for question = 2 marks)

Q5.

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)

Q6.

A water molecule, H2O, contains two hydrogen atoms and one oxygen atom.

The electrons in the outer shells of a hydrogen atom and an oxygen atom are shown in Figure 2.

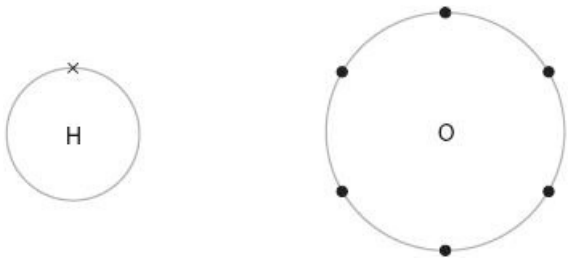


Figure 2

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

(2)

(Total for question = 2 marks)

Q7.

Diamond and carbon dioxide are both covalent substances.

(i) Draw a dot and cross diagram to show the covalent bonding in a molecule of carbon dioxide, CO_2.

Show outer electrons only.

(2)

(ii) Diamond has a very high melting point.

Explain why the melting point of diamond is very high.

(2)

.....

.....

.....

.....

(Total for question = 4 marks)

Q8.

Some questions must be answered with a cross in a box (☒). If you change your mind about an answer, put a line through the box (☒) and then mark your new answer with a cross (☒).

Many fertilisers are produced using ammonia.

Ammonia is produced on an industrial scale from the reaction of nitrogen with hydrogen.

The equation for the reaction is

nitrogen + hydrogen ↔ ammonia

(i) State the name of this industrial process.

(1)

.....

(ii) State the meaning of the ↔ symbol in the equation.

(1)

.....

(iii) Figure 2 shows the electronic configurations for an atom of nitrogen and an atom of hydrogen.

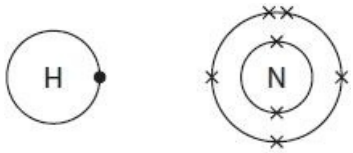
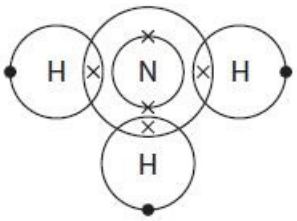


Figure 2

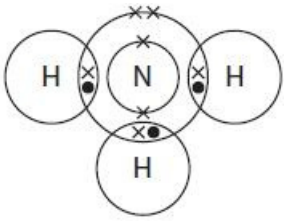
Which dot and cross diagram for ammonia, NH3, is correct?

(1)

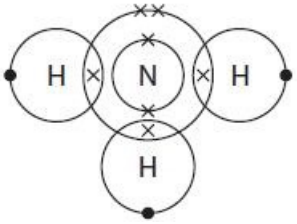
☐ **A**



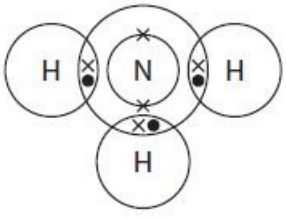
☐ **B**



☐ **C**



☐ **D**



(Total for question = 3 marks)

Q9.

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)

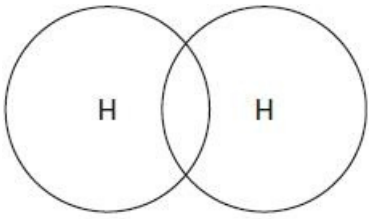


Figure 2

(Total for question = 4 marks)

Q10.

Figure 1 shows the dot and cross diagram for a molecule of ammonia.

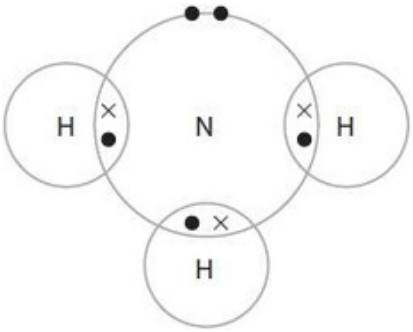


Figure 1

(i) What do the dots and crosses represent in the diagram?

(1)

- ☒ A electrons
- ☒ B neutrons
- ☒ C protons
- ☒ D nuclei

(ii) Give the formula for the molecule of ammonia.

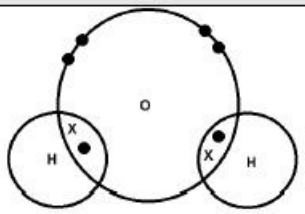
(1)

.....

(Total for question = 2 marks)

Mark Scheme

Q1.

Question number	Answer	Additional guidance	Mark
	 (2)	shared pair of electrons in right hand overlap(1) rest of molecule with 4 electrons drawn in outer shell of O only (1) MP2 dependent on MP1 allow x or • or combinations thereof for any electrons ignore inner shells of electrons even if incorrect	EXP (2)

Q2.

Question number	Indicative content	Mark
*	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO1 (3 marks) and AO2 (3 marks)** • they show methane contains carbon and hydrogen • structure **A** only shows the ratio of C:H (as 1:4) • structure **A** gives no information about bonding in molecule • structure **A** gives no information about shape of molecule • dot & cross diagram, **B**, shows the covalent bonding between the C and H atoms • single bonds, show in structures **B**, **C** and **D** • inner shell not involved in bonding • structure **B** does not show the 3-D positions of atoms • single lines used to show single covalent bonds in structure **C** • only a 2-D representation and not positions in space • ball & stick model, **D**, shows position in space / 3-D arrangement • atoms not actually connected by the sticks • space-filling, structure **E**, model shows 3-D arrangement of atoms • **E** shows approximate relative sizes occupied by separate atoms • no information about type of bond between atoms in structure **E**	**(6)** AO1-1 AO2-1

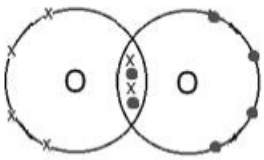
Level	Mark	Additional Guidance	General additional guidance - the decision between levels
	0	No rewardable material.	Read whole answer and ignore all incorrect material/ discard any contradictory material then:
Level 1	1-2	<u>Additional Guidance</u> Makes simple statements about the models that are not explained or linked. OR Gives a description of at least one model OR Identifies limitations of at least one model	<u>Possible Candidate Responses</u> • the models show that methane contains 1 carbon and 4 hydrogen atoms • model A gives no information about the structure of the molecule • model B is a dot and cross diagram showing shared pairs of electrons between carbon and hydrogen • a detailed description of one model scores the upper part of the level
Level 2	3-4	<u>Additional Guidance</u> Gives different descriptions of at least three models OR Gives a description of at least two models and links at least one model to its limitations OR Identifies different limitations of at least three models	<u>Possible Candidate Responses</u> • model B is a dot and cross diagram showing the covalent bonds. Model D is a ball and stick model showing a 3D model. All models show that methane contains one carbon and four hydrogen atoms. • model E shows the relative sizes of carbon and hydrogen atoms but gives no detail about the bonding between the atoms. Model C shows single covalent bonds. • model A gives no information about how the atoms are arranged in methane, and models B and C give no information about how the atoms are arranged in space and model E gives no information about the bonds. • detailed descriptions in all cases score the upper part of the level
Level 3	5-6	<u>Additional Guidance</u> Gives a description of at least three models AND three limitations OR Gives a description of all five models AND at least one limitation for one of the models	<u>Possible Candidate Responses</u> • model C shows the displayed formula and single bonds in methane but is only a 2D model and does not show the position of the atoms in space. Model A is the molecular formula and tells us how many carbon and hydrogen atoms are in the molecule but gives no information about how these are arranged. Model D shows the 3D arrangement of atoms, but model E does not show how the atoms are bonded.

Level	Mark	Descriptor
	0	• No awardable content
Level 1	1-2	• Demonstrates elements of chemical understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • The explanation attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question. (AO2)
Level 2	3-4	• Demonstrates chemical understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • The explanation is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question. (AO2)
Level 3	5-6	• Demonstrates accurate and relevant chemical understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • The explanation is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question. (AO2)

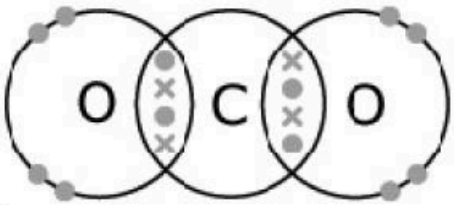
Q3.

Question number	Answer	Additional guidance	Mark
	An answer that provides a description by making reference to: • shared electrons (1) • {a pair of / two} (electrons) (1)	allow one electron from each allow more than one shared pair any idea of ionic bonding / ions = 0	**(2)**

Q4.

Question Number	Answer	Additional guidance	Mark
	 (2)	double bond (1) rest of molecule (1) (dependent on correct double bond) ignore atomic symbol allow all x or ● ignore inner shells of electrons even if incorrect	**(2)** AO 1 1

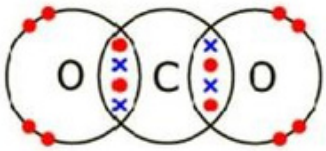
Q5.

Question number	Answer	Additional guidance	Mark
	 (2) or • CO_2 with one correct double bond (1) • rest of structure correct (1)	ignore any inner electrons shown remaining electrons on oxygen either singly or paired allow all dots or all crosses 2nd mark dependent on 1st	**(2)**

Q6.

Question number	Answer		Mark
	shared pair of electrons between a hydrogen atom and an oxygen atom (1) rest of molecule correct (1)	ignore any inner shells drawn ignore symbols	(2)

Q7.

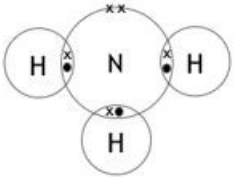
Question number	Answer	Additional guidance	Mark
(i)	 • {2 pairs of/four} electrons shared between an oxygen atom and the carbon atom (1) • rest of structure correct (1)	ignore any inner electrons shown remaining electrons on oxygen either singly or paired allow all dots or all crosses 2nd mark dependent on 1st	(2) EXP

Question number	Answer	Additional guidance	Mark
(ii)	An explanation that makes reference to identification – knowledge (1 mark) and reasoning /justification – knowledge (1 mark): • diamond has a giant (covalent) structure / strong (covalent) bonds / each carbon atom is bonded to four other carbon atoms / all carbon atoms in diamond are bonded together (1) • large amount of (heat) energy is needed to {separate the carbon atoms / break the bonds / break up lattice} (1)	reject ionic lattice reject layers reject bonds between molecules reject intermolecular forces being broken ignore just high heat mark independently	(2) GRAD

Q8.

Question number	Answer	Mark
(i)	Haber (1)	(1) AO1-1

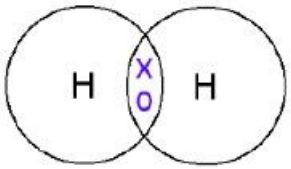
Question number	Answer	Additional guidance	Mark
(ii)	(reaction is) {reversible / can go both ways / can go backwards and forwards}	allow (dynamic) equilibrium ignore 'reversed' alone	(1) AO1-1

Question number	Answer	Mark
(iii)	**B** is  the only correct answer **A** is incorrect as there are no shared pairs and the nitrogen atom shown only has 3 electrons **C** is incorrect as there are no shared pairs **D** is incorrect as the nitrogen atom shown only has 3 electrons	(1) AO2-1

Q9.

Question number	Answer	Additional guidance	Mark
(i)	sodium + hydrochloric acid (1) → sodium chloride + hydrogen (1)	allow reactants either way round allow products either way round reject 'sodium chlorine' allow $Na + HCl \rightarrow NaCl + H_2$ (1) $2Na + 2HCl \rightarrow 2NaCl + H_2$ (2)	(2)

Question number	Answer	Mark
(ii)	**B** flammable **A** corrosive has a different hazard symbol **C** oxidising has a different hazard symbol **D** toxic has a different hazard symbol	(1)

Question number	Answer	Additional guidance	Mark
(iii)		allow dots or crosses or mixture allow other suitable symbols	(1)

Q10.

Question Number	Answer	Mark
(i)	**A** electrons **1. The only correct answer is A** ***B*** *is factually incorrect* ***C*** *is factually incorrect* ***D*** *is factually incorrect*	**(1)** AO 1 1

Question Number	Answer	Additional guidance	Mark
(ii)	NH_3	do not allow NH^3 / nh_3 / NH3 etc allow H_3N	**(1)** AO 3 2b