



## New Document 1

Name: \_\_\_\_\_

Class: \_\_\_\_\_

Date: \_\_\_\_\_

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Time: **24 minutes**

Marks: **24 marks**

Comments:

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**Q1.**

Sulfur is a non-metal.

Sulfur burns in the air to produce sulfur dioxide, SO<sub>2</sub>

(a) Why is it important that sulfur dioxide is **not** released into the atmosphere?

Tick (✓) **one** box.

Sulfur dioxide causes acid rain.

Sulfur dioxide causes global dimming.

Sulfur dioxide causes global warming.

(1)

(b) Sulfur dioxide dissolves in water.

What colour is universal indicator in a solution of sulfur dioxide?  
Give a reason for your answer.

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(2)

(c) Sulfur dioxide is a gas at room temperature.

The bonding in sulfur dioxide is covalent.

Explain, in terms of its structure and bonding, why sulfur dioxide has a low boiling point.

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(3)

(d) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

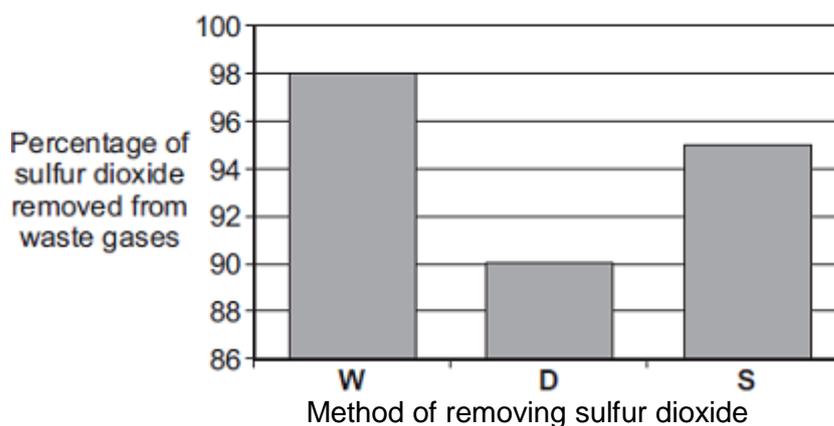
Sulfur dioxide is produced when fossil fuels are burned.

It is important that sulfur dioxide is not released into the atmosphere.

Three of the methods used to remove sulfur dioxide from gases produced when fossil fuels are burned are:

- wet gas desulfurisation (**W**)
- dry gas desulfurisation (**D**)
- seawater gas desulfurisation (**S**).

Information about the three methods is given in the bar chart and in **Table 1** and **Table 2**.



**Table 1**

Method	Material used	How material is obtained
W	Calcium carbonate, CaCO <sub>3</sub>	Quarrying
D	Calcium oxide, CaO	Thermal decomposition of calcium carbonate: CaCO <sub>3</sub> → CaO + CO <sub>2</sub>
S	Seawater	From the sea

**Table 2**

Method	What is done with waste material
W	Solid waste is sold for use in buildings. Carbon dioxide is released into the atmosphere.
D	Solid waste is sent to landfill.
S	Liquid waste is returned to the sea.

Evaluate the three methods of removing sulfur dioxide from waste gases.

Compare the three methods and give a justified conclusion.

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**Q3.**

Read the article and then answer the questions.

**Supermarkets launch eco-friendly plastic milk bags.  
Could this be the end of the milk bottle?**



Milk bottles are made from glass or from plastic.

Glass milk bottles contain 0.5 litres of milk. When the milk is used up the empty bottles are returned to be re-used. Glass milk bottles are re-used 24 times on average. The glass to make new milk bottles is produced when a mixture of sand, limestone, soda and recycled glass is heated to about 1600 °C in a furnace. There are almost unlimited amounts of the raw materials needed to produce this glass. About 35% of used glass is recycled.

The most common plastic milk bottles contain 2 litres of milk. When the milk is used up the empty bottles are discarded as waste. The plastic used to make these milk bottles is poly(ethene). Poly(ethene) is produced from crude oil by first using fractional distillation, then cracking the naphtha fraction and finally polymerising the ethene. About 5% of used poly(ethene) is recycled.

The new plastic milk bags contain 2 litres of milk. The milk bags are also made from poly(ethene). A milk bag uses 75% less poly(ethene) than is used to make the poly(ethene) milk bottles. When the milk is used up the empty bags are discarded as waste.

- (a) Describe what happens in fractional distillation so that fractions, such as naphtha, are separated from crude oil.

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## Mark schemes

### Q1.

- (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]

## **Q2.**

any **four** from:

*to gain 4 marks both pros and cons should be given*

### **Arguments for biodiesel**

max **three** from:

- sustainable / renewable
- (carbon neutral) absorbs CO<sub>2</sub> when growing / during photosynthesis
- burning biodiesel produces low amounts particulates / carbon monoxide  
*allow burning biodiesel produces little / low amount of global dimming*  
*ignore sulfur dioxide*
- can use waste vegetable oils / fats (from food industry) **or** can use waste plant material
- can be used to conserve crude oil (instead of / mixed with petroleum diesel)
- produced by a low energy / temperature process  
*accept produced by a low tech process*
- biodegrades (easily)  
*ignore engine effects*

### **Arguments against biodiesel**

max **three** from:

- creates food shortages  
*accept price of food increases*
- deforestation to plant more crops leads to loss of habitat / biodiversity **or** deforestation leads to a reduction in absorption of CO<sub>2</sub>  
*allow burning trees increases CO<sub>2</sub>*  
*allow deforestation increases global warming*
- burning biodiesel produces high amounts of nitrogen oxides  
*allow increases acid rain*

- crops takes time to grow  
*allow crops can fail*
- vast areas of land needed to grow crops

4

conclusion supported by the argument presented, which must give added value to the points for and against given above

1

[5]

### Q3.

- (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*

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[7]