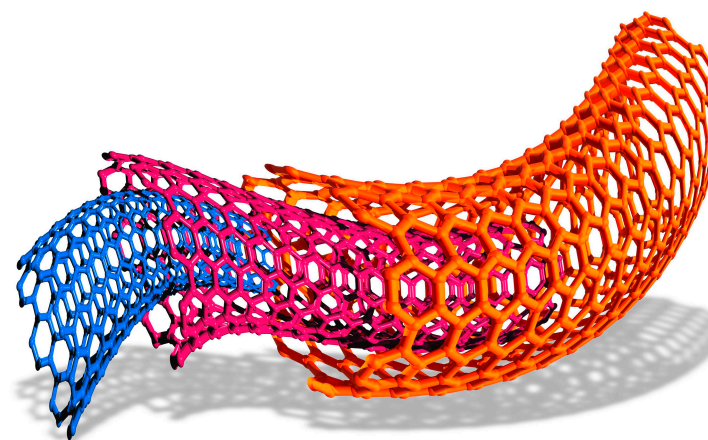


Interactive Example Candidate Responses

Paper 4 (May / June 2016), Question 5

Cambridge IGCSE™
Chemistry 0620



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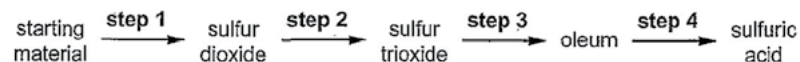
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- 5 Sulfuric acid is produced by the Contact process. The steps of the Contact process are shown.



- (a) Sulfur is a common starting material for the Contact process.

Name a source of sulfur.

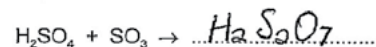
USA volcanoes in the USA [1]

- (b) Describe **step 2**, giving reaction conditions and a chemical equation. Reference to reaction rate and yield is not required.

$2\text{SO}_2 + \text{O}_2 \rightarrow 2\text{SO}_3$ for this reaction a temperature of 450°C is needed as it is exothermic, a higher temperature would result in a faster reaction. This reaction is not reversible. A pressure of 1-2 atmospheres is also needed. ~~A catalyst~~ The catalyst vanadium(V) oxide is also needed. [5]

- (c) **Step 3** involves adding sulfur trioxide to concentrated sulfuric acid to form oleum.

Complete the chemical equation for this reaction.



[1]

Select page

Your Mark

5(a)

5(b)

5(c)

5(d)(i)

5(d)(ii)

5(e)(i)

5(e)(ii)

Q5	Mark scheme
(a)	(sulfur-containing) fossil fuels;
(b)	M1 vanadium pentoxide/vanadium(V) oxide/ V_2O_5 (catalyst); M2 1–5 atmospheres (units required); M3 450°C (units required); M4 $2\text{SO}_2 + \text{O}_2 \rightarrow 2\text{SO}_3$; M5 equilibrium/reversible reaction;
(c)	$\text{H}_2\text{S}_2\text{O}_7$;
(d)(i)	3 correct (2 marks) 2 correct (1 mark) bubbles/effervescence/fizzing; dissolves/disappears/forms a solution; blue (solution);
(d)(ii)	carbon dioxide and water and copper(II) sulfate;
(e)(i)	carbon;
(e)(ii)	dehydration;

(d) Dilute sulfuric acid is a typical acid.

A student adds excess dilute sulfuric acid to a sample of solid copper(II) carbonate in a test-tube.

(i) Give three observations the student would make.

→ bubbles of gas
→ effervescence
→ solution changes blue [2]

(ii) Give the names of all products formed.

→ copper sulphate, carbon dioxide, water [1]

(e) Concentrated sulfuric acid has different properties to dilute sulfuric acid.

When concentrated sulfuric acid is added to glucose, $C_6H_{12}O_6$, steam is given off and a black solid is formed.

(i) Name the black solid.

hydrogen sulphate
~~hydro sulphate~~ [1]

(ii) What type of reaction has occurred?

exothermic reaction [1]

[Total: 12]

Your
Mark

5(a)

5(b)

5(c)

5(d)(i)

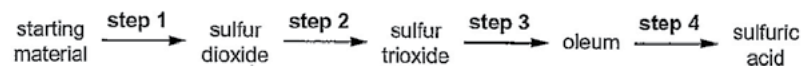
5(d)(ii)

5(e)(i)

5(e)(ii)

Q5	Mark scheme
(a)	(sulfur-containing) fossil fuels;
(b)	M1 vanadium pentoxide/vanadium(V) oxide/ V_2O_5 (catalyst); M2 1–5 atmospheres (units required); M3 450 °C (units required); M4 $2SO_2 + O_2 \rightarrow 2SO_3$; M5 equilibrium/reversible reaction;
(c)	$H_2S_2O_7$;
(d)(i)	3 correct (2 marks) 2 correct (1 mark) bubbles/effervescence/fizzing; dissolves/disappears/forms a solution; blue (solution);
(d)(ii)	carbon dioxide and water and copper(II) sulfate;
(e)(i)	carbon;
(e)(ii)	dehydration;

- 5 Sulfuric acid is produced by the Contact process. The steps of the Contact process are shown.



- (a) Sulfur is a common starting material for the Contact process.

Name a source of sulfur.

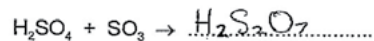
Near volcanoes [1]

- (b) Describe step 2, giving reaction conditions and a chemical equation. Reference to reaction rate and yield is not required.

Sulfur dioxide mixed with excess oxygen to form sulfur trioxide $S + O_2 \rightarrow SO_2$. This is an endothermic reaction so it works best at high temperatures. It is mixed and then passed over separate beds of catalyst vanadium(V) oxide. This forms the sulfur trioxide $2SO_2 + O_2 \rightarrow 2SO_3$. Heat should be supplied [5]

- (c) Step 3 involves adding sulfur trioxide to concentrated sulfuric acid to form oleum.

Complete the chemical equation for this reaction.



Select page

Your Mark

5(a)

5(b)

5(c)

5(d)(i)

5(d)(ii)

5(e)(i)

5(e)(ii)

Q5	Mark scheme
(a)	(sulfur-containing) fossil fuels;
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(c)	$H_2S_2O_7$;
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(d)(ii)	carbon dioxide and water and copper(II) sulfate;
(e)(i)	carbon;
(e)(ii)	dehydration;

(d) Dilute sulfuric acid is a typical acid.

A student adds excess dilute sulfuric acid to a sample of solid copper(II) carbonate in a test-tube.

(i) Give three observations the student would make.

A salt would form, a colourless liquid
would form and bubbles would form

[2]

(ii) Give the names of all products formed.

Copper (II) sulfate, carbon dioxide and
water

[1]

(e) Concentrated sulfuric acid has different properties to dilute sulfuric acid.

When concentrated sulfuric acid is added to glucose, $C_6H_{12}O_6$, steam is given off and a black solid is formed.

(i) Name the black solid.

Carbon sulfite

[1]

(ii) What type of reaction has occurred?

Exothermic reaction

[1]

[Total: 12]

Your
Mark

5(a)

5(b)

5(c)

5(d)(i)

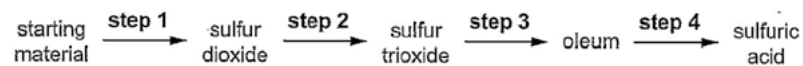
5(d)(ii)

5(e)(i)

5(e)(ii)

Q5	Mark scheme
(a)	(sulfur-containing) fossil fuels;
(b)	M1 vanadium pentoxide/vanadium(V) oxide/ V_2O_5 (catalyst); M2 1–5 atmospheres (units required); M3 450 °C (units required); M4 $2SO_2 + O_2 \rightarrow 2SO_3$; M5 equilibrium/reversible reaction;
(c)	$H_2S_2O_7$;
(d)(i)	3 correct (2 marks) 2 correct (1 mark) bubbles/effervescence/fizzing; dissolves/disappears/forms a solution; blue (solution);
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(e)(i)	carbon;
(e)(ii)	dehydration;

5 Sulfuric acid is produced by the Contact process. The steps of the Contact process are shown.



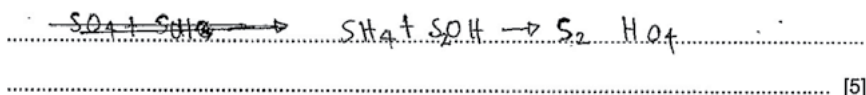
(a) Sulfur is a common starting material for the Contact process.

Name a source of sulfur.

From the oil, which is refined & sulphur is produced. [1]

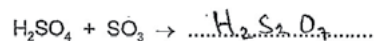
(b) Describe **step 2**, giving reaction conditions and a chemical equation. Reference to reaction rate and yield is not required.

450°C to 700°C and at 10 atmospheric pressure are the reaction conditions. Vanadium Pentoxide is the catalyst use to spur on the reaction.



(c) **Step 3** involves adding sulfur trioxide to concentrated sulfuric acid to form oleum.

Complete the chemical equation for this reaction.



[1]

Select page

Your Mark

5(a)

5(b)

5(c)

5(d)(i)

5(d)(ii)

5(e)(i)

5(e)(ii)

Q5 Mark scheme

(a)	(sulfur-containing) fossil fuels;
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(d)(ii)	carbon dioxide and water and copper(II) sulfate;
(e)(i)	carbon;
(e)(ii)	dehydration;

(d) Dilute sulfuric acid is a typical acid.

A student adds excess dilute sulfuric acid to a sample of solid copper(II) carbonate in a test-tube.

(i) Give three observations the student would make.

- The solid copper(II) carbonate would change color.
- It would react and dissolve completely.
- It would leave behind a reddish-brown color. [2]

(ii) Give the names of all products formed.

- Copper Sulphate
- Carbon sulfate. [1]

(e) Concentrated sulfuric acid has different properties to dilute sulfuric acid.

When concentrated sulfuric acid is added to glucose, $C_6H_{12}O_6$, steam is given off and a black solid is formed.

(i) Name the black solid.

Carbon. [1]

(ii) What type of reaction has occurred?

A displacement reaction. [1]

[Total: 12]

Your
Mark

5(a)

5(b)

5(c)

5(d)(i)

5(d)(ii)

5(e)(i)

5(e)(ii)

Q5 Mark scheme

(a)	(sulfur-containing) fossil fuels;
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(e)(i)	carbon;
(e)(ii)	dehydration;

Cambridge Assessment International Education
The Triangle Building, Shaftesbury Road, Cambridge, CB2 8EA, United Kingdom
t: +44 1223 553554
e: info@cambridgeinternational.org www.cambridgeinternational.org

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