



IGCSE CHEMISTRY

0620

CHEMICAL BONDING

Theory: Structured Questions

2026 EDITION

Q1

0620/41/M/J/21/Q3(b)

Ionic Bonding

(b) Potassium chloride is an ionic compound.

Complete the diagram to show the electron arrangement in the outer shells of the ions present in potassium chloride.

Give the charges on both ions.



[3]

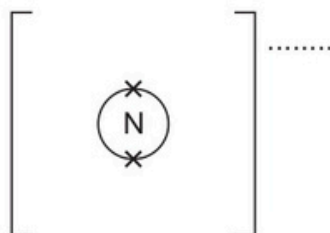
Q2

0620/42/M/J/21/Q5(a)(ii)

Ionic Bonding

(ii) Lithium nitride is ionically bonded.

Complete the diagram to show the electronic structure of the nitride ion. Show the charge on the nitride ion.



[2]

Q3

0620/43/M/J/21/Q3(b)

Ionic Bonding

(b) Sodium fluoride is an ionic compound.

Complete the diagram to show the electron arrangement in the outer shells of the ions present in sodium fluoride.

Give the charges on both ions.



[3]

Q4

0620/43/O/N/21/Q3(f)(ii)

Ionic Bonding

Use your knowledge of structure and bonding to explain why lead(II) oxide has a much higher melting point than carbon dioxide.

Your answer should refer to:

- the types of particles involved
- the relative strength of the forces of attraction between the particles.

.....

.....

.....

..... [3]

Q5

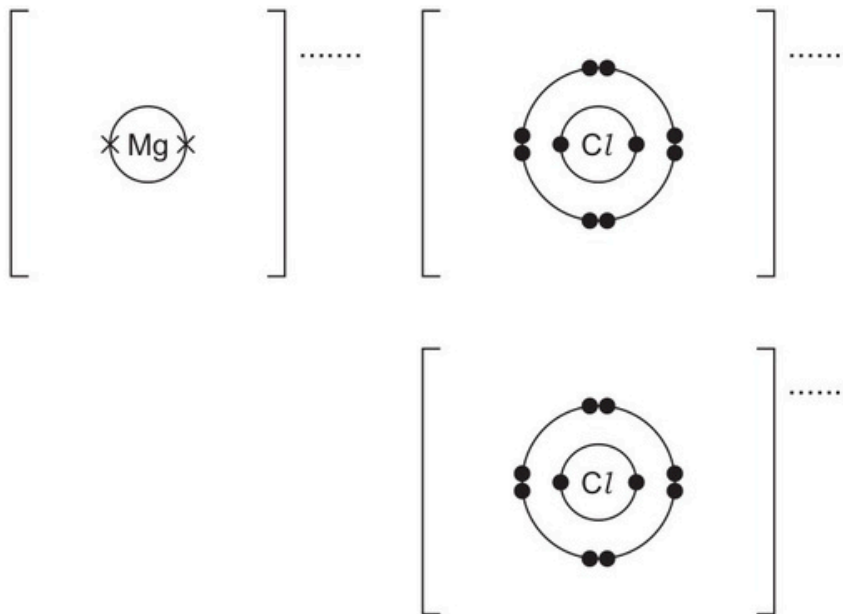
0620/42/F/M/22/Q2(b)

Ionic Bonding

- (b) Complete the dot-and-cross diagram to show the electron arrangement of the ions in magnesium chloride.

The inner shells have been drawn.

Give the charges on the ions.



[3]

Q6

0620/42/F/M/22/Q4(d)(ii)

Ionic Bonding

- (ii) Explain why the ionic compound needs to be aqueous or molten.

..... [1]

Q7

0620/41/M/J/22/Q3(b)(i)-(ii)

Ionic Bonding

- soluble in water.

(i) Name the type of bonding in sodium chloride.

..... [1]

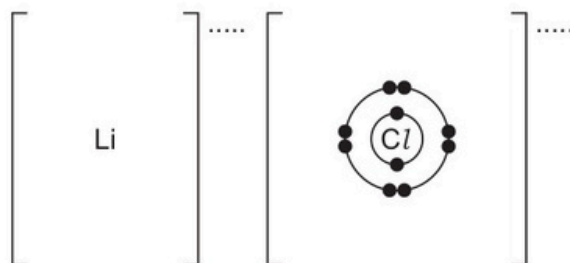
(ii) Explain why sodium chloride conducts electricity when molten.

.....

..... [1]

- (d) Lithium chloride, LiCl , is an ionic compound.

Complete the dot-and-cross diagram to show the electron arrangement and charges of the ions in lithium chloride.



[3]

- (e) Explain, in terms of attractive forces between particles, why LiCl is a solid at room temperature but NCl_3 is a liquid with a relatively low boiling point.

.....
.....
..... [3]

[Total: 13]

(b) Potassium combines with sulfur to form an ionic compound, potassium sulfide, K_2S .

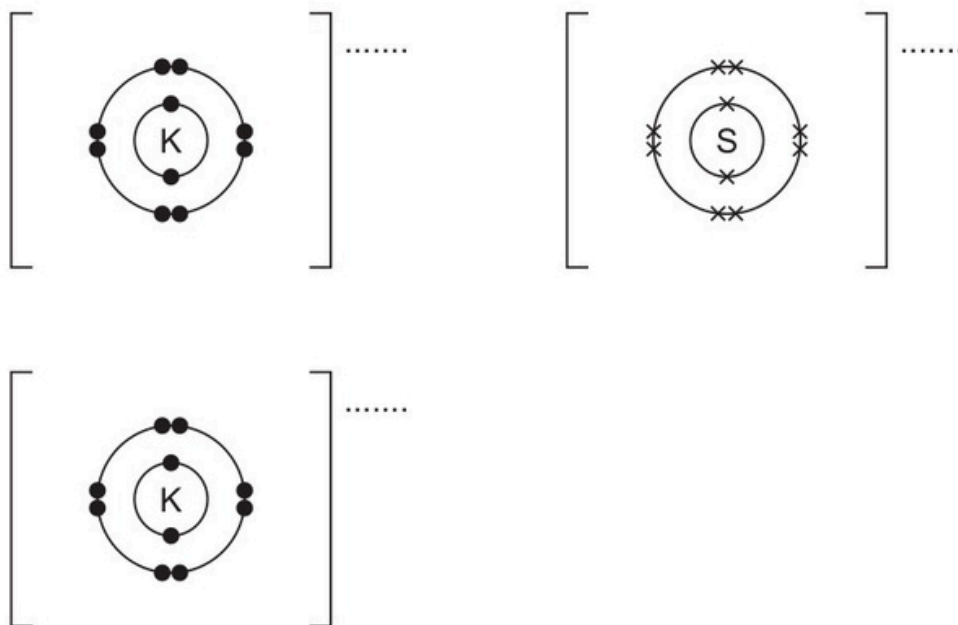
(i) Give **two** physical properties of ionic compounds.

1

2

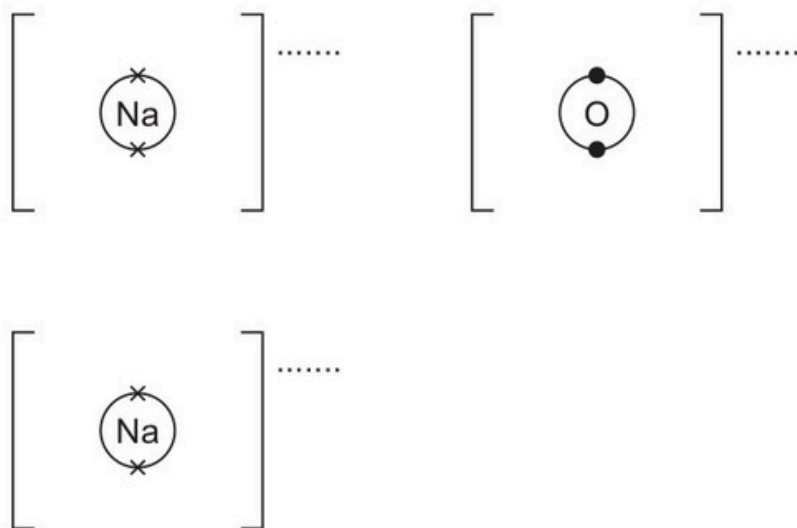
[2]

(ii) Complete the dot-and-cross diagram to show the electron arrangement and charges of the ions in potassium sulfide.



[3]

- (iv) Complete the dot-and-cross diagram to show the electron arrangement and charges of the ions in sodium oxide.



[3]

(d) Potassium oxide, K_2O , is an ionic compound.

Complete Fig. 2.1 to show the electronic configurations of the ions in potassium oxide.
Show the charges on the ions.

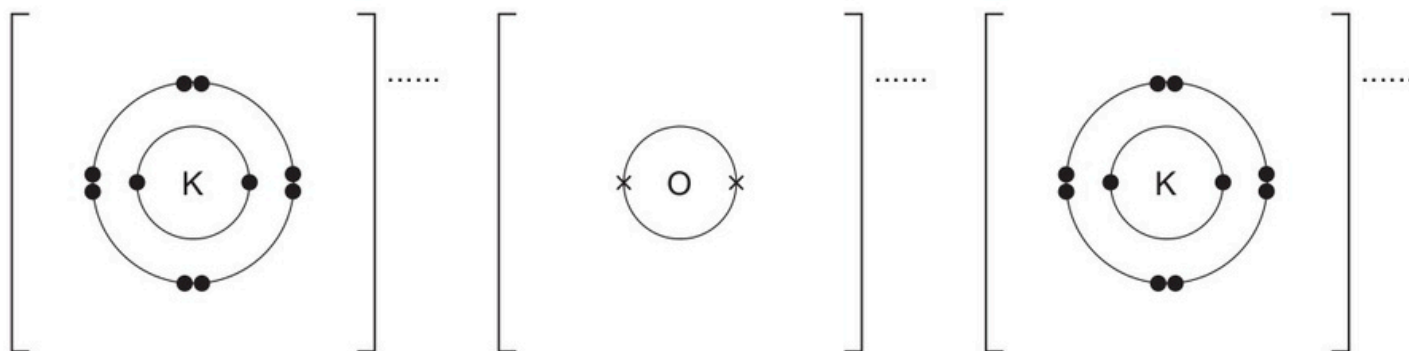


Fig. 2.1

[3]

Q12

0620/41/M/J/23/Q3(a)(i)-(ii)

Ionic Bonding

- (a) (i) Sodium reacts with oxygen to form the ionic compound sodium oxide. The electronic configurations of an atom of sodium and an atom of oxygen are shown in Fig. 3.1.

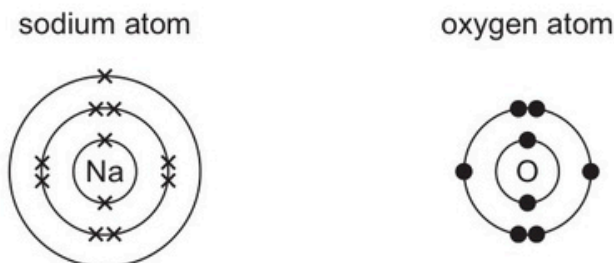


Fig. 3.1

Ions are formed by the transfer of electrons from sodium atoms to oxygen atoms.

Complete the dot-and-cross diagrams in Fig. 3.2 to show the electronic configuration of **one** sodium ion and **one** oxide ion. Show the charges on the ions.

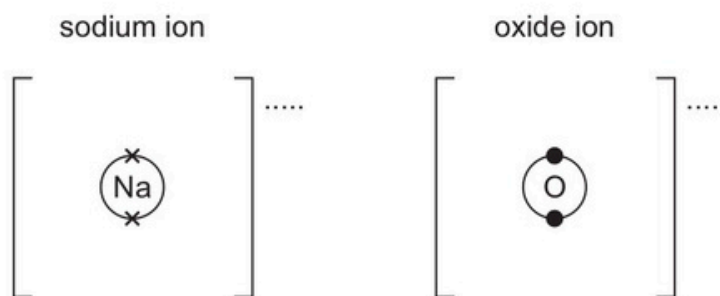


Fig. 3.2

[3]

- (ii) Write the formula of sodium oxide.

..... [1]

Q13

0620/41/M/J/23/Q3(c)(i)

Ionic Bonding

- (i) Explain, in terms of bonding, why sodium oxide has a high melting point.

.....

.....

.....

..... [2]

- (a) Magnesium reacts with fluorine to form the ionic compound magnesium fluoride. The electronic configurations of an atom of magnesium and an atom of fluorine are shown in Fig. 3.1.

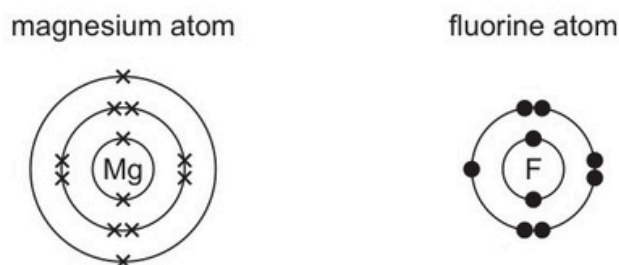


Fig. 3.1

- (i) Ions are formed by the transfer of electrons from magnesium atoms to fluorine atoms.

Complete the dot-and-cross diagrams in Fig. 3.2 to show the electronic configurations of **one** magnesium ion and **one** fluoride ion. Show the charges on the ions.

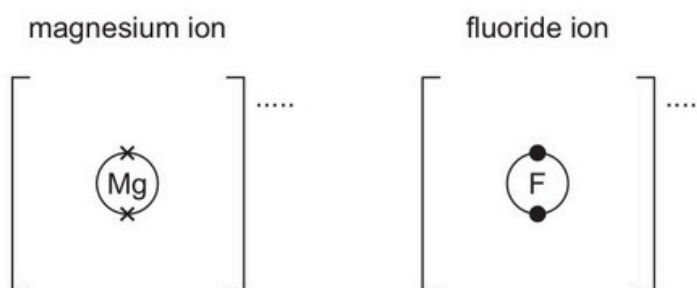


Fig. 3.2

[3]

- (ii) Deduce the formula of magnesium fluoride.

..... [1]

- (iii) When solid magnesium fluoride is dissolved in water it forms a solution that conducts electricity.

State one other change that can be made to solid magnesium fluoride to allow it to conduct electricity.

..... [1]

Q15

0620/42/F/M/24/Q2(f)

Ionic Bonding

- (f) Calcium chloride is an ionic compound.

Complete the dot-and-cross diagram in Fig. 2.1 for the ions in calcium chloride.

Give the charges on each of the ions.

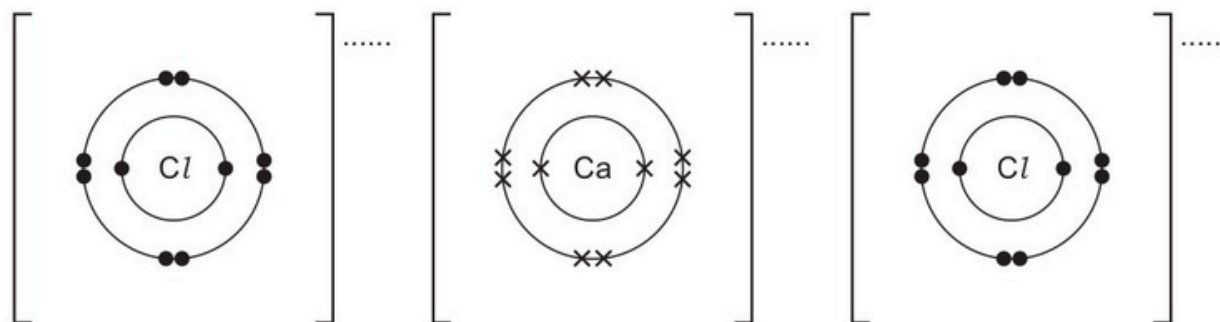


Fig. 2.1

[3]

Q16

0620/42/M/J/24/Q5(b)(i)-(iii)

Ionic Bonding

- (b) Sulfur reacts with magnesium to form magnesium sulfide, MgS , an ionic compound.

- (i) Complete the dot-and-cross diagram in Fig. 5.1 of the ions in magnesium sulfide.

Give the charges on the ions.

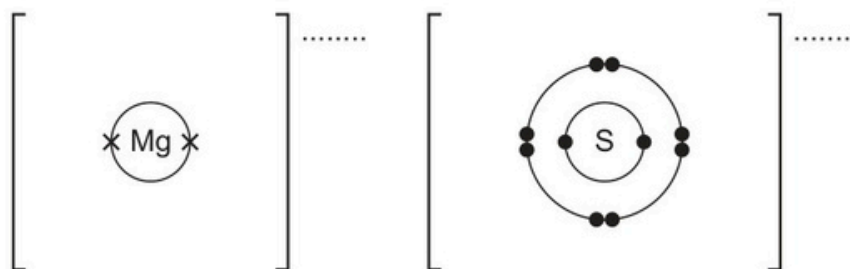


Fig. 5.1

[3]

- (ii) State why MgS has a high melting point.

..... [1]

- (iii) State why molten MgS conducts electricity.

..... [1]

(b) Magnesium oxide, MgO , is an ionic compound.

Complete the dot-and-cross diagram in Fig. 4.1 of the ions in magnesium oxide.

Give the charges on each of the ions.

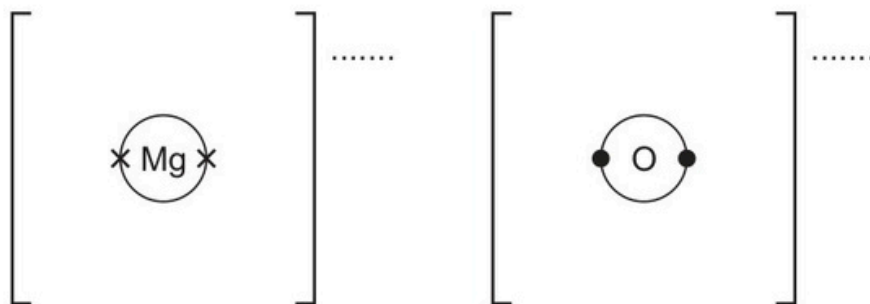


Fig. 4.1

[3]

(f) Aluminium reacts with fluorine to form the ionic compound aluminium fluoride.

Complete the dot-and-cross diagram in Fig. 2.1 of the ions in aluminium fluoride.

Give the charges on the ions.

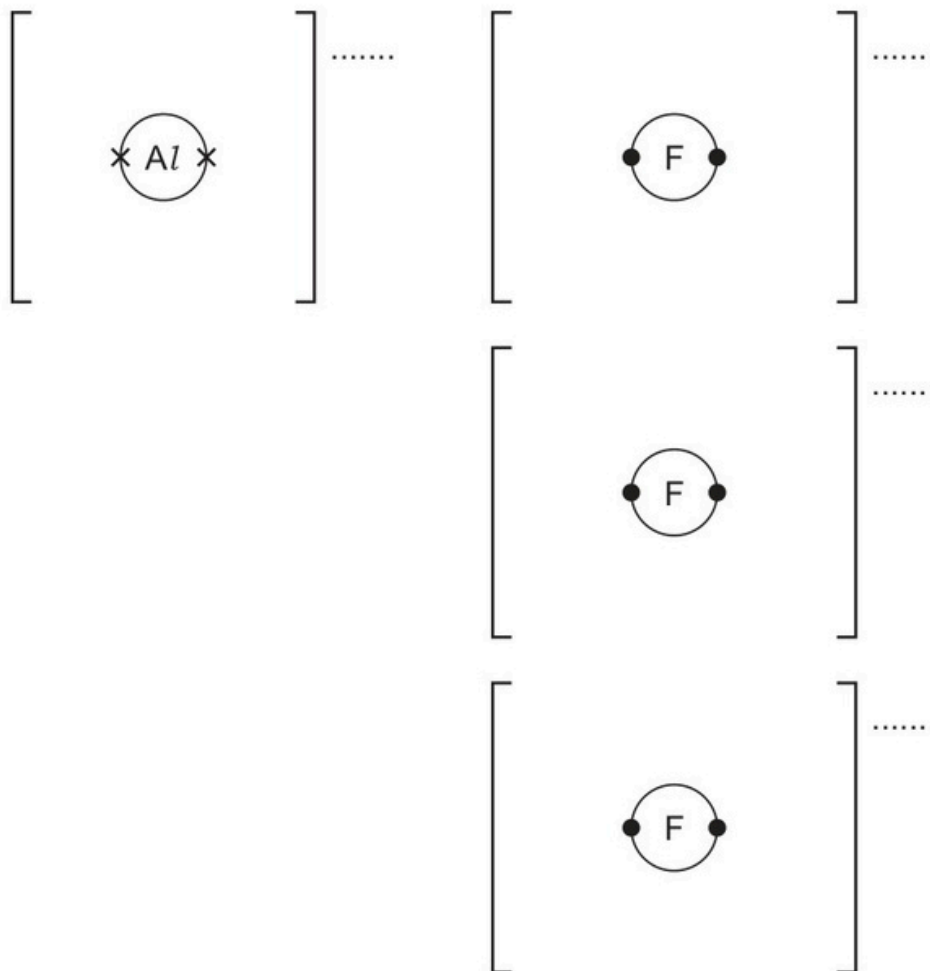


Fig. 2.1

[3]

- (ii) Tin(II) oxide, SnO , is ionically bonded.

The melting points of SnCl_4 and SnO are shown in Table 3.1.

Table 3.1

	melting point/ $^{\circ}\text{C}$
SnCl_4	-33
SnO	1080

Explain, in terms of structure and bonding, why SnCl_4 has a much lower melting point than SnO .

.....

.....

.....

.....

..... [3]

2 This question is about ionic compounds.

(a) State what is meant by the term ionic bond.

.....
..... [2]

(b) Potassium sulfide, K_2S , is an ionic compound.

Complete the dot-and-cross diagram in Fig. 2.1 of the ions in potassium sulfide.

Show the charges on the ions.

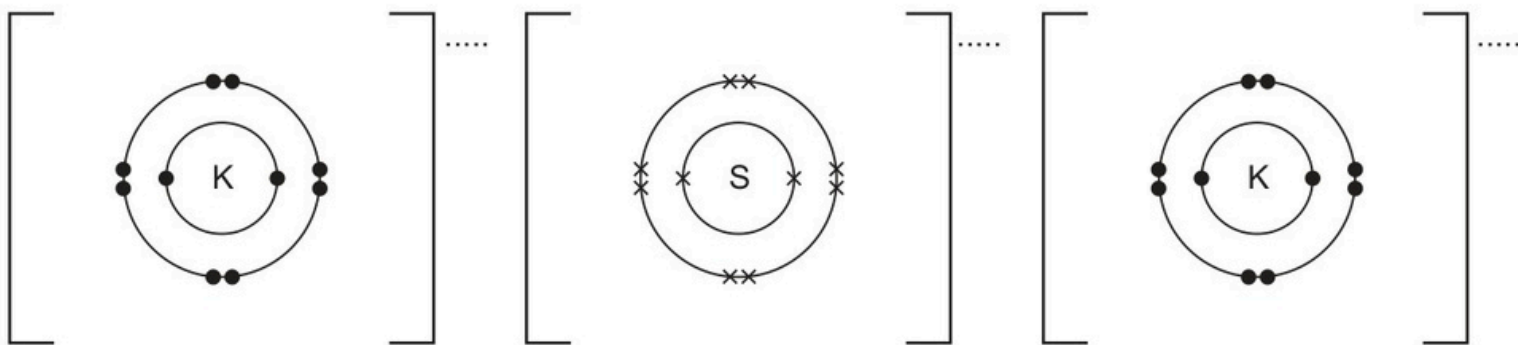


Fig. 2.1

[3]

Q21

0620/42/F/M/25/Q2(c)(i)

Ionic Bonding

(i) Fig. 2.2 shows part of the giant ionic lattice structure of sodium chloride.

Complete the diagram in Fig. 2.2 to show the ions present. Use '+' for sodium ions and '-' for chloride ions. One chloride ion has been completed for you.

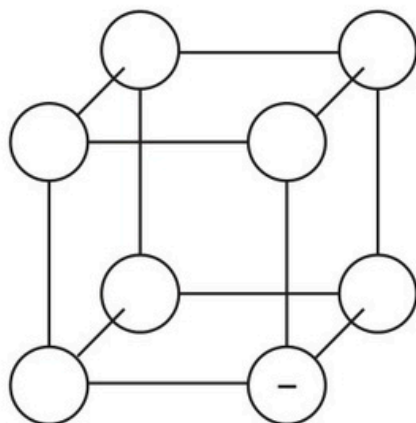


Fig. 2.2

[2]

Q22

0620/42/M/J/25/Q5(c)

Ionic Bonding

(c) Sodium sulfide, Na_2S , is an ionic compound.

Complete Fig. 5.1 to show the electronic configurations of the ions in sodium sulfide.

Show the charges on the ions.

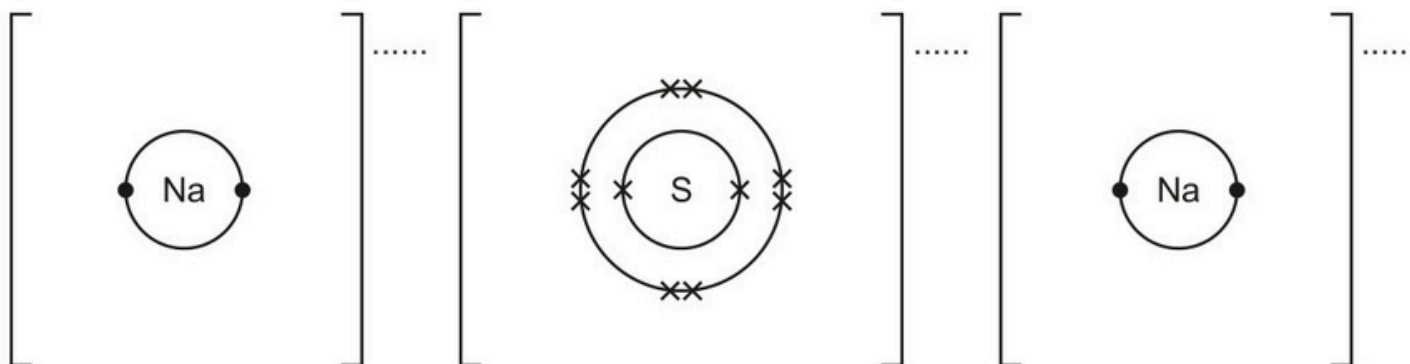


Fig. 5.1

[3]



- 2 Table 2.1 shows the melting points, boiling points and electrical conductivities of seven substances, **A**, **B**, **C**, **D**, **E**, **F** and **G**.

Table 2.1

substance	melting point /°C	boiling point /°C	electrical conductivity when solid	electrical conductivity when molten
A	1600	2230	poor	poor
B	−219	−183	poor	poor
C	770	1420	poor	good
D	−39	357	good	good
E	−7	58	poor	poor
F	44	280	poor	poor
G	1085	2562	good	good

- (ii) Identify which substance, **A**, **B**, **C**, **D**, **E**, **F** or **G**, is an ionic compound.

Use the information in Table 2.1 to give **one** reason for your choice.

substance

reason

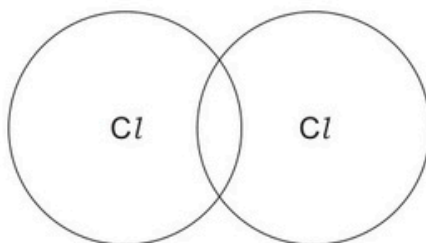
[2]

Q24

0620/41/M/J/21/Q3(e)

Covalent Bonding

- (e) Complete the dot-and-cross diagram to show the electron arrangement in a molecule of chlorine, Cl_2 .
Show the outer electrons only.



[1]

Q25

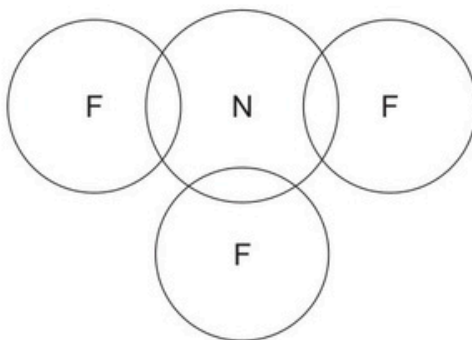
0620/42/M/J/21/Q5(b)(iii)

Covalent Bonding

- (iii) Complete the dot-and-cross diagram to show the electron arrangement in a molecule of NF_3 .

Use dots for nitrogen electrons and crosses for fluorine electrons.

Show outer electrons only.



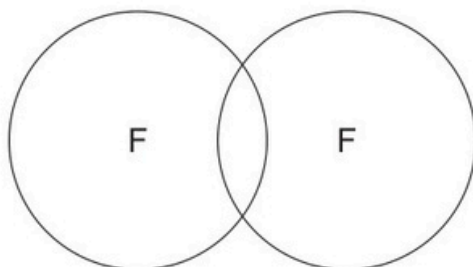
[3]

Q26

0620/43/M/J/21/Q3(e)

Covalent Bonding

- (e) Complete the dot-and-cross diagram to show the electron arrangement in a molecule of fluorine, F_2 .
Show the outer electrons only.



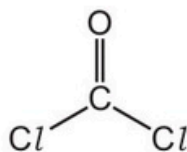
[1]

Q27

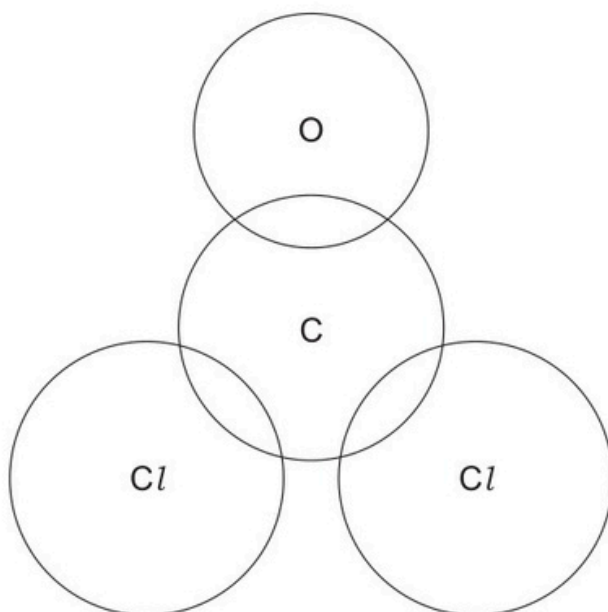
0620/42/O/N/21/Q4(e)

Covalent Bonding

- (e) Complete the dot-and-cross diagram to show the electron arrangement in a molecule of $COCl_2$.



Show outer electrons only.



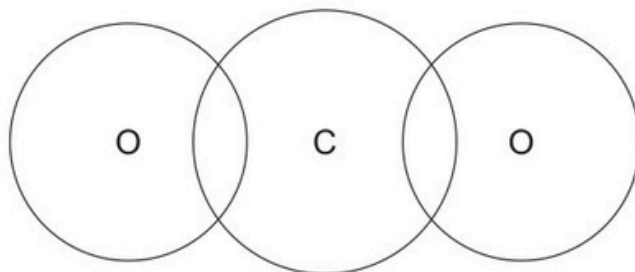
[3]

Q28

0620/43/O/N/21/Q3(f)(i)

Covalent Bonding

- (i) Complete the diagram to show the electron arrangement in one molecule of CO_2 .
Show only the outer electrons.



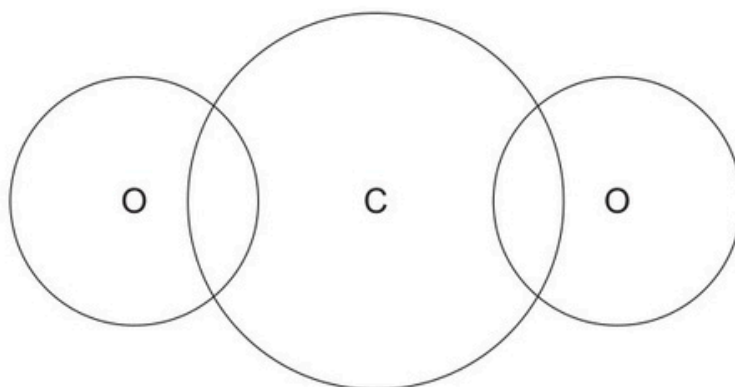
[2]

Q29

0620/42/F/M/22/Q2(c)

Covalent Bonding

- (c) Complete the dot-and-cross diagram to show the electron arrangement in a molecule of carbon dioxide.
Show outer shell electrons only.



[2]

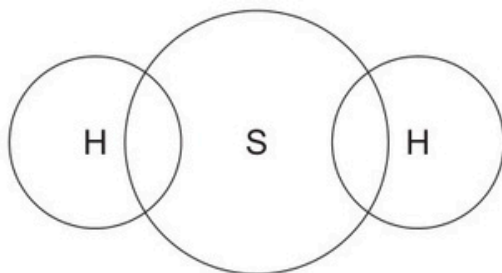
Q30

0620/41/M/J/22/Q4(b)(i)

Covalent Bonding

(b) Hydrogen sulfide has the formula H_2S .

- (i) Complete the dot-and-cross diagram to show the electron arrangement in a molecule of hydrogen sulfide. Show outer shell electrons only.



[2]

Q31

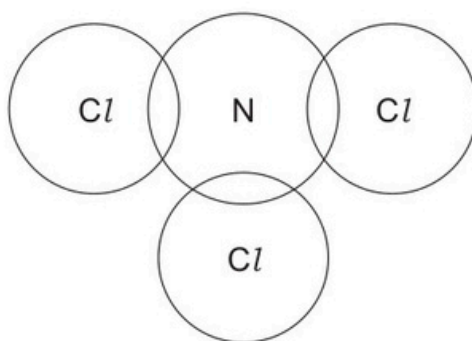
0620/42/M/J/22/Q4(c)

Covalent Bonding

(c) Nitrogen trichloride, NCl_3 , is a covalent compound.

Complete the dot-and-cross diagram to show the electron arrangement in a molecule of NCl_3 .

Show outer electrons only.



[3]

Q32

0620/43/M/J/22/Q3(a)(i)-(iii)

Covalent Bonding

(a) Nitrogen molecules have the formula N_2 .

Some properties of nitrogen are shown:

- melting point of -210°C
- boiling point of -196°C
- non-conductor of electricity when solid
- insoluble in water.

(i) Name the type of bonding between the atoms in an N_2 molecule.

..... [1]

(ii) Explain, in terms of attractive forces between particles, why nitrogen has a low melting point.

.....
..... [1]

(iii) Explain why nitrogen does **not** conduct electricity.

.....
..... [1]

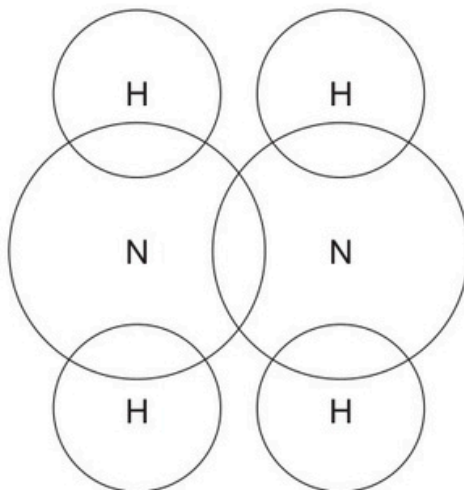
Q33

0620/43/M/J/22/Q3(d)

Covalent Bonding

(d) Hydrazine, N_2H_4 , is another compound that contains nitrogen and hydrogen.

Complete the dot-and-cross diagram to show the electron arrangement in a molecule of hydrazine. Show outer electrons only.



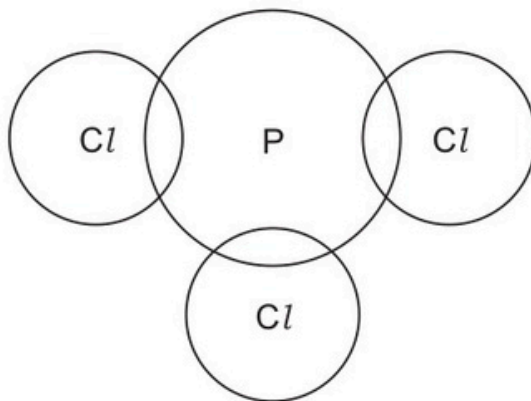
[2]

Q34

0620/43/O/N/22/Q4(b)

Covalent Bonding

- (b) Complete the dot-and-cross diagram to show the electron arrangement in a molecule of phosphorus(III) chloride, PCl_3 . Show outer shell electrons only.



[2]

Q35

0620/42/F/M/23/Q1(h)

Covalent Bonding

- (h) Complete the dot-and-cross diagram in Fig. 1.1 for a molecule of CO_2 .

Show outer shell electrons only.

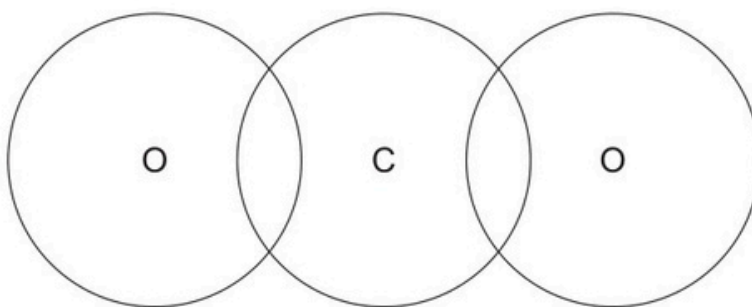


Fig. 1.1

[2]

(b) Carbon dioxide, CO_2 , is a covalent compound.

Complete the dot-and-cross diagram in Fig. 3.3 to show the electronic configuration in a molecule of carbon dioxide. Show outer shell electrons only.

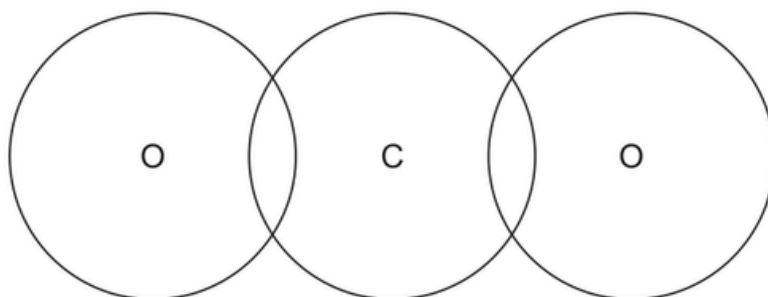


Fig. 3.3

[2]

(ii) Carbon dioxide has a low melting point.

State the general term for the weak forces that cause carbon dioxide to have a low melting point.

..... [1]

- (i) Complete the dot-and-cross diagram in Fig. 4.1 of a molecule of ethanoic acid.

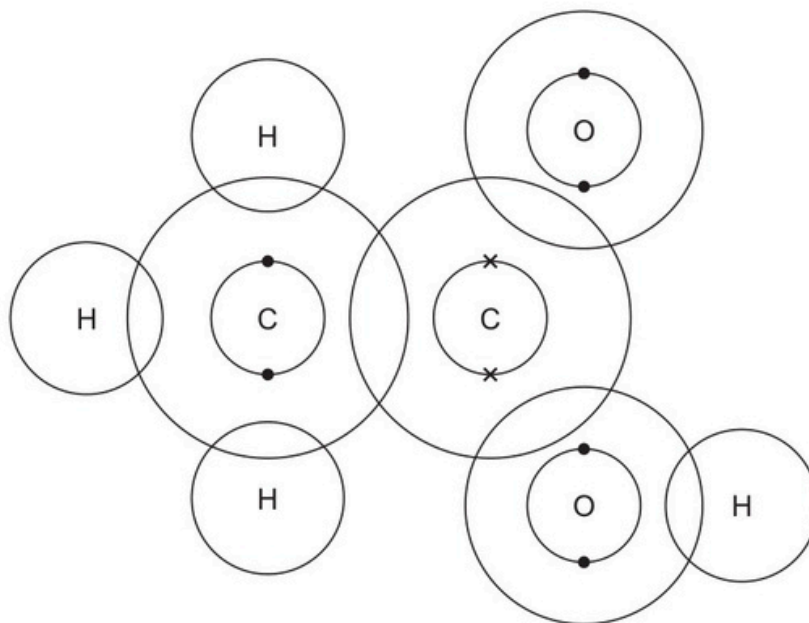


Fig. 4.1

[3]

- (ii) Suggest the pH of dilute ethanoic acid.

..... [1]

- (iii) Complete the symbol equation to show the dissociation of ethanoic acid.

CH_3COOH [3]

- (iv) Write the ionic equation for the reaction when an acid neutralises a soluble base.

..... [1]

- (b) Silicon tetrachloride, SiCl_4 , and silicon(IV) oxide, SiO_2 , are covalent compounds.

Complete the dot-and-cross diagram in Fig. 3.3 to show the electronic configuration in a molecule of silicon tetrachloride. Show outer shell electrons only.

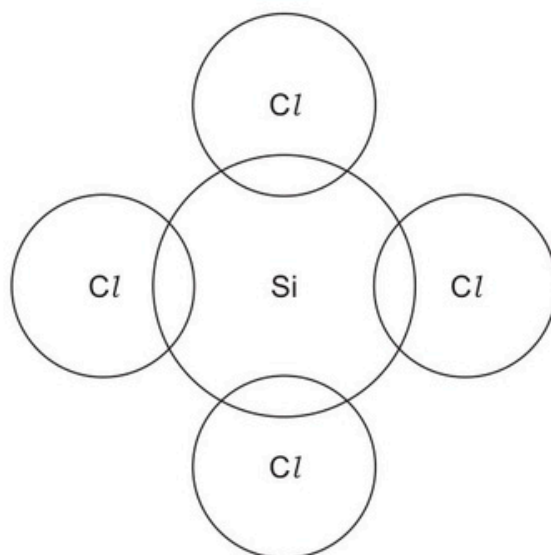


Fig. 3.3

[2]

- (c) The melting points of silicon tetrachloride and silicon(IV) oxide are shown in Table 3.1.

Table 3.1

	melting point/ $^{\circ}\text{C}$
silicon tetrachloride	-69
silicon(IV) oxide	1710

- (i) Silicon tetrachloride has a low melting point because it has weak forces of attraction between particles.

Name the type of particles that are held together by these weak forces of attraction.

..... [1]

- (iii) Complete the dot-and-cross diagram in Fig. 3.1 for a molecule of ammonia.

Show the outer shell electrons only.

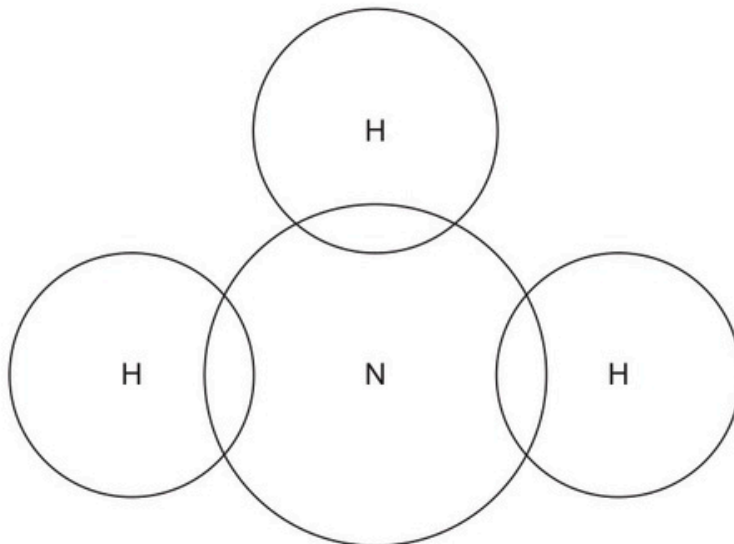


Fig. 3.1

[2]

- (iv) Write a chemical equation for the reaction occurring in the Haber process and give the typical reaction conditions. Include units where appropriate.

chemical equation

reaction conditions:

temperature

pressure

catalyst

[5]

Q40

0620/42/F/M/24/Q2(d)(i)

Covalent Bonding

(d) Bromine molecules have covalent bonding.

(i) State what is meant by the term covalent bond.

.....
..... [2]

Q41

0620/41/M/J/24/Q3(b)(ii), Q3(b)(iv)

Covalent Bonding

(ii) Complete the dot-and-cross diagram in Fig. 3.1 of a molecule of fluorine.

Show outer shell electrons only.

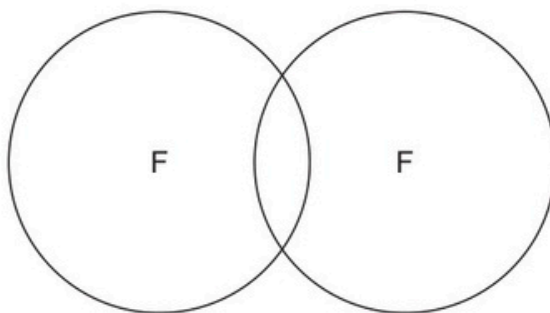


Fig. 3.1

[2]

(iv) Explain in terms of structure and bonding why sodium fluoride has a much higher melting point than fluorine.

.....
.....
.....
.....
..... [3]

- (ii) Complete the dot-and-cross diagram in Fig. 3.1 of a molecule of oxygen.

Show outer shell electrons only.

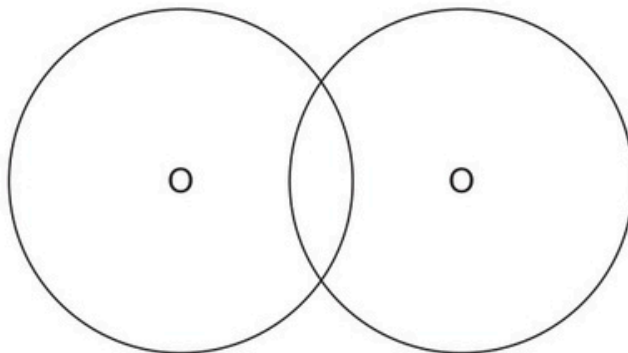


Fig. 3.1

[2]

- (iii) Deduce the physical state of carbon monoxide at -195°C . Use the data in Table 3.1 to explain your answer.

physical state

explanation

.....

[2]

Q43

0620/41/O/N/24/Q4(c)

Covalent Bonding

(c) Oxygen is a covalent molecule.

Complete the dot-and-cross diagram in Fig. 4.2 of a molecule of oxygen.
The inner shells have been drawn.

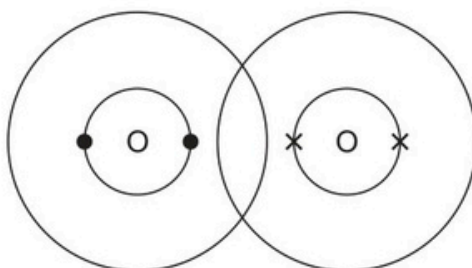


Fig. 4.2

[2]

[Total: 12]

- (a) Both chlorides are covalently bonded and have low melting points.

Suggest, in terms of attraction between particles, why these chlorides have low melting points.

.....
..... [2]

- (c) Complete the dot-and-cross diagram in Fig. 3.1 of a molecule of chloride **Q**, SCl_2 .

Show outer electrons only.

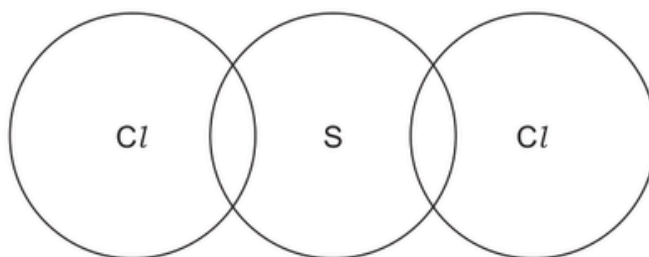


Fig. 3.1

[3]

Q45

0620/43/O/N/24/Q3(d)(i)

Covalent Bonding

(d) (i) Tin(IV) chloride, SnCl_4 , is covalently bonded.

A tin atom has four electrons in its outer shell.

Complete the dot-and-cross diagram in Fig. 3.1 for a molecule of SnCl_4 .
Show the outer shell electrons only.

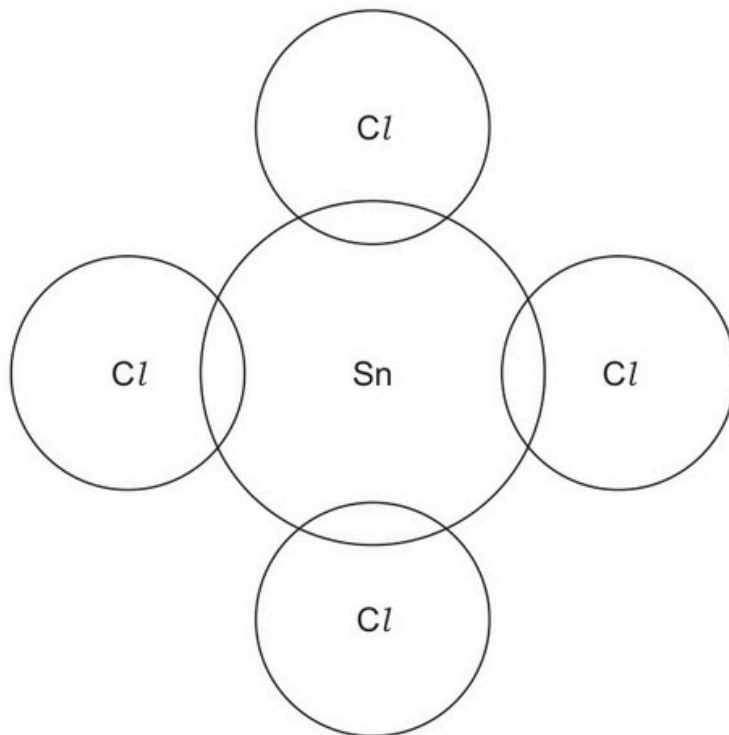


Fig. 3.1

[2]

Q46

0620/42/F/M/25/Q4(g)

Covalent Bonding

(g) Complete the dot-and-cross diagram in Fig. 4.2 of a molecule of carbonyl chloride.

Show outer shell electrons only.

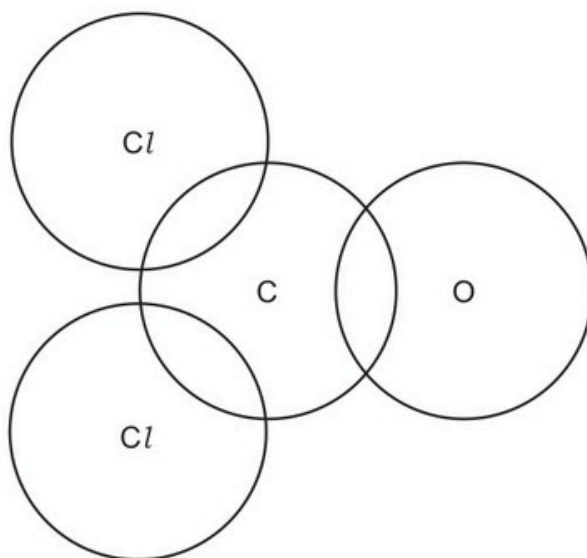


Fig. 4.2

[3]

Q47

0620/41/M/J/25/Q4(a)

Covalent Bonding

(a) Complete the dot-and-cross diagram in Fig. 4.1 to show the electronic configuration in a nitrogen molecule. Show outer-shell electrons only.

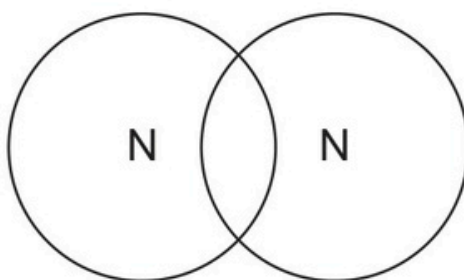


Fig. 4.1

[2]

2 This question is about covalent compounds.

(a) State what is meant by a covalent bond.

.....
..... [2]

(b) Chlorine(I) oxide, Cl_2O , is a simple molecule with covalent bonds.

(i) State what is meant by (I) in the name chlorine(I) oxide.

..... [2]

(ii) Complete the dot-and-cross diagram in Fig. 2.1 of a molecule of chlorine(I) oxide.

Show outer electrons only.

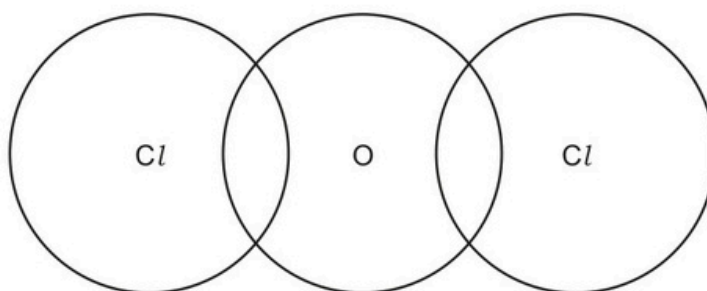


Fig. 2.1

[3]

(iii) Explain, in terms of structure and bonding, why Cl_2O boils at a low temperature and does **not** thermally decompose into its constituent elements, Cl_2 and O_2 .

.....
.....
.....
..... [3]

(iv) Give **two** reasons why liquid Cl_2O is a poor conductor of electricity.

1
2
[2]

- (c) Chlorine reacts with nitrogen to form nitrogen trichloride, NCl_3 .

Complete the dot-and-cross diagram in Fig. 4.1 of a molecule of NCl_3 .

Show outer shell electrons only.

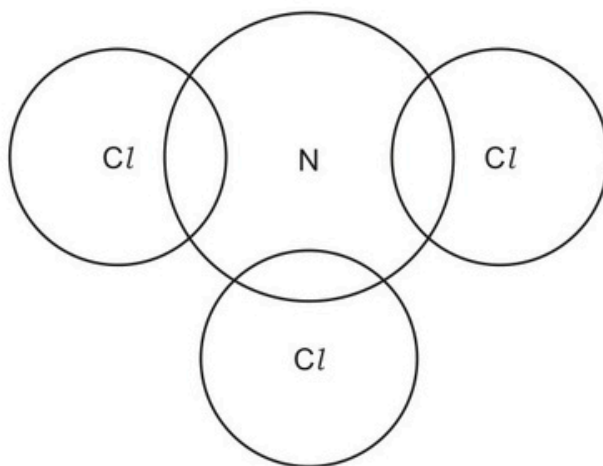


Fig. 4.1

[3]

Q50

0620/42/O/N/21/Q5(a)

Metallic Bonding

(a) Iron and potassium have the same type of bonding.

Name and describe the type of bonding in these two elements.

name

description

.....

.....

.....

[4]

Q51

0620/41/M/J/22/Q3(a)(i)-(ii)

Metallic Bonding

(a) (i) Describe the bonding in a metallic element such as sodium.

You may include a diagram as part of your answer.

.....

.....

..... [3]

(ii) Describe how solid sodium conducts electricity.

..... [1]

Q52

0620/43/M/J/22/Q5(a)

Metallic Bonding

(a) Describe the bonding in a metallic element such as copper.

You may include a diagram as part of your answer.

.....

.....

..... [3]

Q53

0620/42/F/M/23/Q2(a)

Metallic Bonding

(a) Name the type of bonding in these elements.

..... [1]

Q54

0620/43/O/N/23/Q5(a)(i)-(ii)

Metallic Bonding

(a) (i) Describe the bonding in a metallic element such as iron.

You may include a labelled diagram as part of your answer.

.....
.....
..... [3]

(ii) Explain why iron conducts electricity when it is solid.

..... [1]

Q55

0620/43/O/N/23/Q5(c)

Metallic Bonding

(c) Most iron is converted into steel. Steel is an alloy.

Steel is more useful than pure iron because it is harder and stronger.

Explain why the structure of alloys causes them to be harder and stronger than pure metals.

You may include a diagram as part of your answer.

.....
..... [2]

Q56

0620/41/M/J/25/Q3(a)(i)-(ii)

Metallic Bonding

(a) (i) Describe the bonding in a metallic element such as copper.

.....
.....
.....
.....
..... [3]

(ii) Explain how solid copper conducts electricity.

..... [1]

Q57

0620/43/M/J/25/Q3(a)(i)-(iii)

Metallic Bonding

(a) Zinc is held together by electrostatic forces of attraction between particles.

(i) Name the type of bonding in zinc.

..... [1]

(ii) Name the **two** types of particles held together by the bonding in (a)(i).

1

2 [2]

(iii) Name the type of particle whose movement allows zinc to conduct electricity.

..... [1]

Q58

0620/41/O/N/25/Q2(b)

Metallic Bonding

(b) Name and describe the type of bonding found in elements in Group II.

name

description

.....

.....

.....

[4]

Q59 **0620/41/O/N/21/Q3(f)** Giant Covalent Structures

(f) State **two** properties of graphite (carbon) which make it suitable for use as an electrode.

1

2 [2]

Q60 **0620/43/O/N/21/Q4(b)** Giant Covalent Structures

(b) Name **two** forms of the element carbon which have giant covalent structures.

..... and [1]

Q61 **0620/42/F/M/22/Q1(d)** Giant Covalent Structures

1 This question is about the first 30 elements in the Periodic Table.

Name the element which:

(d) forms an oxide with a giant covalent structure [1]

Q62

0620/42/O/N/22/Q1(a)-(e)

Giant Covalent Structures

- 1 Diamond and graphite are different solid forms of carbon. The carbon atoms in diamond and graphite are arranged in different ways.

(a) State the number of covalent bonds each carbon atom has in diamond.

..... [1]

(b) State the term used to describe the structure of diamond.

..... [1]

(c) Name an oxide that has a similar structure to diamond.

..... [1]

(d) Describe the arrangement of atoms in graphite.

.....

..... [2]

(e) Explain how graphite conducts electricity.

..... [1]

Q63

0620/42/M/J/23/Q1(b)

Giant Covalent Structures

1 A list of oxides, **A** to **H**, is shown.

- A** calcium oxide
- B** aluminium oxide
- C** silicon(IV) oxide
- D** sulfur dioxide
- E** carbon dioxide
- F** iron(III) oxide
- G** silver oxide
- H** carbon monoxide

Answer the following questions about the oxides, **A** to **H**.
Each letter may be used once, more than once or not at all.

State which of the oxides **A** to **H**

(b) has a giant covalent structure

..... [1]

Q64

0620/43/M/J/23/Q3(c)(ii)

Giant Covalent Structures

(ii) Explain, in terms of structure and bonding, why silicon(IV) oxide has a high melting point.

.....
.....
.....
..... [2]

Q65

0620/43/M/J/24/Q3(a)(i),Q3(a)(iv)

Giant Covalent Structures

(a) Some properties of graphite, oxygen and carbon monoxide are shown in Table 3.1.

Table 3.1

	melting point /°C	boiling point /°C	conduction of electricity when solid
graphite	3652	4827	good
oxygen	−218	−183	poor
carbon monoxide	−199	−191	poor

(i) Explain why graphite conducts electricity when solid.

.....
 [1]

(iv) Explain in terms of structure and bonding why graphite has a much higher melting point than carbon monoxide.

.....

 [3]

Q66

0620/43/O/N/24/Q1(g)-(h)

Giant Covalent Structures

graphite
 helium
 hematite
 hydrogen
 silicon(IV) oxide
 sodium chloride

(g) is a compound with a giant covalent structure

..... [1]

(h) is used as a lubricant

..... [1]

(c) Carbon and silicon(IV) oxide both exist as giant covalent structures.

(i) Name a giant covalent structure of carbon which conducts electricity.

..... [1]

(ii) Identify the particles responsible for the conduction of electricity in this covalent structure of carbon.

..... [1]

(iii) Silicon(IV) oxide contains silicon atoms, Si, and oxygen atoms, O.

Fig. 2.2 shows part of the giant covalent structure of silicon(IV) oxide.

Complete the diagram in Fig. 2.2 by adding the symbol for each of the 9 atoms shown.

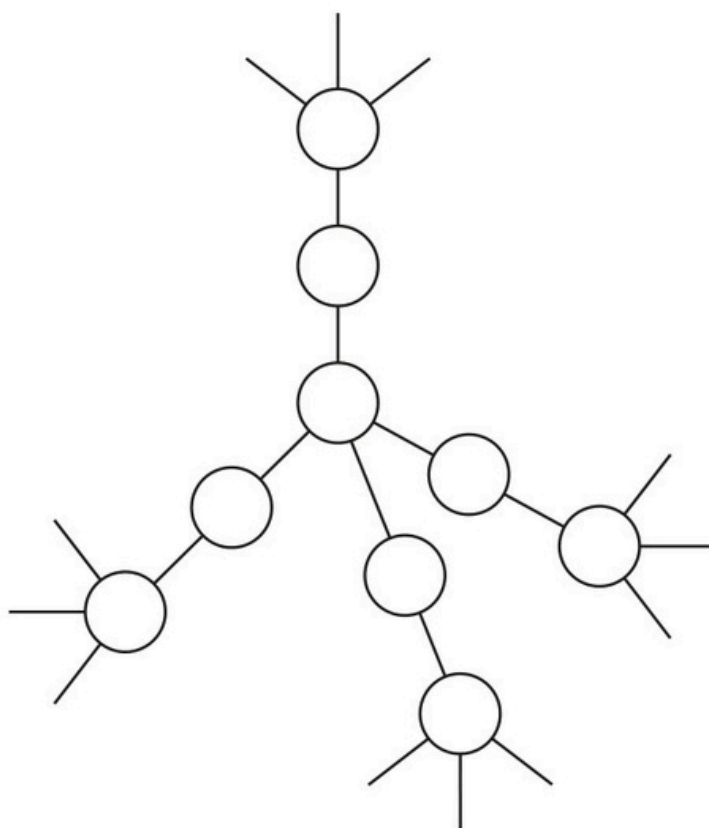


Fig. 2.2

[2]

Q68

0620/43/M/J/25/Q1(a),Q1(d)

Giant Covalent Structures

1 A list of substances is shown.

aluminium oxide

calcium oxide

chlorine

ethanol

graphite

nitrogen

oxygen

propane

propene

silicon(IV) oxide

Answer the questions using the list of substances.

Each substance may be used once, more than once, or not at all.

State which of the substances:

(a) is a compound with a giant covalent structure

..... [1]

(d) is a good conductor of electricity when solid

..... [1]

Q69

0620/43/O/N/25/Q2(b)(i)

Giant Covalent Structures

- 2 Table 2.1 shows the melting points, boiling points and electrical conductivities of seven substances, A, B, C, D, E, F and G.

Table 2.1

substance	melting point / °C	boiling point / °C	electrical conductivity when solid	electrical conductivity when molten
A	1600	2230	poor	poor
B	−219	−183	poor	poor
C	770	1420	poor	good
D	−39	357	good	good
E	−7	58	poor	poor
F	44	280	poor	poor
G	1085	2562	good	good

- (b) (i) Identify which substance, A, B, C, D, E, F or G, has a giant covalent structure.

Use the information in Table 2.1 to give **two** reasons for your choice.

substance

reason 1

reason 2

[3]

Q1 0620/41/M/J/21/Q3(b)

Marking Scheme

K outer shell with 8 crosses (1)
Cl outer shell with 7 dots and 1 cross (1) + and – (1)

Q2 0620/42/M/J/21/Q5(a)(ii)

Marking Scheme

new octet of 8 electrons consisting of 5 crosses and 3 dots in second shell (1) charge of 3– (1)
2

Q3 0620/43/M/J/21/Q3(b)

Marking Scheme

Na outer shell with 8 crosses (1)
F outer shell with 7 dots and 1 cross (1)
Na⁺ and F[–] (1)

Q4 0620/43/O/N/21/Q3(f)(ii)

Marking Scheme

M1 bonds between ions or ionic bonds in lead(II) oxide (1)
M2 attraction between molecules in carbon dioxide (1)

Q5 0620/42/F/M/22/Q2(b)

Marking Scheme

eight crosses in second shell of Mg 7 dots and 1 cross in third shell of both Cl 2+ charge on Mg and – charge on both Cl ions on correct answer line

Q6 0620/42/F/M/22/Q4(d)(ii)

Marking Scheme

mobile ions 1

Q7 0620/41/M/J/22/Q3(b)(i)-(ii)

Marking Scheme

ionic 1
ions move / ions are mobile / ions flow

Q8 0620/42/M/J/22/Q4(d)-(e)

Marking Scheme

two crosses in first shell of Li 7 dots and 1 cross in third shell of Cl '+' charge on Li on correct answer line and '-' charge on Cl ion on correct answer line
ionic bonds in LiCl attraction between molecules in NCl₃ weaker attraction (between particles) in NCl₃ OR A

Q9 0620/41/O/N/22/Q2(b)(i)-(ii)

Marking Scheme

any two (one from each bullet point)
physical constants: high boiling point / melting point
conductivity: conduct electricity when aqueous / conduct electricity when molten
solubility: soluble in water
M1 eight dots in third shell of both K (1)
M2 six crosses and two dots in third shell of S (1)
M3 '+' charge on each K on correct answer line and '2–' charge on S ion on correct answer line (1)

Q10	0620/42/O/N/22/Q2(b)(iv)	Marking Scheme
M1 eight crosses in second shell of both Na (1) M2 six dots and two crosses in second shell of O (1) M3 '+' charge on each Na ion on correct answer line and '2-' charge on O ion on correct answer line (1)		
Q11	0620/42/F/M/23/Q2(d)	Marking Scheme
M1 eight dots in third shell of both K (1) M2 six crosses and two dots in second shell of O (1) M3 '+' charge on each K on correct answer line and '2-' charge on O ion on correct answer line (1)		
Q12	0620/41/M/J/23/Q3(a)(i)-(ii)	Marking Scheme
M1 Na with 2,8 all crosses(1) M2 O with 2,8 outer shell with 6 dots and 2 crosses(1) M3 + AND 2 (1) Na₂O 1		
Q13	0620/41/M/J/23/Q3(c)(i)	Marking Scheme
M1 positive ions and negative ions (1) M2 strong attraction / strong bonds (1)		
Q14	0620/43/M/J/23/Q3(a)(i)-(iii)	Marking Scheme
M1 eight crosses in second shell of Mg M2 7 dots and 1 cross in second shell of F M3 '2+' charge on Mg ion on correct answer line and '-' charge on F ion on correct answer line MgF₂ 1 melting 1		
Q15	0620/42/F/M/24/Q2(f)	Marking Scheme
M1 8 crosses in third shell of Ca M2 7 dots and 1 cross in third shell of both Cl M3 '2+' charge on Ca on correct answer line AND '-' charge on both Cl ions on correct answer line		
Q16	0620/42/M/J/24/Q5(b)(i)-(iii)	Marking Scheme
M1 eight crosses in second shell of Mg M2 6 dots and 2 cross in third shell of S M3 '2+' charge on Mg on correct answer line and '2-' charge on S on correct answer line ionic bonds are strong 1 mobile ions 1		
Q17	0620/41/O/N/24/Q4(b)	Marking Scheme
M1 eight crosses in second shell of Mg M2 six dots and two crosses in second shell of O M3 '2+' charge on Mg ion on correct answer line AND '2-' charge on O ion on correct answer line		

Q18 0620/42/O/N/24/Q2(f)

Marking Scheme

M1 eight crosses in second shell of Al M2 seven dots and one cross in second shell of each F M3 '3+' charge on Al ion on correct answer line AND '–' charge on each F ion on correct answer line

Q19 0620/43/O/N/24/Q3(d)(ii)

Marking Scheme

M1 attraction between molecules or intermolecular forces in tin(IV) chloride M2 tin(II) oxide has a giant ionic structure M3 weaker attraction (between particles) in tin(IV) chloride OR A

Q20 0620/42/F/M/25/Q2(a)–(b)

Marking Scheme

M1 (strong) (electrostatic) attraction between ions M2 ions have opposite charges
M1 8 dots in third shell of each K M2 6 crosses and 2 dots in third shell of S M3 '+' charge on each K ion on correct answer line and '2–' charge on S ion on correct answer line

Q21 0620/42/F/M/25/Q2(c)(i)

Marking Scheme

M1 3 correctly positioned positive ions next to given negative M2 all ions correct

Q22 0620/42/M/J/25/Q5(c)

Marking Scheme

M1 8 dots in second shell of each Na M2 6 crosses and 2 dots in third shell of S M3 '+' charge on each Na ion on correct answer line and '2–' charge on S ion on correct answer line

Q23 0620/43/O/N/25/Q2(b)(ii)

Marking Scheme

Substance E
it has a high melting point and conducts electricity when molten but not when solid. (Accept the substance identified by the table data.)

Q24 0620/41/M/J/21/Q3(e)

Marking Scheme

one shared pair of electrons and 6 non-bonding electrons on each chlorine atom 1

Q25 0620/42/M/J/21/Q5(b)(iii)

Marking Scheme

N with 1 bonding pair with each F (1)
2 non-bonding dots for N (1)
6 non-bonding crosses for F (1)

Q26 0620/43/M/J/21/Q3(e)

Marking Scheme

one shared pair of electrons and 6 non-bonding electrons on each fluorine atom 1

Q27 0620/42/O/N/21/Q4(e)

Marking Scheme

M1 all single bonding dot and cross pairs correct M2 double C=O bond dot and cross pairs are correct
M3 complete diagram is correct

Q28 0620/43/O/N/21/Q3(f)(i)

Marking Scheme

M1 two double bonds (1)

M2 two pairs of non-bonding electrons on each oxygen and no non-bonding electrons on carbon (1)

Q29 0620/42/F/M/22/Q2(c)

Marking Scheme

C atom double bonded to 2 O atoms 4 non-bonding e- on each O and no non-bonding e- on C and both octets complete 2

Q30 0620/41/M/J/22/Q4(b)(i)

Marking Scheme

2 bonding pairs as one dot and cross each (1)

2 lone pairs on S (and no additional electrons on Hs) to complete the outer shell on S and both Hs (1)

Q31 0620/42/M/J/22/Q4(c)

Marking Scheme

N with 1 dot-cross bonding pair with each Cl 2 non-bonding dots for N 6 non-bonding crosses for Cl

Q32 0620/43/M/J/22/Q3(a)(i)-(iii)

Marking Scheme

covalent 1

weak force(s) of attraction between molecules 1

no ions OR no mobile electrons 1

Q33 0620/43/M/J/22/Q3(d)

Marking Scheme

all 4 NH dot and cross bonds (1) single bonding pair between N's and two non-bonding electrons on each N and no non-bonding e on H and nitrogen octet complete (1)

Q34 0620/43/O/N/22/Q4(b)

Marking Scheme

M1 3 dot and cross bonding pairs (1)

M2 All lone pairs correct. All octets should be complete AND dots and crosses should be different on P and all Cl (1)

Q35 0620/42/F/M/23/Q1(h)

Marking Scheme

M1 two dot-and-cross double bonds M2 two pairs of non-bonding electrons on O and zero non-bonding electrons on C

Q36 0620/41/M/J/23/Q3(b),Q3(c)(ii)

Marking Scheme

M1 both bonds with 2 dots and 2 crosses(1)

M2 2 lone pairs (all dots or all crosses) on both oxygen atoms completing all 3 octets(1)
intermolecular forces 1

Q37	0620/42/M/J/23/Q4(f)(i)	Marking Scheme
M1 all single bonding dot and cross pairs correct M2 double C = O bond dot and cross pairs are correct M3 complete diagram is correct		
Q38	0620/43/M/J/23/Q3(b),Q3(c)(i)	Marking Scheme
M1 4 dot and cross single bonds M2 3 pairs of non-bonding e on each Cl and no non-bonding e on Si molecule(s) 1		
Q39	0620/43/O/N/23/Q3(a)(iii)	Marking Scheme
M1 three single bonding pairs containing one dot and one cross (1) M2 two dots or two crosses on N (and no additional electrons on Hs) to complete the outer shell on N and all 3 Hs (1)		
Q40	0620/42/F/M/24/Q2(d)(i)	Marking Scheme
M1 pair of electrons M2 electron(s) shared between two atoms		
Q41	0620/41/M/J/24/Q3(b)(ii),Q3(b)(iv)	Marking Scheme
M1 one shared dot and cross(1) M2 6 non-bonding electrons (either) dots or crosses on each fluorine atom to complete both octets (1) M1 ionic bonds in NaF(1) M2 attraction between molecules or intermolecular forces in F ₂ (1) M3 weaker attraction (between particles) in F ₂ ORA (1)		
Q42	0620/43/M/J/24/Q3(a)(ii)	Marking Scheme
M1 double bond of two dots and two crosses M2 4 non-bonding electrons on each oxygen atom		
Q43	0620/41/O/N/24/Q4(c)	Marking Scheme
M1 two dot-cross pairs as a double bond M2 four non-bonding electrons on each O		
Q44	0620/42/O/N/24/Q3(a),Q3(c)	Marking Scheme
M1 attraction between molecules M2 attraction is weak M1 S with one dot-cross bonding pair with each Cl M2 four non-bonding dots for S M3 six non-bonding crosses for each Cl		
Q45	0620/43/O/N/24/Q3(d)(i)	Marking Scheme
M1 four single bonds using one dot and one cross M2 three pairs of non-bonding electrons on each chlorine and no non-bonding electrons on tin		

Q46	0620/42/F/M/25/Q4(g)	Marking Scheme
M1 both single bonding dot and cross pairs correct M2 double C=O bond dot and cross pairs are correct M3 Complete diagram is correct		
Q47	0620/41/M/J/25/Q4(a)	Marking Scheme
M1 3 dots and 3 crosses shared M2 one non-bonding pair of 2 dots on one N atom and 2 crosses on the other N atom to complete the octet on both		
Q48	0620/42/M/J/25/Q2(a)-Q2(b)(iv)	Marking Scheme
M1 pair of electrons M2 electron(s) shared between two atoms M1 the oxidation number of chlorine / Cl M2 (oxidation number) is +1 M1 O with 1 dot-cross bonding pair with each Cl M2 4 non-bonding dots for O M3 6 non-bonding crosses for each Cl M1 (forces of) attraction between molecules are broken (during boiling) M2 covalent bonds (between Cl and O atoms) are broken (during thermal decomposition) M3 weak attraction between molecules and strong covalent bonds / bonding between atoms correctly applied M1 no ions M2 no mobile electrons		
Q49	0620/43/O/N/25/Q4(c)	Marking Scheme
N at the centre with three single N-Cl shared pairs one lone pair on N each Cl has three lone pairs. [3]		
Q50	0620/42/O/N/21/Q5(a)	Marking Scheme
metallic (1) (lattice of) positive ions (1) sea of / delocalised / mobile electrons (1) attraction between positive ions and electrons (1)		
Q51	0620/41/M/J/22/Q3(a)(i)-(ii)	Marking Scheme
positive ions / cations (1) sea of electrons / mobile electrons / delocalised electrons (1) attraction between positive ions and electrons (1) electrons move / electrons mobile / electrons flow		
Q52	0620/43/M/J/22/Q5(a)	Marking Scheme
(lattice of) positive ions (1) sea of / delocalised / mobile electrons (1) attraction between positive ions and electrons (1)		
Q53	0620/42/F/M/23/Q2(a)	Marking Scheme
metallic 1		

Q54	0620/43/O/N/23/Q5(a)(i)-(ii)	Marking Scheme
M1 positive ions / cations (1) M2 sea of electrons / mobile electrons / delocalised electrons (1) M3 attraction between positive ions and electrons (1) electrons move / electrons mobile / electrons flow 1		
Q55	0620/43/O/N/23/Q5(c)	Marking Scheme
M1 atoms have different sizes (1) M2 layers cannot slide over or past each other (1)		
Q56	0620/41/M/J/25/Q3(a)(i)-(ii)	Marking Scheme
M1 positive ions / cations(1) M2 sea of electrons / mobile electrons / delocalised electrons(1) M3 attraction between positive ions and electrons(1) electrons move / electrons mobile / electrons flow		
Q57	0620/43/M/J/25/Q3(a)(i)-(iii)	Marking Scheme
(i) metallic bonding (ii) positive zinc ions / cations and delocalised electrons (iii) delocalised electrons. [4]		
Q58	0620/41/O/N/25/Q2(b)	Marking Scheme
Refer to the corresponding official Cambridge mark scheme.		
Q59	0620/41/O/N/21/Q3(f)	Marking Scheme
M1 inert (1) M2 conducts electricity (1)		
Q60	0620/43/O/N/21/Q4(b)	Marking Scheme
diamond and graphite 1		
Q61	0620/42/F/M/22/Q1(d)	Marking Scheme
silicon 1		
Q62	0620/42/O/N/22/Q1(a)-(e)	Marking Scheme
4 1 giant covalent 1 silicon dioxide 1 M1 layers M2 hexagon(al) (rings of carbon) mobile electrons 1		

Q63 **0620/42/M/J/23/Q1(b)** Marking Scheme
C 1

Q64 **0620/43/M/J/23/Q3(c)(ii)** Marking Scheme
M1 covalent bonds M2 strong bonds and giant (covalent) structure

Q65 **0620/43/M/J/24/Q3(a)(i),Q3(a)(iv)** Marking Scheme
mobile electrons 1
M1 graphite has a giant covalent structure M2 attraction between molecules in carbon monoxide M3
weaker attraction (between particles) in carbon monoxide ORA

Q66 **0620/43/O/N/24/Q1(g)-(h)** Marking Scheme
silicon(IV) oxide 1
graphite 1

Q67 **0620/42/M/J/25/Q2(c)(i)-(iii)** Marking Scheme
graphite 1
electrons 1
M1 5 correct Si atoms M2 4 correct O atoms

Q68 **0620/43/M/J/25/Q1(a),Q1(d)** Marking Scheme
(a) silicon(IV) oxide
(d) graphite. [2]

Q69 **0620/43/O/N/25/Q2(b)(i)** Marking Scheme
Substance F
very high melting and boiling points, and it does not conduct electricity. (Accept the substance
identified by the table data.)