

# Carbon Compounds as Fuels + Feedstock

## Mark Scheme 1

Level	GCSE (9-1)
Subject	Combined Science: Trilogy - Chemistry
Exam Board	AQA
Topic	5.7 Organic Chemistry
Sub-Topic	Carbon Compounds as Fuels + Feedstock
Difficulty Level	Gold Level
Booklet	Mark Scheme 1

Time Allowed: 58 minutes

Score: /58

Percentage: /100

Grade Boundaries:

**M1.(a)** circle round any one (or more) of the covalent bonds

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

1

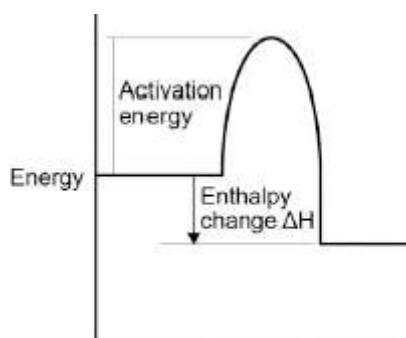
(b) Methane contains atoms of two elements, combined chemically

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]

**M2.(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]

**M3.(a)** any **two** from:

*asks for cause therefore no marks for just describing the change*

*must link reason to a correct change in a gas*

**carbon dioxide has decreased due to:**

*accept idea of 'used' to indicate a decrease*

- plants / microorganisms / bacteria / vegetation / trees
- photosynthesis  
*ignore respiration*
- 'locked up' in (sedimentary) rocks / carbonates / fossil fuels
- dissolved in oceans  
*ignore volcanoes*

**oxygen has increased due to:**

*accept idea of 'given out / produced'*

- plants / bacteria / microorganisms / vegetation / trees
- photosynthesis  
*ignore respiration*

**nitrogen increased due to:**

*accept idea of 'given out / produced'*

- ammonia reacted with oxygen
- bacteria / micro organisms  
*ignore (increase in) use of fossil fuels / deforestation*

2

- (b) (because methane's) boiling point is greater than the average / surface temperature **or** Titan's (average / surface) temperature is below methane's boiling point

*ignore references to nitrogen **or** water*

1

any methane that evaporates will condense

*accept boils for evaporates*

*accept cooling and produce rain for condensing*

1

(c)  $C_nH_{2n}$

1

[5]

M4.(a) (i)  $CH_4$

*allow  $H_4C$*

*do **not** allow lower-case h*

*do **not** allow superscript*

1

(ii) single

1

(iii) alkanes

1

(b) (i) carbon / C

*any order*

1

hydrogen / H

*allow phonetic spelling*

1

sulfur / sulphur / S

1

(ii) air / atmosphere

1

(iii) acid rain

1

damages trees / plants **or** kills aquatic organisms **or** damages buildings / statues **or** causes respiratory problems  
*allow harmful to living things*

1

(c) carbon / C

*accept soot / particulates / charcoal*

1

(d) any **four** from:

- (supports hypothesis) because when the fuel contained more carbon the temperature of the water went up more / faster (in 2 minutes)
- (does not support hypothesis as) temperature change per gram decreases as the number of carbons increases
- (does not support hypothesis) because the more carbon in the fuel the more smoke **or** the dirtier / sootier it is
- only tested hydrocarbons / alkanes / fuels with between 5 and 12 carbon atoms
- valid, justified, conclusion  
*accept converse statements*

4

(e) (i) 0.15

*correct answer with or without working gains 2 marks*  
*if answer incorrect,  $M_r$  carbon dioxide = 44 gains 1 mark*  
*allow 0.236 / 0.24 / 0.2357142 (ecf from  $M_r$  of 28) for 1 mark*

2

(ii) 0.4(0)

1

(iii)  $C_3H_8$

*correct formula with or without working scores 2 marks*

$$0.15 / 0.05 = 3$$

*allow ecf from (e)(i)*

**and**

$$0.4 / 0.05 = 8 \text{ (1)}$$

*allow ecf from (e)(ii)*

*allow 1 mark for correct empirical formula from their values*

If use 'fall-back-values:

$$0.50 / 0.05 = 10$$

**and**

$$0.20 / 0.05 = 4$$

*1 mark*



*1 mark*

*if just find ratio of C to H using fall-back values, get  $\text{C}_2\text{H}_5$*

*allow 1 mark*

2

[19]

- M5.** (a) *allow answers referring specifically to the naphtha fraction*

crude oil is evaporated/vaporised (by heating)

1

the vapours are condensed (by cooling)

1

(fractions condense) / boil at different temperatures

*allow fractions have different boiling points*

1

- (b) any **four** from:

*answer yes or no does not gain credit*

*ignore references to volume of milk held / number of bottles used / biodegradability / habitats / pollution / mining / dust*

*each marking point must be a comparison*



milk bag points

- uses (75%) less **crude oil** to make (than a plastic milk bottle)  
*allow eg uses 75% less*  
*poly(ethene) which is made from crude oil*
- uses less **energy** / fuel to make (than a plastic / glass milk bottle)
- produces less **carbon dioxide** to manufacture (than a plastic / glass milk bottle)  
*allow produces less greenhouse gases / causes less global warming*  
*allow produces less CO<sub>2</sub> on burning*
- produces less **waste** (than a plastic / glass milk bottle)  
*allow takes up less landfill (space)*  
*allow an argued case for more waste eg milk bags are discarded / cannot be reused*
- less fuel used for **transport** than glass milk bottles
- (produces waste because) milk bags are only used once whereas glass bottles can be **re-used**  
*allow milk bags are discarded but glass bottles can be reused (24 / many times)*  
*allow glass bottles can be reused but milk bags can't*

poly(ethene) points

- uses a limited **raw material** / crude oil whereas the raw materials for glass are almost unlimited
- **less** (5%) poly(ethene) is **recycled** (compared to glass (35%))  
*allow (35%) glass is recycled or (5%) poly(ethene) (bottles) recycled BUT milk bags aren't / are discarded*  
**or**  
*recycled poly(ethene) is not used to make new bags whereas recycled glass is used to make new bottles*