

# MARK SCHEME

# GCSE

## CHEMISTRY

## AQA - COMBINED SCIENCE

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### C2 - TEST 6

BONDING, STRUCTURE AND PROPERTIES OF MATTER

### Advanced

## Mark schemes

1.

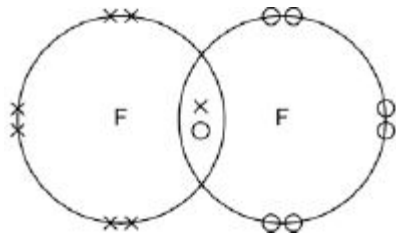
(a) g

do **not** accept upper case (G)

do **not** accept gas

1

(b)



one shared pair anywhere in overlap between two circles **or** on intersection

1

6 other electrons on each atom

1

allow dots **or** crosses **or** mixture for all marks

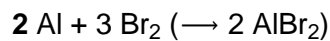
ignore any inner shell electrons

(c) 18

1

(d)  $\text{AlBr}_3$

1



1

allow 1 mark for balancing their equation with an incorrect product

- (e) chlorine is a smaller atom  
**or** has fewer energy levels  
**or** outer shell closer to nucleus

*ignore chlorine has fewer electrons*

1

chlorine has less shielding

**or**

has the greater attraction between the nucleus and the outer shell **or** incoming electron

1

therefore chlorine can gain an electron (into the outer shell) more easily

1

*if no other marks awarded allow 1 mark for correct trend in reactivity in Group 7*

*do **not** accept reference to incorrect particles e.g. chloride atom*

***max 2** if outer shell / level not mentioned*

*'it' refers to chlorine*

*allow converse reasons for bromine being less reactive*

[9]

2.

- (a) covalent bonds

1

giant structure / macromolecule

*allow each C has 4 bonds*

*allow giant covalent structure for 2 marks*

*allow giant ionic / lattice structure for 1 mark*

*ignore lattice*

1

lots of energy needed to break / overcome

*allow disrupt structure*

*ignore heat and high temperature*

*if no other marks awarded allow 1 mark for strong / many bonds*

1

- (b) dissolved (in water) **or** aqueous

*allow in solution*

1

molten / liquid

1

so ions are mobile **or** free moving

1

***max 2** for incorrect reference to particles or bonds*

- (c) delocalised electrons (from outer shell) 1
- (free to) move 1
- energy transferred (through structure)
- ignore conducts thermal energy*
- ignore electricity*
- if no other mark awarded allow 1 mark for ions / atoms vibrate*
- 1

[9]

3.

- (i) can be from diagram chlorine (2.8).7. 1
- accept chlorine needs one more electron*
- can be from diagram shares a pair of electrons 1
- shared pair of electrons is a covalent bond
- do **not** accept ionic bond*
- 1
- (ii) can be from diagram and appropriately annotated sodium (2.8). 1. and chlorine (2.8).7 1
- sodium loses one electron and chlorine gains one electron 1
- Na<sup>+</sup> and Cl<sup>-</sup> formed 1
- bond formed between oppositely charged ions **or** ionic bond is formed
- do **not** accept covalent bond*
- 1

[7]

4.

- (a) (i) **Quality of Written Communication**
- The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.*
- maximum 2 marks if ideas not expressed well*

layers / lattice / giant structure / regular pattern of atoms (diagram)

*allow layers / lattice / giant structure / regular pattern of ions*

*do not accept particles*

1

outer (shell) electrons

*accept valence electrons*

1

(free to) move (through whole structure)

*accept delocalised / mobile / free*

1

(ii) the free electrons (allow the metal to conduct electricity)

*accept electrons move / mobile / delocalised*

1

(iii) atoms / ions / layers can slide / slip / move over each other

1

(b) (i) copper oxide formed **or** Cu reacts with oxygen **or** Cu is oxidised

1

this is a poor conductor **or** gets in the way of free moving electrons **or** fewer mobile electrons

*do not accept electricity*

1

**or**

oxygen atoms / oxygen molecules / oxide ions in metal

*do not accept oxygen pockets / bubbles*

prevents / disrupts flow of electrons /  
current or fewer mobile electrons (1)

*do not accept macro explanations*

*do not accept electricity*

(ii) hydrogen reacts with oxygen or water is formed **or** hydrogen reduces  
copper oxide etc.

1

[8]

5.

(a) *reference to incorrect bonding **or** incorrect structure  
**or** incorrect particles = max 3*

giant structure / lattice

*ignore many bonds*

1

made up of positive ions surrounded by delocalized / free electrons

*allow positive ions surrounded by a sea of electrons*

1

with strong bonds / attractions  
*allow hard to break for strong*

1

so a lot of energy is needed to break these bonds / attractions / forces  
*ignore high temperature*  
*ignore heat*

1

(b) (i) that they are very small

**or**

1-100 nanometres **or** a few(hundred) atoms

*accept tiny / really small / a lot smaller / any indication of very small*  
*eg. microscopic, smaller than the eye can see*  
*ignore incorrect numerical values if very small is given*

1

(ii) delocalised / free electrons  
*allow sea of electrons*

1

one non-bonded electron from each atom

*accept electron(s) moving through the structure / nanotube*  
*allow electron(s) carry / form / pass current / charge*

1

[7]

6.

answers apply to:

*accept diagrams and/or descriptions*

carbon dioxide CO<sub>2</sub>

ammonia NH<sub>3</sub>

methane CH<sub>4</sub>

water H<sub>2</sub>O

\*outer electronic structure of one atom correct **or** needs  
correct number of electrons to complete outer shell

1

\*outer electronic structure of other atom correct **or** needs  
correct number of electrons to complete outer shell

1

\*one shared **pair** of electrons (as one covalent bond)

*use of ions or reference to ionic bonding negates this mark*

1

\*outer electronic structure of compound correct **or** each atom now has a full outer shell/noble gas electron structure

1

[4]

7.

(a) 118

1

(b) it loses / transfers electrons

*it = Au / gold atom*

1

three electrons

*sharing / covalency = max 1 mark*

1

(c) (i) O<sub>2</sub>

1

**2 CO and 2 CO<sub>2</sub>**

**or**

correct balancing of equation from O

*accept correct multiples / fractions throughout*

1

(ii) *reference to incorrect bonding = 1 mark max*

because carbon dioxide is simple molecular / small molecules

1

there are intermolecular forces (between the molecules)

*allow intermolecular bonds*

1

so a small amount of energy needed (to separate molecules) **or** (*intermolecular forces*) are weak

1

(d) any **three** from:

- gold is the only catalyst for some reactions
- catalysts are not used up
- improves speed of reaction

reduces amount of energy **or** process needs low(er) temperature

*if no mark awarded, allow catalyst reduce costs (of the process) for 1 mark*

- only small quantities (of catalyst) needed

3

[11]

8.

- (a) (i) *mention of molecules **or** any reference to incorrect bonding = max 2*

giant structure / lattice or particles arranged in a regular pattern  
*allow close packed / layers*

1

sea of electrons / delocalised electrons  
*allow free electrons*

1

positive ions and electrons attract each other  
*ignore metallic bonds*  
*appropriately labelled diagrams can gain first two marks*

1

- (ii) (sea of) electrons can move through the structure  
*allow free / roaming / mobile electrons*

**or** delocalised electrons

1

- (b) (metal) oxide / ionic compound formed

1

ions not free to move

**or**

electrons cannot move through the structure  
*allow no / fewer delocalised / free / roaming / mobile electrons*

1

[6]

9.

any **three** from:

*any reference to incorrect bonding = max 2*

- giant structure / lattice / macromolecule
- covalent (bonds)
- bonds are (very) strong  
*allow bonds difficult to break*  
**or** *takes a lot of energy to break bonds*
- each atom / carbon joined to four others  
*accept each atom / carbon forms four bonds*

3

[3]



10.

(a) (i) ionic / molecules / metallic / (inter)molecular = max 2

because graphene / it has a giant structure / lattice / macromolecular  
accept all / every / each atom is bonded to 3 other atoms

1

because graphene / it has covalent bonds / is covalent

1

because in graphene / the bonds are strong **or**  
a lot of energy needed / hard to break the bonds

1

(ii) there are delocalised / free electrons

1

because one (delocalised / free) electron per atom linked to first marking point

accept because three electrons per atom used (in bonding)

accept because one electron per atom not used (in bonding)

1

(b) opaque (owtte)

*eg could not see through them*

**or** layers slide

**or** layers not aligned

*ignore thick*

1

[6]