Mark scheme

Chemical bonding

Chemistry 0620 · Questions from Paper 3 and Paper 4

Total marks

90

MARKS FOR EACH QUESTION

1	2	3	4	5	6	7	8	9	10	Total
7	8	11	5	8	6	7	10	12	16	**90**

Question 1 [7]

1 **(a)** **(i)** A: giant ionic [1]
B: simple atomic [1]
C: simple molecular [1]
D: metallic [1]

(ii) B and C (both needed for mark) [1]

(b) solid; molten; [2]

Question 2 [8]

2(a)(i)	has two atoms (in a molecule)	1
2(a)(ii)	78 (%)	1
2(b)	3 bonding pairs between each H and N **AND** no extra electrons on H atoms (1) two non-bonding electrons on N atom (1)	2
2(c)(i)	cation	1
2(c)(ii)	high melting point / high boiling point **OR** (good) electrical conductivity when molten **OR** (good) electrical conductivity in aqueous solution	1
2(d)(i)	lubricant	1
2(d)(i)	4th box down ticked (giant covalent)	1

STEM | Exam Builder

Question 3 [11]

3 **(a)** Any **four** from: [4]

- both giant structures
- both have layered structures
- graphite covalent
- sodium chloride ionic
- graphite macromolecule / giant covalent structure
- graphite has layers which are separated / further apart (than C-C bonds)
- sodium chloride has ions touching
- graphite has only one type of particle / graphite is an element / only has C atoms
- sodium chloride has two types of particles / sodium chloride is a compound
- graphite has hexagonal arrangement (of atoms)
- sodium chloride has cubic arrangement **allow**: square arrangement
- graphite has atoms all of one size
- sodium chloride has different sized particles / ions

ignore: properties / weak or strong bonding

(b) **(i)** substance containing only one type of atom [1]
allow: substance that cannot be split up (by chemical means)

(ii) $C + O_2 \rightarrow CO_2$ [2]

(c) **(i)** A [1]

(ii) C [1]

(iii) B [1]

(iv) D [1]

[Total: 11]

Question 4 [5]

4 **(a)** to complete the outer shell (of oxygen) / full outer or valence shell / 8 (electrons) in outer shell / Noble gas structure / to complete outer shell / to complete the octet
ignore reference to hydrogen atoms / reference to accepting / sharing or gaining electrons [1]

(b) loses (one) electron [1]
not loses electron**s**

(c) opposite charges attract / electrostatic attraction / positive attracts negative / + and – attract [1]

(d) in solid ions cannot move / flow / no free ions / ions in a lattice [1]
in solution ions can move / flow / mobile ions / ions free (to move) [1]

[Total: 5]

STEM | Exam Builder

Question 5 [8]

5(a)(i)	**B**	**1**
5(a)(ii)	**F**	**1**
5(a)(iii)	**D**	**1**
5(b)(i)	**M1 A** **M2** high melting point **AND/OR** high boiling point **M3** poor conductor of electricity when solid **AND** molten	**3**
5(b)(ii)	**M1 C** **M2** only conducts electricity when molten	**2**

Question 6 [6]

6 **(a)** weak forces between layers or between (hexagonal) rings / weak bonds between layers or between (hexagonal) rings / Van der Waals forces between layers or between (hexagonal) rings; [1]
(layers/rings) slip/slide (over each other) / move over each other [1]

(b) strong bonds (between atoms) / covalent bonds (between atoms); [1]
all bonds are covalent/strong / each atom covalently bonded / carbon (atoms) is bonded to four others / bonds are directional / (atoms are arranged) tetrahedrally; [1]
accept: carbon has four bonds

(c) graphite has delocalised / mobile / free electrons; [1]
diamond (outer shell) electrons used / fixed / localised in bonding / no delocalised electrons / no mobile electrons / no free electrons; [1]

Question 7 [7]

7 **(a)** neon has full outer shell / energy level / valency shell / octet / 8 (electrons) in outer shell / neon does not need to lose or gain electrons; [1]
fluorine atoms have 7 electrons / needs 1 to fill / has incomplete shell / forms bonds with other fluorine atoms / fluorine (atoms) form covalent bonds / shares electrons; [1]

(b) atomic number / proton number / number of protons (in one atom); [1]

(c) weak intermolecular (or between molecules) forces / Van der Waals forces between molecules / low amount of energy required to break bonds between molecules; [1]
strong bonds don't break / covalent bonds don't break / (unnamed) bonds within molecules / between atoms don't break; [1]

(d) 1 non-bonding pair on each nitrogen atom; [1]
6 electrons between nitrogen atoms; [1]

STEM Exam Builder

Question 8 [10]

8(a)(i)	**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	**3**
8(a)(ii)	MgF_2	**1**
8(a)(iii)	melting	**1**
8(b)	**M1** 4 dot and cross single bonds **M2** 3 pairs of non-bonding e on each Cl and no non-bonding e on Si	**2**
8(c)(i)	molecule(s)	**1**
8(c)(ii)	**M1** covalent bonds **M2** strong bonds **and** giant (covalent) structure	**2**

Question 9 [12]

9(a)	regular arrangement / lattice of positive ions / magnesium ions / Mg^{2+} ions	**1**
	sea of electrons **OR** delocalised electrons	**1**
	attraction between (positive) ions and (delocalised / sea of) electrons	**1**
9(b)	electrons	**1**
	move / flow (throughout / through the structure)	**1**
9(c)	layers (of atoms or ions)	**1**
	layers / atoms / ions can slide / slip / glide (over each other) (without breaking the metallic bonds)	**1**
9(d)(i)	magnesium shown as (2, 8) using crosses	**1**
	sulfide shown as (2, 8, 8), with the two gained electrons in the outer shell of sulfur shown as crosses and all other electrons on sulfur shown as dots	**1**
	magnesium ion charge as 2^+ **AND** sulfide charge as 2^-	**1**
9(d)(ii)	melt / fused	**1**
	ions can move **OR** are mobile	**1**

STEM | Exam Builder

Question 10 [16]

10(a)	M1 **pair** of electrons M2 electron(s) shared between **two** atoms	**2**
10(b)(i)	M1 the oxidation number of chlorine / Cl M2 (oxidation number) is +1	**2**
10(b)(ii)	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	**3**
10(b)(iii)	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	**3**
10(b)(iv)	M1 no ions M2 no mobile electrons	**2**
10(c)(i)	graphite	**1**
10(c)(ii)	electrons	**1**
10(c)(iii)	M1 5 correct Si atoms M2 4 correct O atoms	**2**

STEM | Exam Builder