

# Chemical Bonds; Ionic; Covalent; Metal

## Mark Scheme

Level	GCSE (9-1)
Subject	Combined Science: Trilogy - Chemistry
Exam Board	AQA
Topic	5.2 Bonding Structure + Props Matter
Sub-Topic	Chemical Bonds; Ionic; Covalent; Metal
Difficulty Level	Gold Level
Booklet	Mark Scheme

Time Allowed: 59 minutes

Score: /57

Percentage: /100

Grade Boundaries:

**M1.(a)** bonded pair of electrons and

6 non-bonded electrons on chlorine

1

(b) **Level 3 (5–6 marks):**

A detailed and coherent explanation of comparative results of a reaction in terms of concentration and ionisation. The response makes logical links between the points raised and uses sufficient examples to support these links.

**Level 2 (3–4 marks):**

A description of a reaction with results is given but may miss some details. Links are made but may not be fully articulated and / or precise.

**Level 1 (1–2 marks):**

Simple statements are made. The response may fail to make logical links between the points raised.

**0 marks:**

No relevant content

**Indicative content**

Simple statements / descriptions of a reaction

- correct comparative pH, such as, 0–3 (strong) 4–6 (weak)
- named reaction, such as, with a reactive metal or a named carbonate
- comparative results or observations of the named reaction, such as, faster reaction (strong) or greater volume of gas produced in a given time (strong)

Explanations of different results

- weak acids are only partially ionised in aqueous solution
- strong acids are completely ionised in aqueous solution / greater concentration of  $H^+$  ions
- aqueous solutions of acids at the same concentration / same state of division of metal / powder, same temperature

6

[7]

**M2.(a)** (medicine is) a mixture **and**

(designed as) a useful product

1

(b) sugar / flavouring

1

to make it taste better

**or**

colouring

to make it look more attractive

1

(c)  $\text{C}_8\text{H}_9\text{NO}_2$

*any order of elements*

1

151

1

(d) mass of acetylsalicylic acid = 0.3 g

1

$$= \frac{0.3}{100} \text{ (mol)}$$

*method mark – divide mass by  $M_r$*

1

$$= 0.00167 \text{ (mol)}$$

*allow 0.0016666(66)*

1

$$1.67 \times 10^{-3} \text{ (mol)}$$

*correct answer with or without working scores 4 marks*

allow ecf from steps 1, 2 and 3

1

[9]

M3.(a) because sulfur dioxide causes acid rain

1

which kills fish / aquatic life **or** dissolves / damages statues / stonework **or** kills / stunts growth of trees

*if no other mark awarded then award 1 mark for sulfur dioxide is toxic or causes breathing difficulties.*

1

(b) (i) electrons are lost

1

(ii)  $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$

*allow  $\text{Cu}^{2+} \rightarrow \text{Cu} - 2\text{e}^-$*

*ignore state symbols*

1

(iii) copper sulfate

*allow any ionic copper compound*

1

(c) (lattice of) positive ions

1

delocalised electrons

*accept sea of electrons*

1

(electrostatic) attraction between the positive ions and the electrons

1

electrons can move through the metal / structure **or** can flow

*allow electrons can carry charge through the metal / structure*

*if wrong bonding named or described or attraction between oppositely charged ions then do not award M1 or M3 – MAX 2*

1

- (d) (copper compounds are absorbed / taken up by) plants  
*allow crops*

1

which are burned

1

the ash contains the copper compounds

*do not award M3 if the ash contains copper (metal)*

1

(e)

/ A <sub>r</sub>	55.6 / 63.5	16.4 / 56	28.0 / 32
moles	0.876	0.293	0.875
ratio	3	1	3
formula	Cu <sub>3</sub> FeS <sub>3</sub>		

*award 4 marks for Cu<sub>3</sub>FeS<sub>3</sub> with some correct working*

*award 3 marks for Cu<sub>3</sub>FeS<sub>3</sub> with **no** working*

*if the answer is not Cu<sub>3</sub>FeS<sub>3</sub> award up to 3 marks for correct steps from the table apply ecf*

*if the student has inverted the fractions award 3 marks for an answer of CuFe<sub>3</sub>S*

4

[16]

- M4.(a)** circle round any one (or more) of the covalent bonds

*any correct indication of the bond – the line between letters*

1

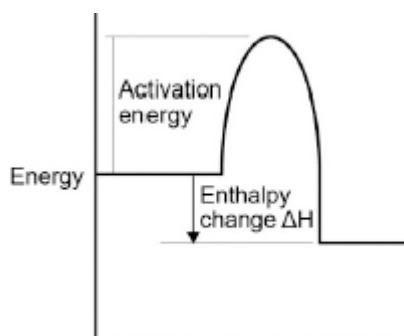
- (b) Methane contains atoms of two elements, combined chemically

1

- (c) (i) activation energy labelled from level of reagents to highest point of curve  
*ignore arrowheads*

1

enthalpy change labelled from reagents to products



arrowhead **must** go from reagents to products only

1

(ii)  $2\text{O}_2$

1

$2\text{H}_2\text{O}$

*if not fully correct, award 1 mark for all formulae correct.*

*ignore state symbols*

1

(iii) carbon monoxide is made

1

this combines with the blood / haemoglobin **or** prevents oxygen being carried in the blood / round body **or** kills you **or** is toxic **or** poisonous

*dependent on first marking point*

1

(iv) energy is taken in / required to break bonds

*accept bond breaking is endothermic*

1

energy is given out when bonds are made

*accept bond making is exothermic*

1

the energy given out is greater than the energy taken in

*this mark only awarded if both of previous marks awarded*

1

(d) (i) energy to break bonds = 1895

*calculation with no explanation max = 2*

1

energy from making bonds = 1998

1

$1895 - 1998 (= -103)$

**or**

energy to break bonds = 656  
energy from making bonds = 759  
 $656 - 759 (= -103)$

*allow:*

*bonds broken – bonds made =*

$413 + 243 - 327 - 432 = -103$  for 3 marks.

1

(ii) The C — Br bond is weaker than the C — Cl bond

1

[15]

**M5.(a)** (i) silver nitrate

*allow AgNO<sub>3</sub>*

1

(ii) potassium carbonate **or**

*allow K<sub>2</sub>CO<sub>3</sub>*

sodium carbonate

*allow Na<sub>2</sub>CO<sub>3</sub>*

1

(b) base

*allow ionic*

*ignore insoluble or soluble*

*ignore alkali*

1

(c) (i) evaporate  
**or**  
crystallise

*allow heat or boil or leave (to evaporate)*

*allow cool*

*ignore filtration unless given as an alternative*

*do **not** accept freeze or solidify*

1

(ii) 2 (HNO<sub>3</sub>)

*accept multiples*

1

(iii) 9

*accept nine*

1

(d)  $6.21 / 207$        $0.72 / 16$

*1 mark for dividing mass by  $A_r$*

1

$= 0.03$

$= 0.045$

*1 mark for correct proportions (allow multiples)*

1

2

3

*1 mark for correct whole number ratio (allow multiples). Can be awarded from formula.*

1



*allow  $\text{O}_3\text{Pb}_2$*

***ecf** allowed throughout if sensible attempt at step 1  
correct formula with no working gains 1 mark*

1

[10]