

12: Equilibria – Topic questions

Paper 3

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

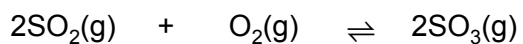
Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
3	2016	June	32
6	2016	June	31
7	2016	November	31

The mark scheme for each question is provided at the end of the document.

You can find the complete question papers and the complete mark schemes (with additional notes where available) on the School Support Hub at www.cambridgeinternational.org/support

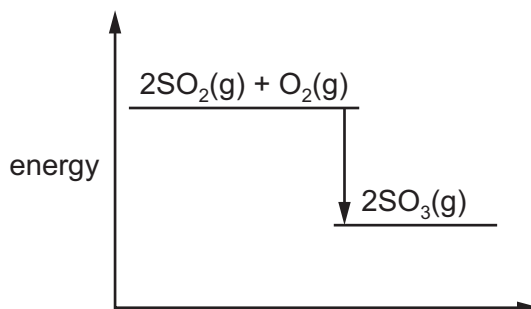
- 3 Sulfur dioxide reacts with excess oxygen to form sulfur trioxide.



- (a) What is the meaning of the symbol \rightleftharpoons ?

..... [1]

- (b) The energy level diagram for the reaction is shown.

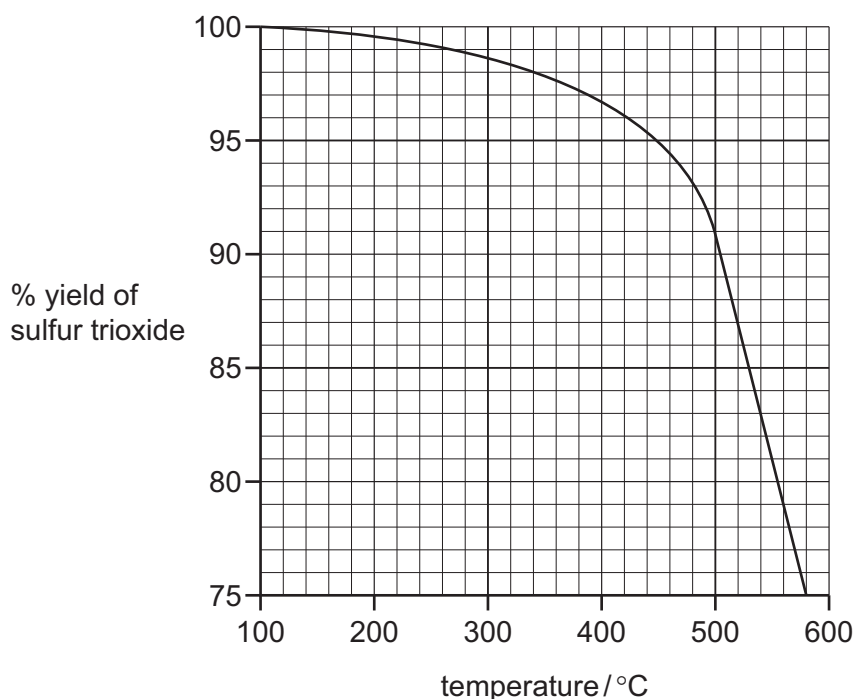


Is this reaction exothermic or endothermic?

Give a reason for your answer.

.....
..... [1]

- (c) The graph shows how the percentage yield of sulfur trioxide changes with temperature when the pressure is kept constant.



- (i) Describe how the percentage yield of sulfur trioxide changes with temperature.

..... [1]

- (ii) Determine the percentage yield of sulfur trioxide when the temperature is 500°C.

..... [1]

- (d) Describe a test for sulfur dioxide.

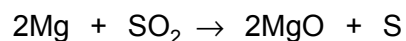
test

result [2]

- (e) Give one **use** of sulfur dioxide.

..... [1]

- (f) Sulfur dioxide reacts with magnesium.



Which substance is reduced in this reaction?

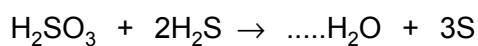
Explain your answer.

.....

..... [2]

- (g) Sulfur dioxide reacts with water to form sulfurous acid, H_2SO_3 . Sulfurous acid reacts with hydrogen sulfide to form water and sulfur.

Complete the chemical equation for this reaction.



[1]

[Total: 10]

6 Ammonia is manufactured by the reaction of nitrogen with hydrogen in the presence of a catalyst.

(a) What is the purpose of a catalyst?

..... [1]

(b) The reaction is reversible.

Complete the equation below by adding the sign for a reversible reaction.

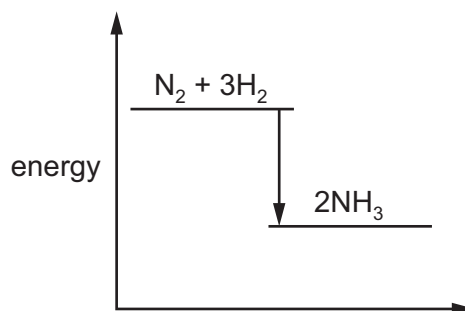


[1]

(c) The energy level diagram for this reaction is shown.

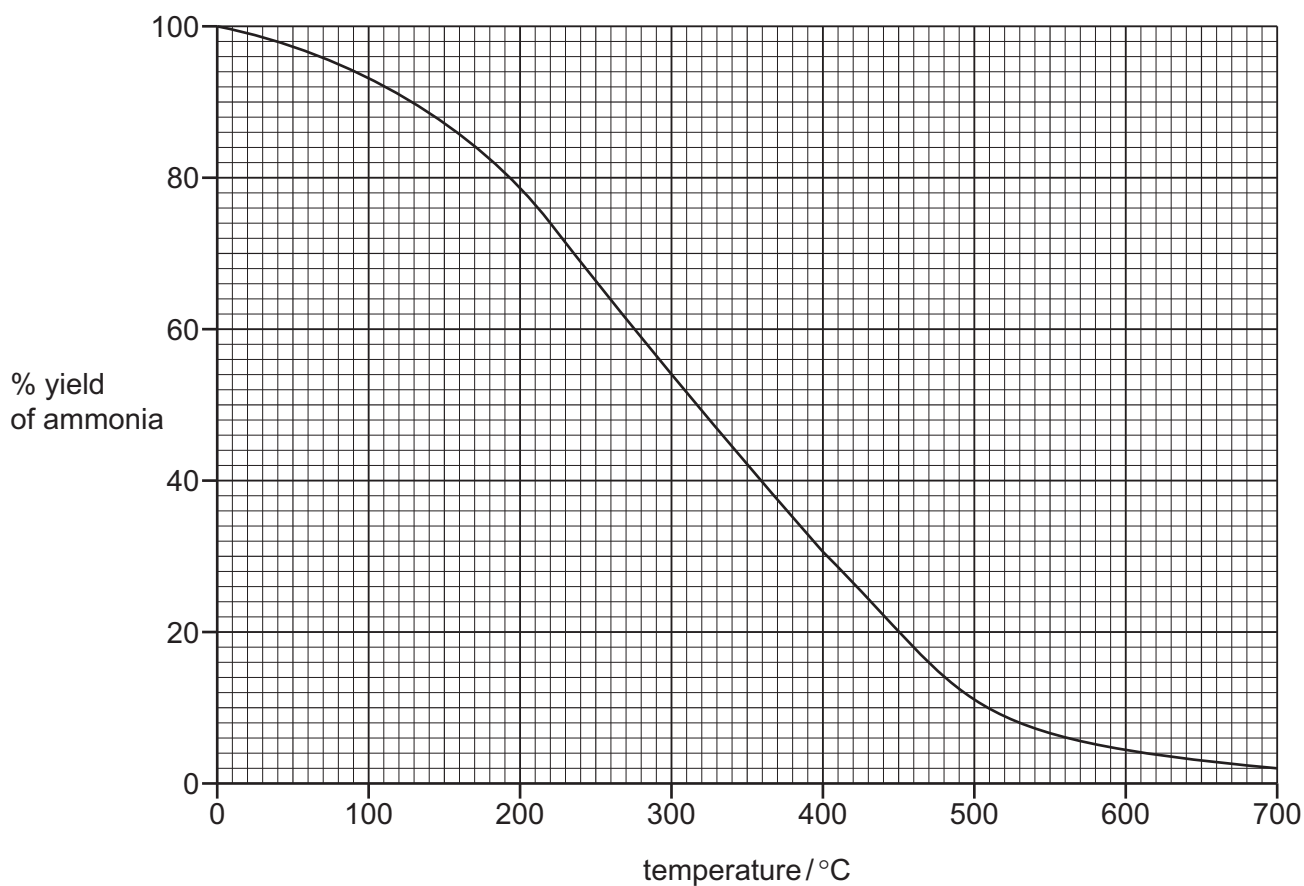
Is this reaction exothermic or endothermic?

Give a reason for your answer.



.....
..... [1]

- (d) The graph shows how the percentage yield of ammonia changes with temperature when the pressure is kept constant.



- (i) Describe how the percentage yield of ammonia changes with temperature.

..... [1]

- (ii) Determine the percentage yield of ammonia at 350°C.

..... [1]

- (e) Describe a test for ammonia.

test.....

result..... [2]

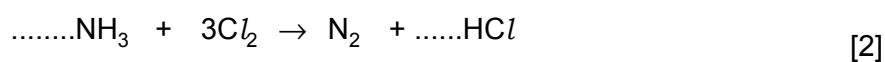
(f) Ammonia is a weak base.

Describe how you would measure the pH of an aqueous solution of a weak base using Universal Indicator.

.....

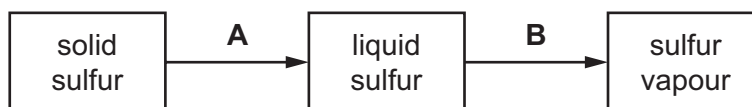
..... [2]

(g) Complete the chemical equation for the reaction of ammonia with chlorine.



[Total: 11]

- 7 The diagram shows the changes of state when sulfur is heated.



- (a) Give the names of the changes of state labelled **A** and **B**.

A

B [2]

- (b) Describe the arrangement and motion of the particles in sulfur vapour.

arrangement

motion [2]

- (c) Give **one** use of sulfur.

..... [1]

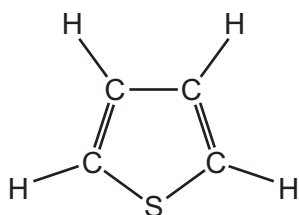
- (d) Some compounds of sulfur are found in coal.

Explain why the presence of sulfur in coal has an adverse effect on human health when the coal is burnt.

.....

..... [2]

- (e) One of the compounds of sulfur in coal is thiophene.
The structure of thiophene is shown.



- (i) Determine the formula of thiophene.

..... [1]

- (ii) Thiophene can be made in the laboratory by heating ethyne, C_2H_2 , with hydrogen sulfide, H_2S , in the presence of a catalyst.

What is the purpose of the catalyst?

..... [1]

- (iii) When 2.6 g of ethyne react with excess hydrogen sulfide, 4.2 g of thiophene are formed.

Calculate the mass of thiophene formed when 15.6 g of ethyne react with excess hydrogen sulfide.

[1]

[Total: 10]

Question	Answer	Marks
3 (a)	reversible reaction / equilibrium;	1
3 (b)	exothermic and products have less energy than reactants;	1
3 (c) (i)	percentage yield decreases as temperature increases;	1
3 (c) (ii)	91%;	1
3 (d)	test: acidified potassium manganate(VII) / potassium permanganate; result: (pink solution) turns colourless;	2 1 1
3 (e)	any suitable use, e.g. food preservation / manufacture of sulfuric acid;	1
3 (f)	sulfur dioxide; (sulfur dioxide) loses oxygen;	2 1 1
3 (g)	3 (H ₂ O);	1
Total: 10		
6 (a)	increase rate of reaction / speeds up reaction;	1
6 (b)	\rightleftharpoons ;	1
6 (c)	exothermic and products have less energy than reactants;	1
6 (d) (i)	(yield) decreases with increasing temperature ora / the lower the temperature, the higher the yield ora;	1
6 (d) (ii)	42%;	1
6 (e)	(damp) red litmus paper turns blue (1 mark for red litmus paper) OR concentrated HCl (on glass rod) gives white fumes (1 mark for concentrated HCl (on glass rod))	2 2
6 (f)	add Universal Indicator to the solution / observe colour; compare with colour chart;	2 1 1
6 (g)	2 (NH ₃); 6 (HCl);	2 1 1
Total: 11		

Continues on next page ...

Question	Answer	Marks
7 (a)	A = melting / fusion B = boiling / vaporisation	1 1
7 (b)	<i>arrangement</i> : irregular / random / no fixed position / no (fixed) arrangement <i>motion</i> : rapid / fast / random	2
7 (c)	any suitable use, e.g. tyre manufacture / making sulfur dioxide / making sulfuric acid / pesticide / insecticide	1
7 (d)	sulfur dioxide is formed sulfur dioxide causes irritation to the throat (OR nose OR lungs OR eyes OR skin)	1 1
7 (e) (i)	C ₄ H ₄ S	1
7 (e) (ii)	speeds up the rate of a reaction	1
7 (e) (iii)	25.2 (g)	1
		Total: 10