

Group 7

Question Paper 2

Level	International A Level
Subject	Chemistry
Exam Board	CIE
Topic	Group 7
Sub-Topic	
Paper Type	Theory
Booklet	Question Paper 2

Time Allowed: 75 minutes

Score: /62

Percentage: /100

Grade Boundaries:

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

1 The elements of Group VII of the Periodic Table show variation in their properties.

(a) (i) Complete the table below, stating the colour of each element in its normal state at room temperature.

halogen	melting point/°C	colour
chlorine	-101	
bromine	-7	
iodine	114	

(ii) Briefly explain why the melting points of the halogens increase from chlorine to iodine.

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.....

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[4]

(b) The halogens form many interhalogen compounds in which two different halogens are combined. One such compound is bromine monochloride, BrCl.

(i) Complete the electronic configurations of chlorine and bromine.

chlorine	$1s^22s^22p^6$
bromine	$1s^22s^22p^6$

(ii) Draw a 'dot-and-cross' diagram of the BrCl molecule. Show outermost electrons only.

[2]

(c) Interhalogen compounds like BrCl have similar properties to the halogens.

(i) By considering your answers to (a) and (b), predict the physical state of BrCl at room temperature. Explain your answer.

physical state

explanation

.....

.....

(ii) Suggest the colour of BrCl .

.....

[4]

(d) Cl_2 and BrCl each react with aqueous KI.

(i) Describe what would be seen when Cl_2 is bubbled through aqueous KI for several minutes.

initially

.....

after several minutes

.....

(ii) Construct an equation for the reaction that occurs.

.....

(iii) Suggest an equation for the reaction that occurs between BrCl and aqueous KI.

.....

(iv) How do Cl_2 and BrCl behave in these reactions?

.....

[5]

[Total: 15]

2 (a) Write equations, with state symbols, to define the following.

(i) the C–Br bond energy in CH₃Br

.....

(ii) the Al–Cl bond energy in AlCl₃

.....

[3]

(b) Describe and explain the trend in bond energies of the bonds in Cl₂, Br₂ and I₂.

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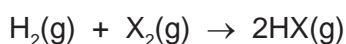
(ii) Fluorine, F₂, does **not** follow this trend. Suggest a possible reason why.

.....

.....

[3]

(c) Use data from the *Data Booklet* to calculate the enthalpy change of the following reaction.



when X = Cl

$\Delta H = \dots\dots\dots \text{kJ mol}^{-1}$

when X = I

$\Delta H = \dots\dots\dots \text{kJ mol}^{-1}$

(ii) Use these results to describe and explain the trend in the thermal stabilities of the hydrides of Group VII.

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.....

.....

[5]

(d) Bromine reacts with hot NaOH(aq) to give a solution which on cooling produces white crystals of compound **A**.

A has the following percentage composition by mass: Na, 15.2; O, 31.8; Br, 53.0.

The remaining solution contains mostly NaBr, with a little of compound **A**.

(i) Calculate the empirical formula of **A**.

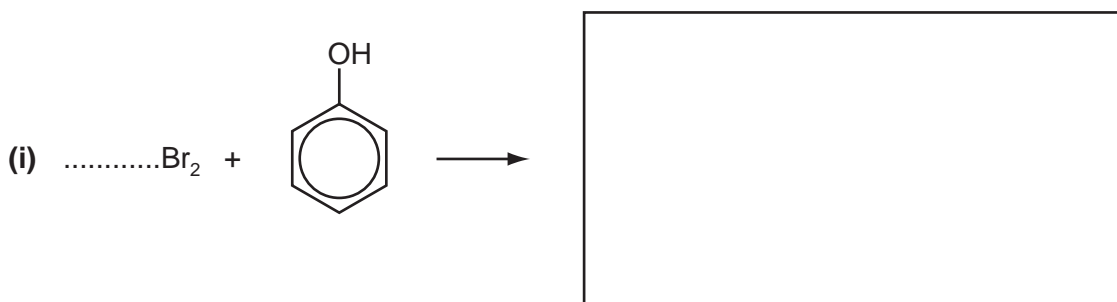
(ii) Construct an equation for the reaction between Br₂ and hot NaOH(aq).

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[4]

[Total: 15]

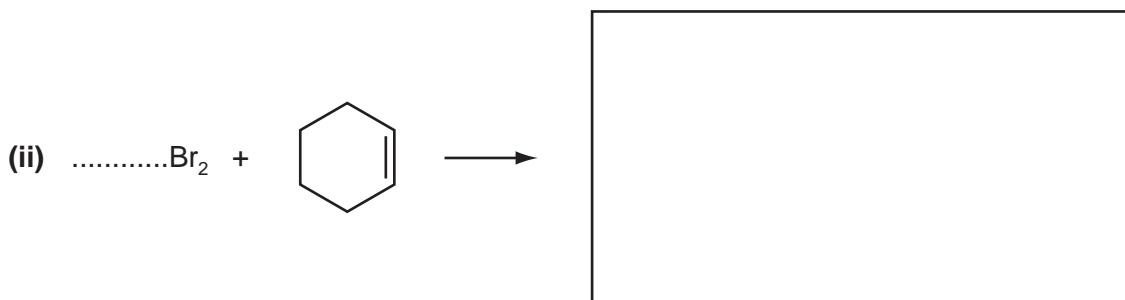
- 3 (a) Bromine reacts with a variety of organic compounds.
For each of the following reactions,

- complete and **balance the equation**, including the structural formula of the organic product,
- state the specific conditions (if any) under which the reaction takes place and the *type of reaction* that occurs.



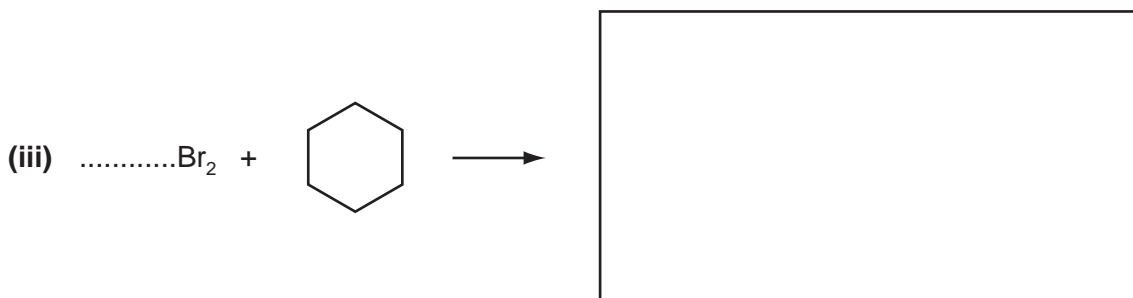
reaction conditions

type of reaction



reaction conditions

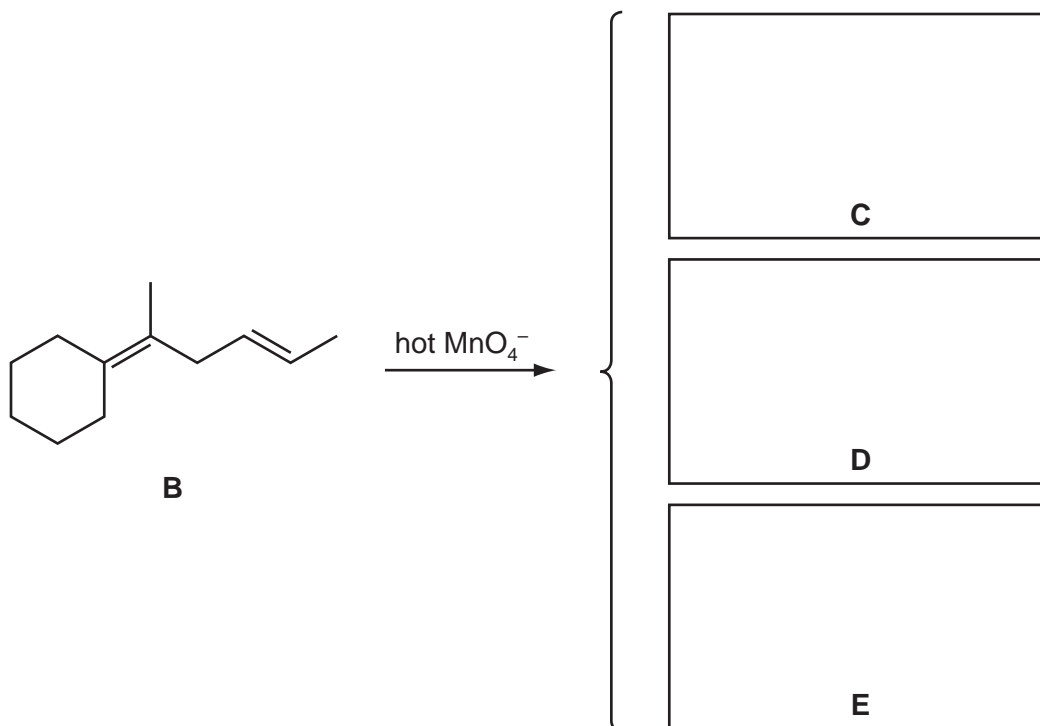
type of reaction



reaction conditions

type of reaction

- (b) When hydrocarbon **B** is heated with concentrated manganate(VII) ions, three organic compounds, **C**, **D** and **E**, are formed.



- (i) Suggest the identities of compounds **C**, **D** and **E**, drawing their structures in the boxes above.
- (ii) Use the relevant letter, **C**, **D** or **E**, to identify which of your compounds will react with each of the following reagents. Each reagent may react with more than one of **C**, **D** and **E**, in which case state **all** the compounds that may react with each reagent.
- 2,4-dinitrophenylhydrazine
 - alkaline aqueous iodine
 - aqueous sodium hydroxide

[6]

[Total: 16]

4 The elements of the third period of the Periodic Table, sodium to sulfur, all form chlorides by direct combination.

(a) (i) Sulfur forms a number of chlorides which are liquid at room temperature. Which other element of the third period forms a chloride which is liquid at room temperature?

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(ii) Name **one** element of the third period which burns in chlorine with a coloured flame.

.....

(iii) Aluminium chloride may be produced by passing a stream of chlorine over heated aluminium powder in a long hard-glass tube. State **two** observations you could make during this reaction.

..... and

(iv) Write a balanced equation, with state symbols, for this reaction of aluminium with chlorine.

.....

(v) No chloride of argon has ever been produced. Suggest a reason for this.

.....

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(b) When chlorides of the elements of the third period are added to water, some simply dissolve while others can be seen to react with the water.

(i) Complete the table below, stating how the chlorides of Na, Al, and Si behave when mixed with water. In the first column use only the terms 'dissolve' or 'react'.

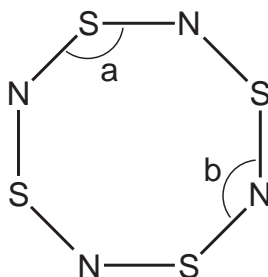
element	Does the chloride dissolve or react?	approximate pH of the resulting solution
Na		
Al		
Si		

(ii) What *type of reaction* takes place between a chloride and water?

.....

[7]

(c) Sulfur forms the compound S_4N_4 with nitrogen. The structure of S_4N_4 is shown below. Assume all bonds shown are single bonds.



(i) Determine the number of lone pairs of electrons around a nitrogen atom and a sulfur atom in S_4N_4 .

nitrogen atom

sulfur atom

(ii) Which bond angle, a or b, in the S_4N_4 molecule will be smaller? Explain your answer.

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[2]

[Total: 16]