

- M1.(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]

M2.(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

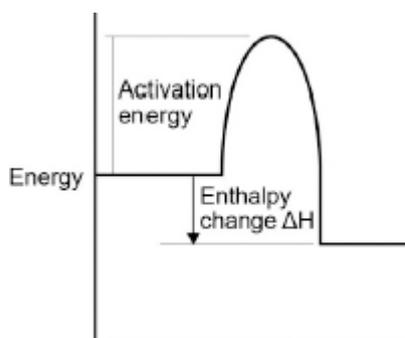
1

(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 O<sub>2</sub>

1

2 H<sub>2</sub>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]

M3.(a) any four from:

- (crude oil is) heated
- to evaporate / vaporise / boil (the substances / hydrocarbons)
- the column is hotter at the bottom or is cooler at the top
- (vapours / fractions) condense
- at their boiling points or at different levels.

*marks can be taken from a diagram*

*max 3 marks for reference to cracking*

*allow fractional distillation allow vapours (enter the column)*

*allow temperature gradient or (vapours) cool as they rise*

*allow description e.g. vapour turns to liquid)*

*allow they have different boiling points*

4

(b) acid rain is caused by

*allow consequences of acid rain*

1

sulfur dioxide or oxides of nitrogen

*second marking point is dependent on first marking point*

1

they react with / are neutralised by calcium carbonate or limestone

**OR**

global warming is caused by

carbon dioxide

carbon dioxide will react or dissolve in suspension of limestone

*allow greenhouse effect is caused by or allow consequences of global warming*

1

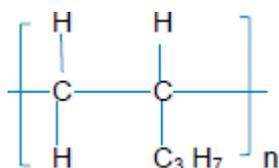
(c) (i)  $C_2H_4$

*must be formula*

*ignore any name*

1

(ii) a single bond between carbon atoms



would score 3 marks

1

other four bonds linking hydrogen atoms and  $C_3H_7$  group plus two trailing / connecting bonds

1

n at the bottom right hand corner of the bracket

1

(iii) has a shape memory

**or**

(a smart polymer) can return to original shape (when conditions change)

1

[12]

M4.(a) Sulfur dioxide causes acid rain. 1

(b) red / orange / yellow  
*do not accept any other colours* 1

because sulfur dioxide (when in solution) is an acid 1

(c) (there are) weak forces (of attraction)  
*do not accept any reference to covalent bonds breaking* 1

between the molecules  
*do not accept any other particles* 1

(these) take little energy to overcome  
*award third mark only if first mark given* 1

(d) Marks awarded for this answer will be determined by the Quality of Communication (QC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5 and apply a 'best-fit' approach to the marking.

**0 marks**

No relevant content

**Level 1 (1 – 2 marks)**

A relevant comment is made about the data.

**Level 2 (3 – 4 marks)**

Relevant comparisons have been made, and an attempt made at a conclusion.

**Level 3 (5 – 6 marks)**

Relevant, detailed comparisons made and a justified conclusion given.

**examples of the points made in the response**

**effectiveness**

- W removes the most sulfur dioxide
- D removes the least sulfur dioxide

**material used**

- Both W and D use calcium carbonate
- Calcium carbonate is obtained by quarrying which will create scars on landscape / destroy habitats
- D requires thermal decomposition, this requires energy
- D produces carbon dioxide which may cause global warming / climate change
- S uses sea water, this is readily available / cheap

**waste materials**

- W product can be sold / is useful
- W makes carbon dioxide which may cause global warming / climate change
- D waste fill landfill sites
- S returned to sea / may pollute sea / easy to dispose of

6

[12]