

# Group 7

## Question Paper 1

<b>Level</b>	International A Level
<b>Subject</b>	Chemistry
<b>Exam Board</b>	CIE
<b>Topic</b>	Group 7
<b>Sub-Topic</b>	
<b>Paper Type</b>	Theory
<b>Booklet</b>	Question Paper 1

**Time Allowed:** 72 minutes

**Score:** /60

**Percentage:** /100

**Grade Boundaries:**

A*	A	B	C	D	E	U
>85%	77.5%	70%	62.5%	57.5%	45%	<45%

1 (a) In this question, **K**, **L** and **M** refer to a halogen atom or halide ion.  
For each part question, read the information and complete the answer lines below.

(i) When concentrated sulfuric acid is added to solid Na**K**, white fumes are produced that turn damp blue litmus paper red. No other colour changes are observed.

identity of **K** = .....

equation for reaction .....

explanation of observation .....

..... [3]

(ii) When silver nitrate solution is added to an aqueous solution of Na**L**, a precipitate forms that remains after the addition of concentrated ammonia solution.

identity of **L** = .....

colour of precipitate .....

equation for reaction ..... [3]

(iii) **M**<sub>2</sub> is a liquid at room temperature with a boiling point higher than that of chlorine but lower than that of iodine.

identity of **M** = .....

explanation .....

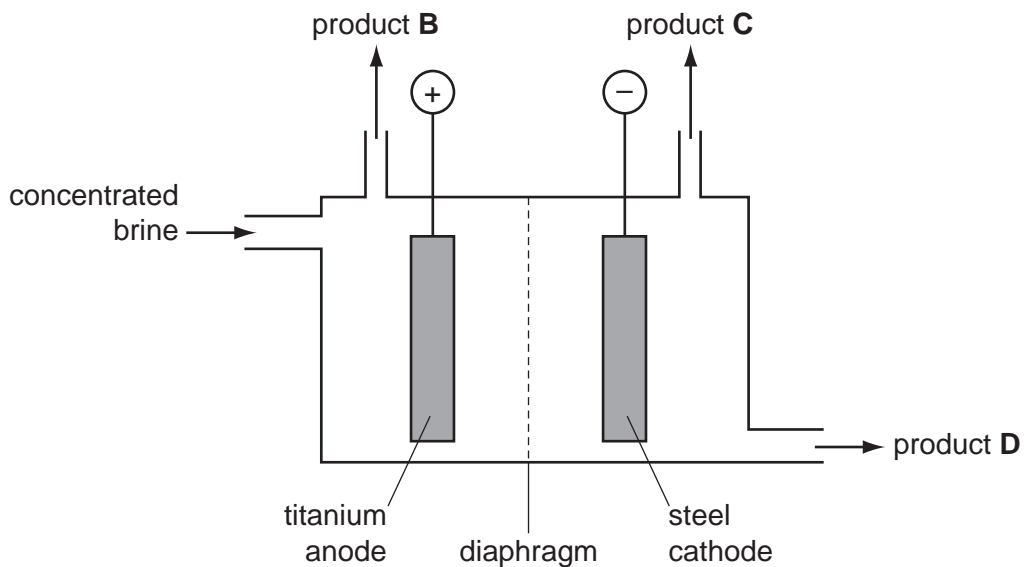
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.....

.....

..... [2]

(b) The diagram below is a simplified representation of a diaphragm cell.



(i) Identify each of the products.

**B** .....

**C** .....

**D** .....

[3]

(ii) Give the equations for the two electrode reactions.

anode .....

cathode .....

[2]

[Total: 13]

2 The halogens and their compounds have a wide variety of uses and the chemical and physical properties of the elements show regular patterns related to their positions in Group VII.

(a) Chlorine, bromine and iodine all react with hydrogen.

(i) State the trend in the reactivities of the halogens with hydrogen.

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

(ii) Explain this trend in terms of bond energies.

.....  
.....  
..... [2]

(b) In the laboratory it is not very convenient to prepare hydrogen halides from their elements.

Hydrogen halides can be prepared from their salts.

(i) Write an equation for the reaction of calcium chloride,  $\text{CaCl}_2$ , with concentrated sulfuric acid.

..... [1]

(ii) Explain why hydrogen iodide is not prepared in this way.

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

(iii) When potassium bromide,  $\text{KBr}$ , reacts with concentrated sulfuric acid, sulfur dioxide,  $\text{SO}_2$ , is produced. State what you would see and write an equation for this reaction.

.....  
..... [3]

- (c) (i) Give the structures of the four structural isomers of  $C_4H_9Br$  and identify each as primary, secondary or tertiary.

.....

.....

[4]

- (ii) Name the isomer of  $C_4H_9Br$  that contains a chiral centre and draw the three-dimensional structures of the two optical isomers.

name .....

structures

.....

[3]

- (d) Aqueous silver nitrate solution was added to separate tubes containing chloroethane, bromoethane and iodoethane. The tubes were heated in a water bath.

A yellow precipitate appeared first in the tube containing iodoethane, followed by a cream precipitate in the tube containing bromoethane and finally a white precipitate appeared in the tube containing chloroethane.

Explain these observations.

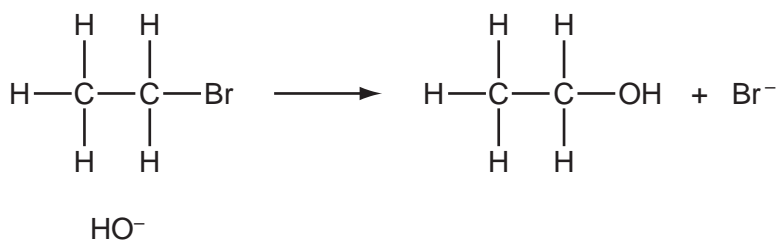
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[2]

- (e) Give the full name of the mechanism for the reaction between aqueous sodium hydroxide and bromoethane.

..... [2]

- (ii) Complete the diagram below to represent this mechanism. Include all necessary curly arrows, partial charges and lone pairs.



[2]

- (f) In the past, CFCs such as  $\text{CF}_3\text{Cl}$  were widely used as refrigerants.

- (i) State a property of CFCs which makes them suitable for use as refrigerants.

..... [1]

- (ii) State the damaging effect of CFCs in the upper atmosphere.

.....

Explain your answer.

.....

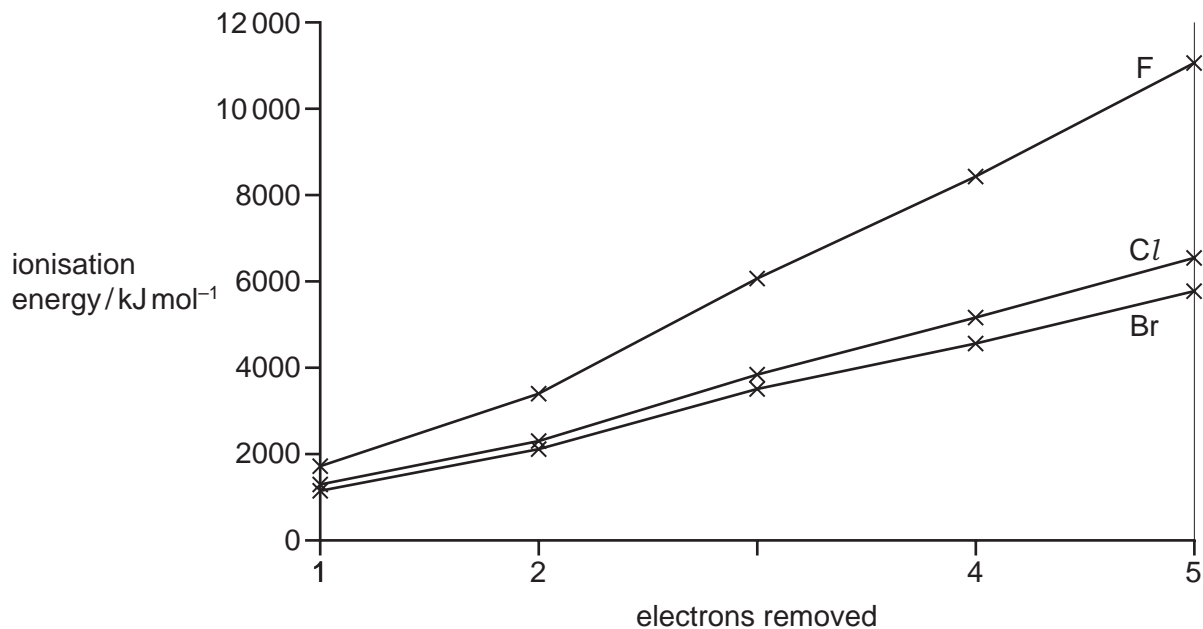
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[2]

[Total: 24]

- 3 (a) Successive ionisation energies for the elements fluorine, F, to bromine, Br, are shown on the graph.



- (i) Explain why the first ionisation energies decrease down the group.

.....

.....

.....

..... [3]

- (ii) Explain why there is an increase in the successive ionisation energies of fluorine.

.....

.....

..... [2]

- (b) Group VII is the only group in the Periodic Table containing elements in all three states of matter at room conditions.

State and explain, in terms of intermolecular forces, the trend in the boiling points of the elements down Group VII.

.....  
.....  
.....  
.....  
.....  
..... [4]

- (c) Compounds containing different halogen atoms covalently bonded together are called interhalogen compounds.

- (i) One interhalogen compound can be prepared by the reaction between iodine and fluorine. This compound has  $M_r = 222$  and the percentage composition by mass: F, 42.8; I, 57.2.

Calculate the molecular formula of this interhalogen compound.

molecular formula ..... [3]

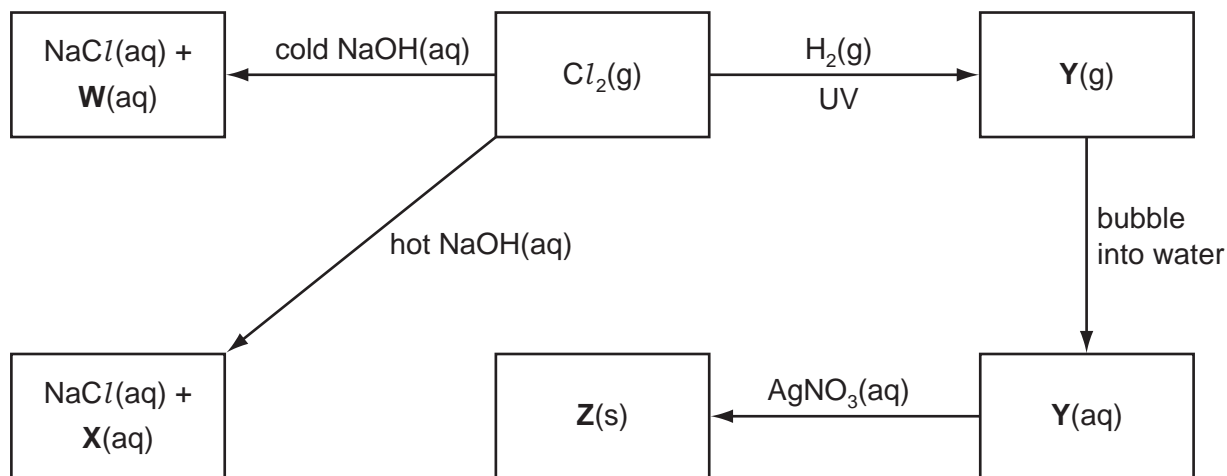
- (ii) Another interhalogen compound has the formula  $ICl_3$ .

Draw a 'dot-and-cross' diagram of a molecule of this compound, showing outer shell electrons only. Explain whether or not you would expect this molecule to be polar.

.....  
.....  
..... [2]



(d) Some reactions involving chlorine and its compounds are shown in the reaction scheme below.



(i) Give the **formulae** of **W**, **X**, **Y** and **Z**.

**W** .....

**X** .....

**Y** .....

**Z** .....

[4]

(ii) Write an equation for the reaction of chlorine with **hot** NaOH(aq).

..... [2]

(iii) State the oxidation numbers of chlorine at the start and at the end of the reaction in (ii).

..... [2]

(iv) Write an **ionic** equation for the reaction of **Y** with AgNO<sub>3</sub>(aq). Include state symbols.

..... [1]

[Total: 23]