

Gold Paper

AS & A Level

Question Paper 1

Level	A Level
Subject	Chemistry
Exam Board	OCR
Paper	AS & A Level
Booklet	Question Paper 1

Time allowed: 78 minutes

Score: /58

Percentage: /100

Grade Boundaries:

A*	A	B	C	D	E
>85%	73%	60%	47%	34%	21%

Question 1

In the compound $[\text{ICl}_2]^+ [\text{SbCl}_6]^-$, the oxidation number of chlorine is -1 .

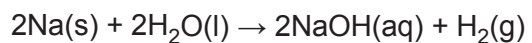
What are the oxidation numbers of I and Sb in the compound?

	I	Sb
A	+1	+5
B	+1	+7
C	+3	+5
D	+3	+7

[1]

Question 2

Sodium reacts with water as shown below.



Which mass of sodium reacts with water to produce 960 cm³ of hydrogen gas at RTP?

- A 0.46g
- B 0.92g
- C 1.84g
- D 3.68g

[1]

Question 3

The first five successive ionisation energies of an element **Y** are shown below.

1st	2nd	3rd	4th	5th
496	4563	6913	9544	13352

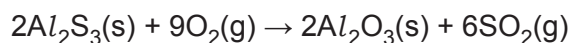
What is the formula of a chloride of **Y**?

- A. YCl
- B. YCl_2
- C. YCl_3
- D. YCl_4

[1]

Question 4

The equation for the reaction of aluminium sulfide, Al_2S_3 , with oxygen is shown below.



The table shows standard enthalpy changes of formation, $\Delta_f H^\ominus$.

Substance	$Al_2S_3(s)$	$O_2(g)$	$Al_2O_3(s)$	$SO_2(g)$
$\Delta_f H^\ominus / \text{kJ mol}^{-1}$	-723.8	0	-1675.7	-296.8

What is the standard enthalpy change of combustion of $Al_2S_3(s)$, in kJ mol^{-1} ?

- A -3684.6
- B -1842.3
- C +1842.3
- D +3684.6

[1]

Question 5

Which alcohol is likely to have a fragment ion at $m/z = 31$ in its mass spectrum?

- A. $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_3$
- B. $\text{CH}_3\text{CH}_2\text{CH}_2\text{C}(\text{OH})(\text{CH}_3)_2$
- C. $\text{CH}_3\text{CH}(\text{OH})\text{CH}_2\text{CH}_2\text{CH}_3$
- D. $(\text{CH}_3)_2\text{CHCH}_2\text{OH}$

[1]

Question 6

The Periodic Table is arranged in periods and groups.

- (a) Elements in the Periodic Table show a periodic trend in atomic radius.

State and explain the trend in atomic radius from Li to F.



In your answer you should use appropriate technical terms, spelled correctly.

trend

Explanation

[3]

- (b) (i) Complete the electron configuration of a bromide **ion**.

1s²

[1]

- (ii) A student adds a small volume of aqueous silver nitrate to an aqueous solution of bromide ions in a test-tube. The student then adds a similar volume of dilute aqueous ammonia to the same test-tube.

Describe what the student would see in the test-tube after the addition of aqueous ammonia.

[1]

- (iii) Write an ionic equation for any precipitation reaction which occurs in the student's tests.

Include state symbols

[1]

(c) The Group 7 element chlorine reacts with sodium hydroxide, NaOH, under different conditions to give different products.

(i) Chlorine reacts with aqueous sodium hydroxide to form bleach.

Write the equation and state the conditions for this reaction.

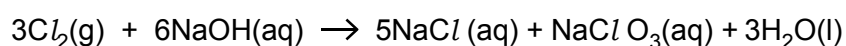
equation

conditions

[2]

(ii) Under different conditions, chlorine reacts differently with aqueous sodium hydroxide.

A disproportionation reaction takes place as shown below.



State what is meant by disproportionation and show that disproportionation has taken place in this reaction.

Use oxidation numbers in your answer.

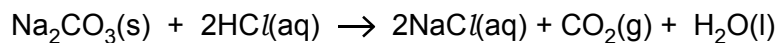
[3]

[Total 11 Marks]

Question 7

This question is about the determination of enthalpy changes.

- (a) A student carries out an experiment to find the enthalpy change of reaction, ΔH_r , for the reaction below.



In the experiment, 3.18 g of Na_2CO_3 are added to 50.0 g of $2.00 \text{ mol dm}^{-3} \text{HCl}$, an excess. The temperature of the reaction mixture increases by 5.5°C .

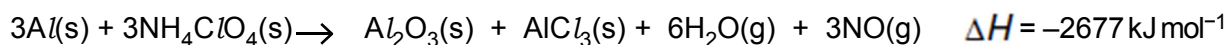
Calculate ΔH_r , in kJ mol^{-1} .

Give your answer to **three** significant figures.

The specific heat capacity, c , of the reaction mixture is $4.18 \text{ J g}^{-1} \text{ K}^{-1}$.

[4]

(b) The booster rocket of a spacecraft uses a mixture of aluminium and ammonium chlorate(VII), NH_4ClO_4 , as a fuel. The equation and some enthalpy changes are shown below.



Substance	Standard enthalpy change of formation, $\Delta H_f^\circ / \text{kJ mol}^{-1}$
$\text{NH}_4\text{ClO}_4(s)$	-295
$\text{Al}_2\text{O}_3(s)$	-1676
$\text{AlCl}_3(s)$	-704
$\text{H}_2\text{O}(g)$	-242

(i) What is meant by the term *standard enthalpy change of formation*?

Give the standard conditions.

[3]

(ii) Write the equation, including state symbols, for the reaction that represents the standard enthalpy change of formation of $\text{NH}_4\text{ClO}_4(s)$.

[2]

(iii) Calculate the enthalpy change of formation of $\text{NO}(g)$ using the data above.

[3]

[Total 12 Marks]

Question 8

(a) Reaction rates can be increased or decreased by changing conditions of temperature and pressure.

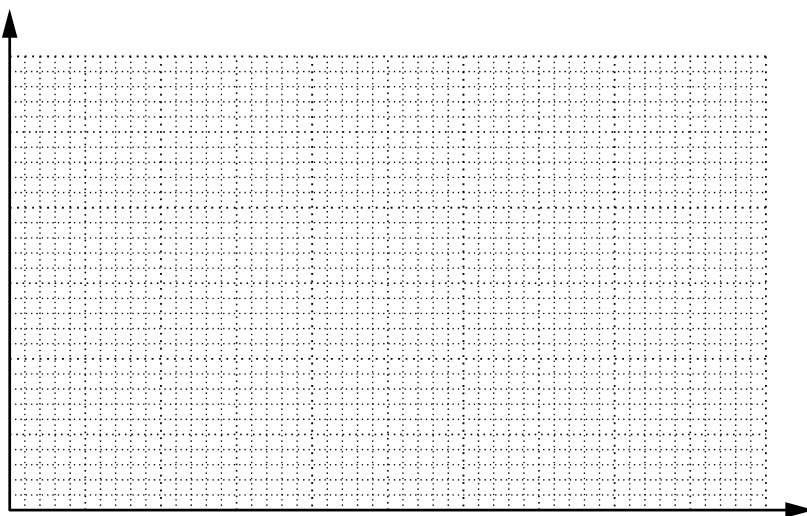
(i) Explain how increasing the temperature increases the rate of reaction.

Include a labelled sketch of the Boltzmann distribution, on the grid below.

Label the axes.



Your answer needs to be clear and well organised using the correct terminology.



[4]

(ii) Describe and explain the effect of decreasing the pressure on the rate of a reaction. [2]

(b) Catalysts are used to speed up chemical reactions.

(i) Write an equation for an industrial preparation of ethanol which involves the use of an enzyme in yeast.

State a suitable temperature for this reaction and **one** other essential condition. [2]

(ii) Catalytic converters are used to decrease the emission of nitrogen monoxide and carbon monoxide from the internal combustion engine. These two gases react together on the surface of the catalyst.

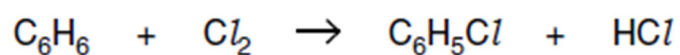
Write an equation for this reaction. [1]

[Total 9 Marks]

Question 9

Benzene and other arenes can be chlorinated to produce chloroarenes which are used in the manufacture of pesticides, drugs and dyes.

Chlorobenzene, C_6H_5Cl , is formed by the reaction of benzene and chlorine in the presence of a suitable catalyst, such as $AlCl_3$.

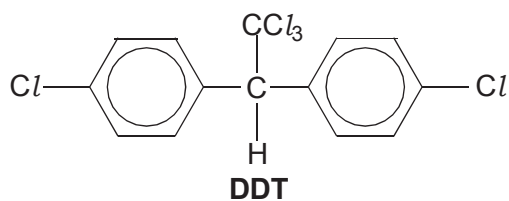


Outline the mechanism for the formation of chlorobenzene from benzene.

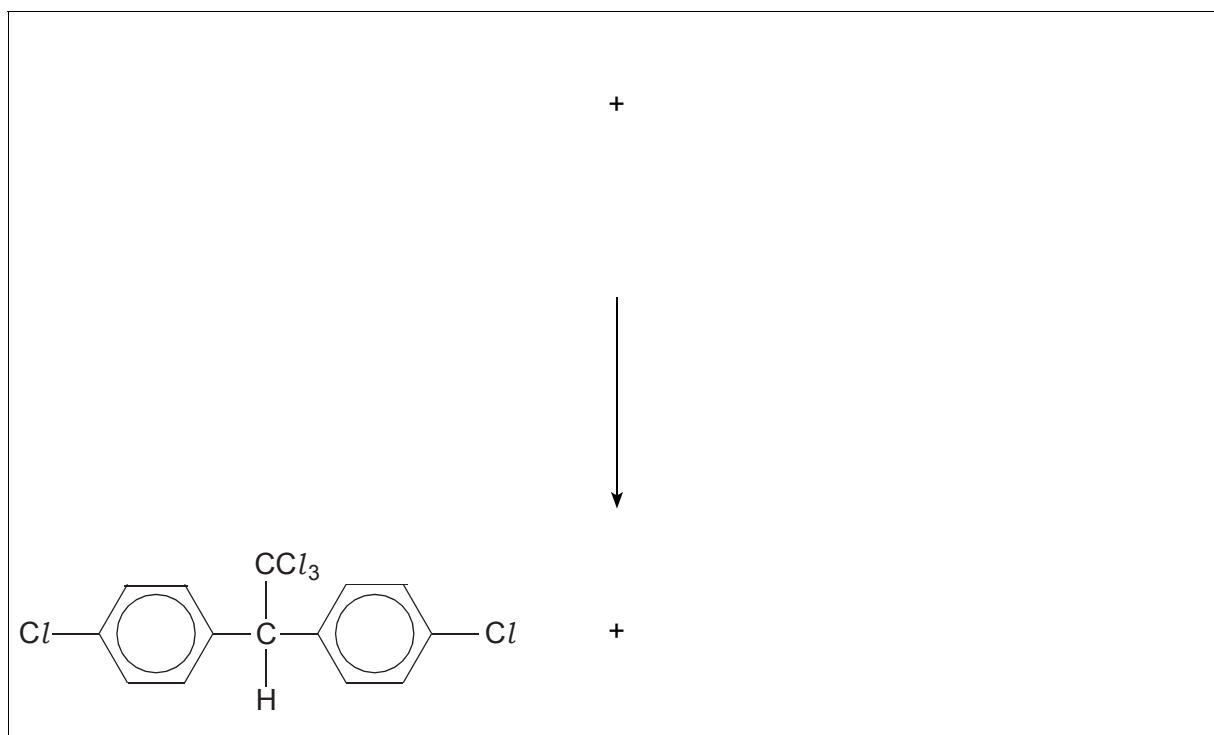
[6]

Show how $AlCl_3$ behaves as a catalyst.

(b) Chlorobenzene reacts with trichloroethanal, Cl_3CCHO , to produce the pesticide DDT.



(i) Construct an equation for the reaction of chlorobenzene with trichloroethanal to form DDT. [2]



(ii) Predict the number of peaks in the ^{13}C NMR spectrum of DDT. [1]

(c) Chlorobenzene can be nitrated to form a mixture of products.

Suggest why the reaction forms a mixture of products. [1]

(d) Explain why phenol reacts more readily with chlorine than benzene reacts with chlorine.



In your answer, you should use appropriate technical terms, spelled correctly.

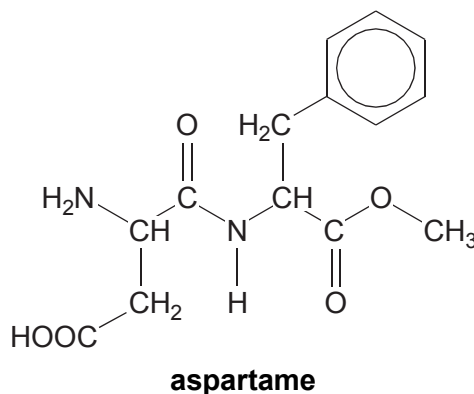
[3]

[Total 13 Marks]

Question 10

The addition of sucrose, table sugar, to food and drink has been linked to the increased risk of obesity and insulin resistance. Aspartame is used as an alternative to sugar.

The structure of aspartame is shown below.



(a) Aspartame contains five functional groups including the benzene ring, and has two chiral carbon atoms.

(i) Circle the **two** chiral carbon atoms on the structure above. [1]

(i) **Name** the **four** functional groups, other than the benzene ring, in aspartame. [2]

(b) Aspartame consumed in food or drink might be hydrolysed by the acid in the stomach. This acid consists mainly of hydrochloric acid.

Draw the structures of the **three** organic products formed by the **complete** acid hydrolysis of aspartame.

[4]

(c) Some artificial sweeteners commonly available many years ago have now been withdrawn from use.

Suggest why.

[1]

[Total 8 Marks]