



O-Level Chemistry (5070)

TOPICAL PAST PAPER

CHEMICAL BONDING

MCQS

2026 EDITION

SECTION A: IONIC BONDING

Q1

5070/11/M/J/21/Q27

Ionic Bonding

Elements X and Y combine to form an ionic compound.

Atoms of X have more protons than atoms of Y.

Atoms of Y have more valence electrons than atoms of X.

Which statement is correct?

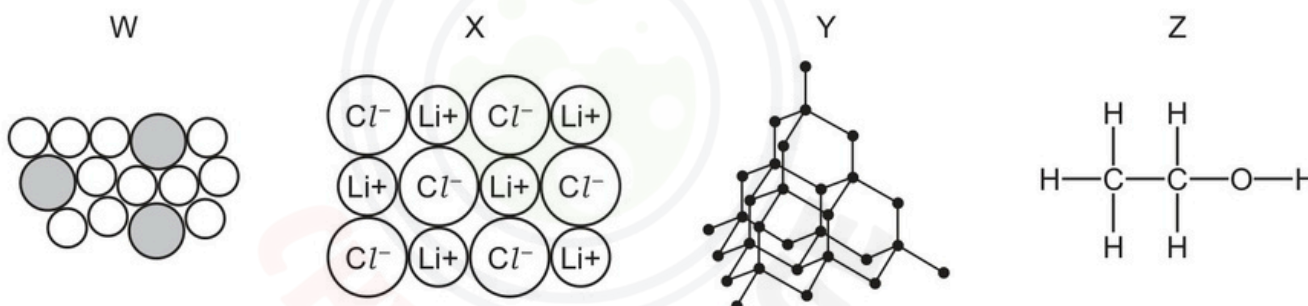
- A Ions of X are negatively charged.
- B Atoms of X have more electron shells than atoms of Y.
- C X and Y are in the same period of the Periodic Table.
- D X and Y are in the same group of the Periodic Table.

Q2

5070/11/M/J/22/Q8

Ionic Bonding

Which statement about the substances, at room temperature and pressure, is correct?



- A W and X conduct electricity.
- B W and Y are elements.
- C X and Z dissolve in water.
- D Y and Z have low melting points.

Q3

5070/11/M/J/22/Q9

Ionic Bonding

A piece of magnesium reacts with dilute hydrochloric acid.

The resulting solution is then evaporated leaving a solid residue of magnesium chloride.

Which statement is correct?

- A A covalent solid is formed in this process.
- B Each chlorine atom gains one electron in this process.
- C Each magnesium atom loses only one electron in this process.
- D Molecules of an element are formed during the reaction.

SECTION A - IONIC BONDING

Q4

5070/11/M/J/22/Q17

Ionic Bonding

Compound X is sodium iodide, NaI.

Compound Y is methyl methanoate, HCO_2CH_3 .

At room temperature and pressure, ...1..... solid. In aqueous solution, ...2..... electricity.

Which words correctly complete gaps 1 and 2?

	1	2
A	both X and Y are	both X and Y conduct
B	both X and Y are	only X conducts
C	only X is	both X and Y conduct
D	only X is	only X conducts

Q5

5070/12/M/J/22/Q9

Ionic Bonding

Which statement about ionic compounds is correct?

- A They are all solids at room temperature.
- B They all conduct electricity at room temperature.
- C They are all soluble in water.
- D They all have strong intermolecular forces.

Q6

5070/11/O/N/22/Q10

Ionic Bonding

Elements X and Y react to form compound XY. Element Y has more electrons in its outer shell than element X. Compound XY conducts electricity in the molten state.

Which row correctly states the electron change that occurs during the reaction and the type of bonding in compound XY?

	electron change during formation of compound XY	type of bonding in compound XY
A	X donates electrons to Y	ionic
B	X shares electrons with Y	covalent
C	Y donates electrons to X	covalent
D	Y shares electrons with X	ionic

Q7

5070/11/O/N/22/Q12

Ionic Bonding

The formula of ammonium metavanadate is NH_4VO_3 . It consists of NH_4 ions and VO_3 ions.

What are the charges on these ions?

	NH_4 ion	VO_3 ion
A	1+	1-
B	2+	2-
C	3+	4-
D	4+	3-

Q8

5070/12/O/N/22/Q7

Ionic Bonding

The table contains information about four substances.

Which substance is an ionic compound?

	state at room temperature	conducts electricity at room temperature	conducts electricity when molten	conducts electricity when in aqueous solution
A	liquid	x	x	✓
B	solid	✓	✓	✓
C	solid	✓	✓	insoluble
D	solid	x	✓	✓

Q9

5070/12/O/N/22/Q9

Ionic Bonding

An ionic compound has the formula Al_2O_3 .

What are the charges on the ions?

- A** $\text{Al}^+ \text{O}^-$ **B** $\text{Al}^{2+} \text{O}^{2-}$ **C** $\text{Al}^{2+} \text{O}^{3-}$ **D** $\text{Al}^{3+} \text{O}^{2-}$

Q10

5070/11/M/J/23/Q4

Ionic Bonding

Some statements about the bonding in magnesium chloride are listed.

- 1 Each magnesium atom donates two electrons; each chlorine atom accepts one electron.
- 2 Chlorine forms an ion with a 2⁻ charge.
- 3 Magnesium atoms and chlorine atoms share electrons.
- 4 Magnesium forms an ion with a 2⁺ charge.

Which statements are correct?

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

Q11

5070/12/M/J/23/Q4

Ionic Bonding

Element X and element Y react together to form a compound.

The electronic configurations of X and Y are X = 2,8,3 and Y = 2,6.

Which row shows the electron transfer that takes place and the type of compound formed?

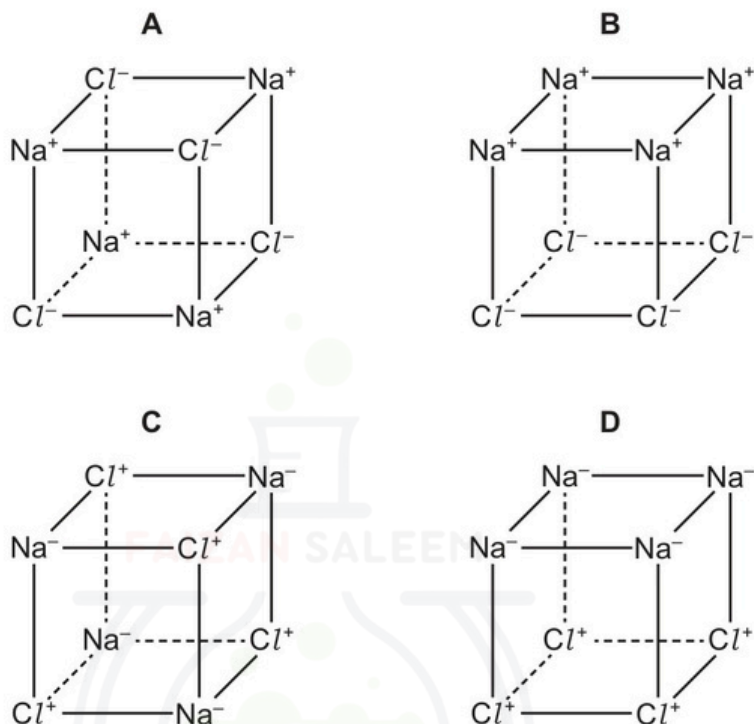
	element X	element Y	type of compound
A	2 atoms each lose 3 electrons	3 atoms each receive 2 electrons	covalent
B	2 atoms each lose 3 electrons	3 atoms each receive 2 electrons	ionic
C	2 atoms each receive 3 electrons	3 atoms each lose 2 electrons	covalent
D	2 atoms each receive 3 electrons	3 atoms each receive 2 electrons	ionic

Q12

5070/12/O/N/23/Q5

Ionic Bonding

Which diagram shows a section of the ionic lattice of sodium chloride?



Q13

5070/12/O/N/24/Q5

Ionic Bonding

Which statement about electrical conductivity is correct?

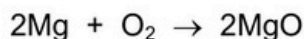
- A** Covalent compounds, such as glucose, conduct when molten or dissolved in water.
- B** Dilute acids, such as sulfuric acid, conduct because all the ions are free to move.
- C** Ionic compounds, such as sodium chloride, conduct due to movement of electrons.
- D** Metals, such as copper, conduct due to movement of positive ions.

Q14

5070/11/M/J/25/Q6

Ionic Bonding

Magnesium reacts with oxygen to form magnesium oxide.



Which row is correct?

	structure of Mg	structure of O ₂	Mg ²⁺	O ²⁻
A	giant lattice	simple molecules	anion	cation
B	simple molecules	giant lattice	anion	cation
C	giant lattice	simple molecules	cation	anion
D	simple molecules	giant lattice	cation	anion

Q15

5070/11/M/J/25/Q7

Ionic Bonding

Which statement about solid calcium chloride is correct?

- A It conducts electricity.
- B It has a low melting point.
- C It has an ionic lattice structure.
- D It is insoluble in water.

Q16

5070/11/M/J/25/Q9

Ionic Bonding

The ions Ca²⁺ and PO₄³⁻ combine to form an ionic compound.

What is the formula of the compound?

- A Ca₂PO₄ B Ca(PO₄)₃ C Ca₂(PO₄)₃ D Ca₃(PO₄)₂

Q17

5070/12/M/J/25/Q7

Ionic Bonding

Which statement about magnesium oxide is correct?

- A It has a high melting point and good electrical conductivity at r.t.p.
- B It is made up of magnesium anions and oxygen cations.
- C It is an ionic compound and has good electrical conductivity when molten.
- D It is strongly bonded because of electrons shared between magnesium atoms and oxygen atoms.

Q18

5070/11/O/N/25/Q5

Ionic Bonding

Metals lose electrons when they combine with a non-metal to form an ionic compound.

Calcium combines with hydrogen to form the ionic compound calcium hydride, CaH_2 .

How many electrons are there in the outer shell of each of the two hydride ions in CaH_2 ?

- A 0 B 1 C 2 D 4

Q19

5070/11/O/N/25/Q8

Ionic Bonding

Aluminium ions, Al^{3+} , react with sulfate ions, SO_4^{2-} , to form aluminium sulfate.

Which row shows the correct empirical formula and ionic formula of aluminium sulfate?

	empirical formula	ionic formula
A	AlSO_4	$\text{Al}^{3+}\text{SO}_4^{2-}$
B	$\text{Al}_2\text{S}_2\text{O}_8$	$\text{Al}^{3+}(\text{SO}_4^{2-})_2$
C	$\text{Al}_2\text{S}_3\text{O}_{12}$	$\text{Al}^{3+}_2(\text{SO}_4^{2-})_3$
D	$\text{Al}_3\text{S}_2\text{O}_8$	$\text{Al}^{2+}_3(\text{SO}_4^{3-})_2$

Q20

5070/12/O/N/25/Q4

Ionic Bonding

In which ionic compound do all the ions have the same electronic configuration?

- A beryllium sulfide
- B lithium fluoride
- C magnesium chloride
- D sodium oxide

Q21

5070/12/O/N/25/Q21

Ionic Bonding

The atomic number of element X is 12.

What is the formula of the chloride of X?

- A XCl B XCl_2 C XCl_4 D X_2Cl

SECTION B: COVALENT BONDING

Q22

5070/11/M/J/21/Q8

Covalent Bonding

What is a covalent bond?

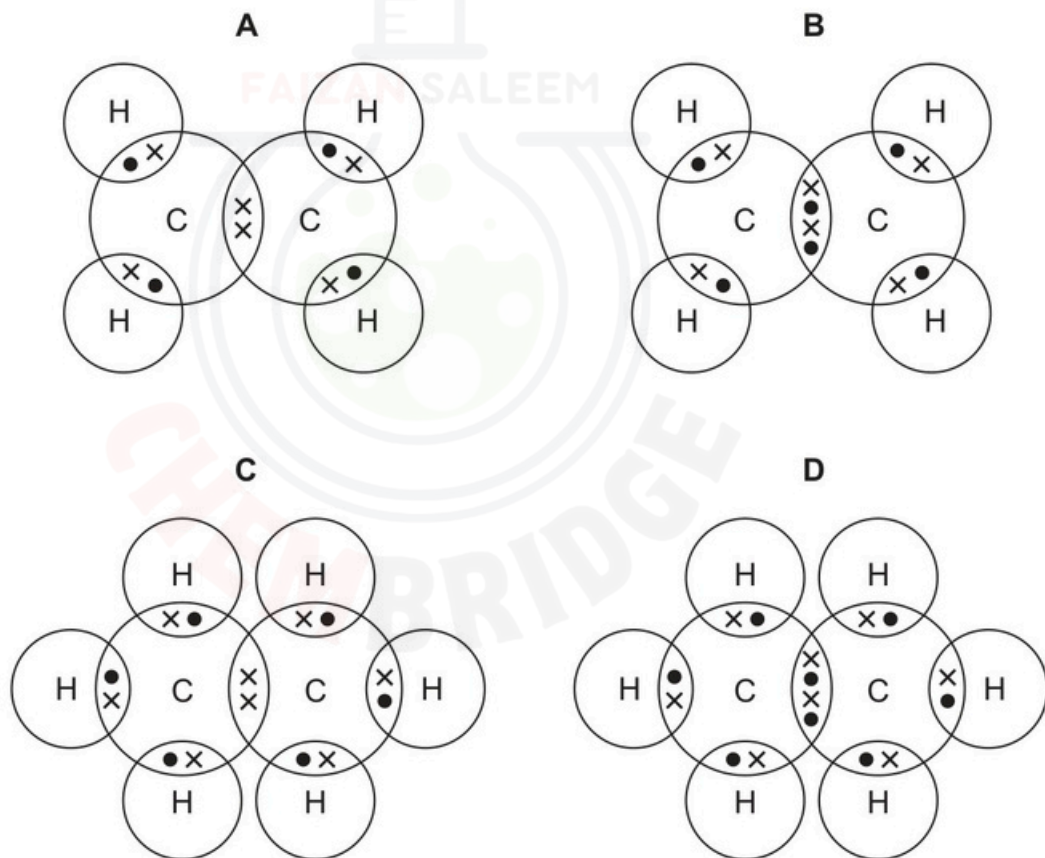
- A a pair of electrons shared by two non-metallic atoms
- B electrons being shared by a lattice of positively charged ions
- C elements losing electrons to achieve a noble gas structure
- D oppositely charged particles strongly attracting each other

Q23

5070/12/M/J/21/Q9

Covalent Bonding

Which dot-and-cross diagram correctly shows a molecule of ethene?



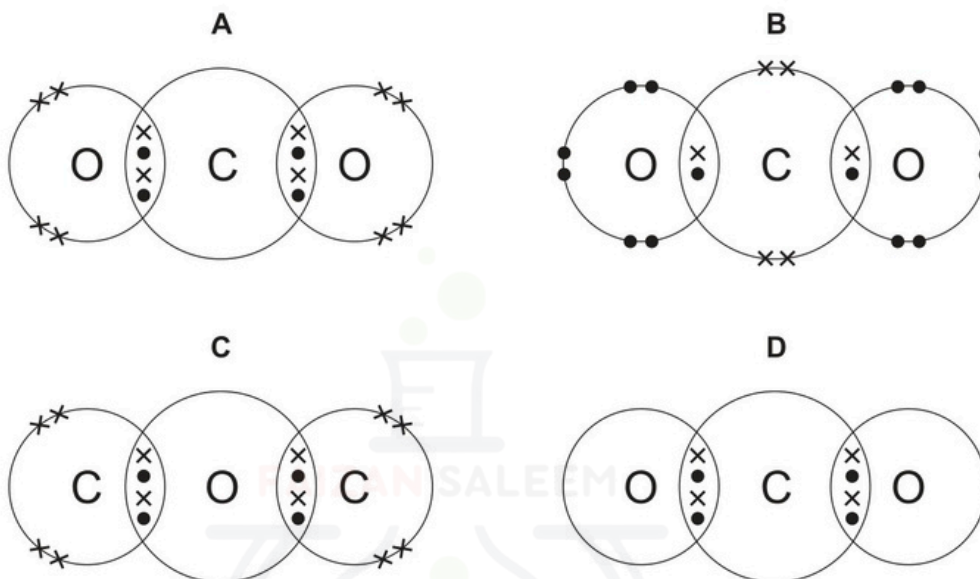
Q24

5070/11/O/N/21/Q9

Covalent Bonding

The bonding in a molecule of carbon dioxide can be represented by a dot-and-cross diagram.

Which diagram is correct?



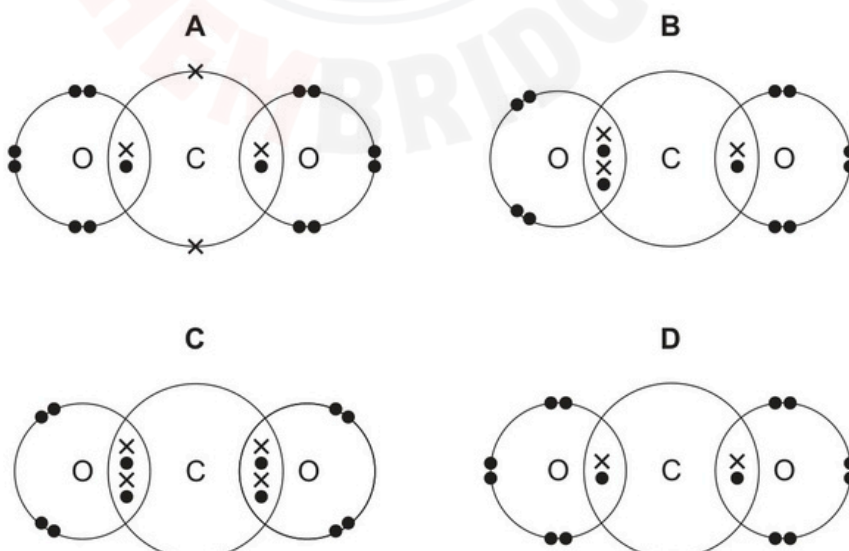
Q25

5070/11/M/J/22/Q10

Covalent Bonding

Which dot-and-cross diagram represents carbon dioxide?

Only outer shell electrons are shown.

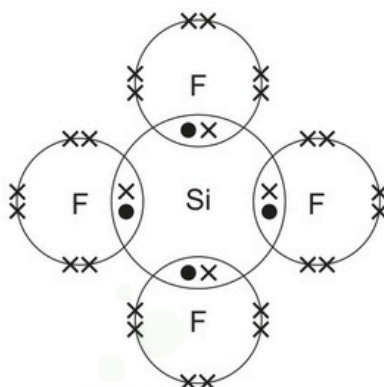


Q26

5070/12/M/J/22/Q10

Covalent Bonding

A molecule of tetrafluorosilane, SiF_4 , is shown in the dot-and-cross diagram. Only the outer shell electrons are shown.



Which statement is correct?

- A** Each molecule of SiF_4 has exactly 16 pairs of electrons.
- B** In SiF_4 both the silicon and the fluorine have the same electronic configuration as neon.
- C** Molten SiF_4 will conduct electricity.
- D** SiF_4 has a low melting point.

Q27

5070/11/O/N/22/Q11

Covalent Bonding

Which compound has the most single bonds in one molecule?

- A** CH_3CH_3
- B** $\text{CH}_3\text{CH}_2\text{OH}$
- C** $\text{CH}_3\text{CO}_2\text{H}$
- D** CH_3CHCH_2

Q28

5070/12/O/N/22/Q10

Covalent Bonding

Which two pairs of atoms are held together by the same number of bonds?

	first pair of atoms	second pair of atoms
A	the two carbon atoms in a C_2H_4 molecule	the carbon atom and one oxygen atom in a CO_2 molecule
B	the two nitrogen atoms in an N_2 molecule	the two hydrogen atoms in an H_2 molecule
C	the two oxygen atoms in an O_2 molecule	the carbon atom and one hydrogen atom in a CH_4 molecule
D	the two oxygen atoms in an O_2 molecule	the two nitrogen atoms in an N_2 molecule

Q29

5070/12/O/N/22/Q11

Covalent Bonding

Boron trifluoride, BF_3 , is a simple molecule. There are three covalent bonds in each BF_3 molecule. Each of these bonds is made by sharing one electron from the boron atom and one electron from a fluorine atom.

What is unusual about the bonding in boron trifluoride?

- A It is unusual for a non-metal such as fluorine to form covalent bonds.
- B The boron atom in each molecule does **not** gain the electronic configuration of a noble gas.
- C The covalent bonds do **not** consist of shared pairs of electrons.
- D The fluorine atoms in each molecule do **not** gain the electronic configuration of a noble gas.

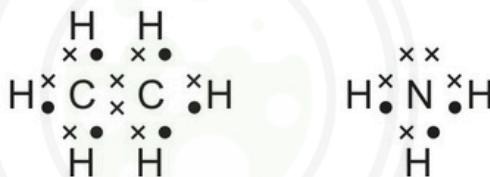
Q30

5070/11/M/J/23/Q5

Covalent Bonding

Ethane, C_2H_6 , and ammonia, NH_3 , are covalent compounds.

The dot-and-cross diagrams of these compounds are shown.



Which statements are correct?

- 1 A molecule of ethane contains twice as many hydrogen atoms as a molecule of ammonia.
 - 2 An unreacted nitrogen atom has five outer-shell electrons.
 - 3 In a molecule of ethane, the bond between the carbon atoms is formed by sharing two electrons, one from each carbon atom.
- A 1, 2 and 3 B 1 and 2 only C 1 and 3 only D 2 and 3 only

Q31

5070/12/M/J/23/Q5

Covalent Bonding

Which molecule has the **largest** number of electrons involved in covalent bonds?

- A C_2H_4 B CO_2 C CH_3OH D N_2

Q32

5070/12/M/J/24/Q5

Covalent Bonding

Which molecule has only four electrons involved in covalent bonds?

A Cl_2 B CO_2 C H_2S D N_2

Q33

5070/11/O/N/24/Q6

Covalent Bonding

Which pair of molecules have the same number of electrons in covalent bonds?

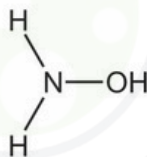
A CH_3OH and C_2H_4 B CO_2 and H_2O C NH_3 and N_2 D O_2 and Cl_2

Q34

5070/11/O/N/25/Q4

Covalent Bonding

The structure of hydroxylamine, NH_2OH , is shown.



Which row about hydroxylamine is correct?

	total number of electrons in the molecule	number of electrons in the bonds of the molecule
A	14	8
B	14	6
C	18	8
D	18	6

SECTION C: METALLIC BONDING

Q35

5070/11/M/J/21/Q29

Metallic Bonding

The properties of four substances are shown.

Which substance is a metal?

- A** It conducts electricity when dissolved in water but not when solid.
- B** It has a high melting point and conducts heat when solid.
- C** It has a low melting point and is brittle.
- D** It has a giant covalent structure with a high melting point.

Q36

5070/11/O/N/21/Q10

Metallic Bonding

Which statement about the structure or bonding of metals is correct?

- A** A metal lattice consists of negative ions in a 'sea of electrons'.
- B** Electrons in a metal move randomly through the lattice.
- C** Metals are malleable because the ions present are mobile.
- D** The ions in a metal move when positive and negative electrodes are attached.

Q37

5070/12/O/N/21/Q10

Metallic Bonding

Which statement about the structure or bonding of metals is correct?

- A** A metal lattice consists of negative ions in a 'sea of electrons'.
- B** Electrons in a metal move randomly through the lattice.
- C** Metals are malleable because the ions present are mobile.
- D** The ions in a metal move when positive and negative electrodes are attached.

Q38

5070/11/M/J/22/Q11

Metallic Bonding

Two statements about the structure and properties of metals are given.

statement 1 Metals are malleable and have high melting points.

statement 2 Metals have mobile electrons in their structure.

What is correct?

- A Both statements are correct and statement 2 explains statement 1.
- B Both statements are correct but statement 2 does not explain statement 1.
- C Statement 1 is correct but statement 2 is incorrect.
- D Statement 2 is correct but statement 1 is incorrect.

Q39

5070/12/M/J/22/Q11

Metallic Bonding

The table describes two properties associated with metals.

Which row shows a correct reason for the stated property?

	property	reason
A	malleable	the layers of metal anions can slide over each other
B	malleable	the layers of metal cations can slide over each other
C	conduct electricity	metallic structures contain mobile anions
D	conduct electricity	metallic structures contain mobile cations

Q40

5070/11/M/J/23/Q24

Metallic Bonding

Three statements about the properties of metals are shown.

- 1 All metals conduct electricity.
- 2 All metals have two electrons in their innermost shell.
- 3 All metals have high melting points.

Which statements are correct?

- A 1 and 2 only B 1 and 3 only C 2 and 3 only D 1, 2 and 3

Q41

5070/12/O/N/24/Q27

Metallic Bonding

Substance X conducts electricity in the solid state. Substance X is malleable.

Which statement is correct?

- A X conducts electricity by the movement of electrons between layers of negative ions.
- B X conducts electricity by the movement of positive ions through a giant lattice.
- C X has a giant lattice of positive ions in a 'sea' of delocalised electrons.
- D X has layers of atoms with delocalised electrons between the layers.

Q42

5070/11/M/J/25/Q8

Metallic Bonding

Which description of metallic bonding is correct?

- A the electrostatic attraction between negative ions in a lattice and a 'sea' of electrons
- B the electrostatic attraction between negative ions in a lattice and a 'sea' of protons
- C the electrostatic attraction between positive ions and negative ions in a lattice
- D the electrostatic attraction between positive ions in a lattice and a 'sea' of electrons

Q43

5070/12/M/J/25/Q26

Metallic Bonding

Substance X has the following properties.

- melting point 1237°C
- boiling point 2595°C
- malleable
- good electrical and thermal conductivity at r.t.p.

What is the structure of substance X?

- A giant covalent
- B giant ionic lattice
- C giant metallic lattice
- D simple molecular

Q44

5070/11/O/N/25/Q7

Metallic Bonding

Which statement about the bonding in copper is correct?

- A Copper atoms are attracted to a 'sea' of delocalised electrons.
- B Copper atoms are attracted to a shared pair of electrons.
- C Copper ions are attracted to a 'sea' of delocalised electrons.
- D Copper ions are attracted to a shared pair of electrons.

Q45

5070/12/O/N/25/Q24

Metallic Bonding

Solid 1 and solid 2 are both elements.

Solid 1 is **not** malleable.

Solid 2 is ductile.

Which statement is correct?

- A Solid 1 has good electrical conductivity only when molten.
- B Solid 2 has good electrical conductivity only when molten.
- C The layers of ions in solid 1 can slide over one another.
- D The layers of ions in solid 2 can slide over one another.

SECTION D: GIANT COVALENT STRUCTURES

Q46

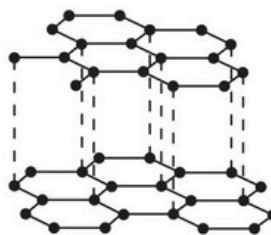
5070/11/M/J/21/Q7

Giant Covalent Structures

The diagrams show the structures of two solids, P and Q.



P



Q

Which row is correct?

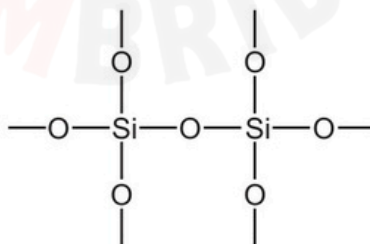
	has covalent bonding	conducts electricity
A	P only	P only
B	P only	Q only
C	both P and Q	P only
D	both P and Q	Q only

Q47

5070/11/O/N/22/Q9

Giant Covalent Structures

Silicon dioxide has a giant structure. Each silicon atom is joined to four oxygen atoms by covalent bonds. Part of the structure is shown.



Which property would silicon dioxide be expected to have?

- A** a good conductor of electricity
- B** a high melting point
- C** reacts with hydrochloric acid
- D** soluble in water

Q48

5070/12/M/J/23/Q6

Giant Covalent Structures

X is the arrangement of bonds around a carbon atom in graphite.

Y is the arrangement of bonds around a carbon atom in diamond.

Z is the arrangement of bonds around a silicon atom in silicon(IV) oxide, SiO_2 .

Which arrangements of bonds are the same?

- A** X and Y only **B** X and Z only **C** Y and Z only **D** X, Y and Z

Q49

5070/11/O/N/23/Q6

Giant Covalent Structures

Four statements about graphite, diamond and silicon(IV) oxide are listed.

- 1 Diamond and silicon(IV) oxide are both very hard and have similar structures.
- 2 In diamond, each carbon atom is joined to four other carbon atoms.
- 3 Silicon(IV) oxide forms a giant structure of silicon and oxygen atoms.
- 4 Diamond and graphite both conduct electricity because they are both forms of carbon.

Which statements are correct?

- A** 1, 2 and 3 **B** 1, 2 and 4 **C** 1, 3 and 4 **D** 2, 3 and 4

Q50

5070/11/M/J/24/Q5

Giant Covalent Structures

Statements about graphite and silicon(IV) oxide, SiO_2 , are given.

Which statement is correct?

- A** Silicon(IV) oxide is found as an impurity in iron ore.
- B** The angles between the atoms in silicon(IV) oxide and graphite are the same.
- C** The melting points of silicon(IV) oxide and graphite are high because ionic bonds are stronger than covalent bonds.
- D** When graphite acts as a lubricant, the covalent bonds between the layers are broken.

SECTION D - GIANT COVALENT STRUCTURES

Q51

5070/12/O/N/24/Q2

Giant Covalent Structures

Substance X has a simple molecular structure and substance Y has a giant covalent structure.

Which row is correct?

	X could be	Y could be
A	an element only	an element only
B	an element only	an element or a compound
C	an element or a compound	an element only
D	an element or a compound	an element or a compound

Q52

5070/12/O/N/24/Q6

Giant Covalent Structures

Which substance is **not** malleable and conducts electricity by the movement of electrons through a lattice of atoms?

- A aqueous sodium chloride
- B gold
- C graphite
- D solid sodium chloride

Q53

5070/11/O/N/25/Q6

Giant Covalent Structures

What is a property of diamond?

- A It can be used as a lubricant.
- B It has a melting point below 200 °C.
- C It has good electrical conductivity.
- D It is extremely hard.

Q54

5070/12/O/N/25/Q6

Giant Covalent Structures

Which row is correct?

	structure and bonding of hydrogen chloride	structure and bonding of diamond
A	giant covalent	giant covalent
B	giant covalent	simple molecular
C	simple molecular	giant covalent
D	simple molecular	simple molecular



MARKING SCHEME - SECTION A: IONIC BONDING

Q	Answer	Paper reference
Q1	B	5070/11/M/J/21/Q27
Q2	C	5070/11/M/J/22/Q8
Q3	D	5070/11/M/J/22/Q9
Q4	D	5070/11/M/J/22/Q17
Q5	A	5070/12/M/J/22/Q9
Q6	A	5070/11/O/N/22/Q10
Q7	A	5070/11/O/N/22/Q12
Q8	D	5070/12/O/N/22/Q7
Q9	D	5070/12/O/N/22/Q9
Q10	B	5070/11/M/J/23/Q4
Q11	B	5070/12/M/J/23/Q4

Q	Answer	Paper reference
Q12	A	5070/12/O/N/23/Q5
Q13	B	5070/12/O/N/24/Q5
Q14	C	5070/11/M/J/25/Q6
Q15	C	5070/11/M/J/25/Q7
Q16	D	5070/11/M/J/25/Q9
Q17	C	5070/12/M/J/25/Q7
Q18	C	5070/11/O/N/25/Q5
Q19	C	5070/11/O/N/25/Q8
Q20	D	5070/12/O/N/25/Q4
Q21	B	5070/12/O/N/25/Q21

MARKING SCHEME - SECTION B: COVALENT BONDING

Q	Answer	Paper reference
Q22	A	5070/11/M/J/21/Q8
Q23	B	5070/12/M/J/21/Q9
Q24	A	5070/11/O/N/21/Q9
Q25	C	5070/11/M/J/22/Q10
Q26	D	5070/12/M/J/22/Q10
Q27	B	5070/11/O/N/22/Q11
Q28	A	5070/12/O/N/22/Q10

Q	Answer	Paper reference
Q29	B	5070/12/O/N/22/Q11
Q30	A	5070/11/M/J/23/Q5
Q31	A	5070/12/M/J/23/Q5
Q32	C	5070/12/M/J/24/Q5
Q33	C	5070/11/O/N/24/Q6
Q34	C	5070/11/O/N/25/Q4

MARKING SCHEME - SECTION C: METALLIC BONDING

Q	Answer	Paper reference
Q35	B	5070/11/M/J/21/Q29
Q36	B	5070/11/O/N/21/Q10
Q37	B	5070/12/O/N/21/Q10
Q38	B	5070/11/M/J/22/Q11
Q39	B	5070/12/M/J/22/Q11
Q40	A	5070/11/M/J/23/Q24

Q	Answer	Paper reference
Q41	C	5070/12/O/N/24/Q27
Q42	D	5070/11/M/J/25/Q8
Q43	C	5070/12/M/J/25/Q26
Q44	C	5070/11/O/N/25/Q7
Q45	D	5070/12/O/N/25/Q24

MARKING SCHEME - SECTION D: GIANT COVALENT STRUCTURES

Q	Answer	Paper reference
Q46	D	5070/11/M/J/21/Q7
Q47	B	5070/11/O/N/22/Q9
Q48	C	5070/12/M/J/23/Q6
Q49	A	5070/11/O/N/23/Q6
Q50	A	5070/11/M/J/24/Q5

Q	Answer	Paper reference
Q51	D	5070/12/O/N/24/Q2
Q52	C	5070/12/O/N/24/Q6
Q53	D	5070/11/O/N/25/Q6
Q54	C	5070/12/O/N/25/Q6