

Group 7

Question Paper 3

Level	International A Level
Subject	Chemistry
Exam Board	CIE
Topic	Group 7
Sub-Topic	
Paper Type	Theory
Booklet	Question Paper 3

Time Allowed: 60 minutes

Score: /50

Percentage: /100

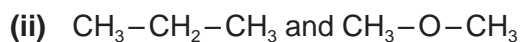
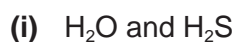
Grade Boundaries:

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

- 1 (a) Describe and explain the trend in the volatilities of the halogens Cl_2 , Br_2 and I_2 .

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

- (b) For each of the following pairs of compounds, predict which compound has the higher boiling point, and explain the reasons behind your choice. Use diagrams in your answers where appropriate.



[4]

- (c) Briefly explain the shape of the SF_6 molecule, drawing a diagram to illustrate your answer.

[2]

[Total: 9]

2 Each of the Group VII elements chlorine, bromine and iodine forms a hydride.

(a) Outline how the relative thermal stabilities of these hydrides change from HCl to HI.

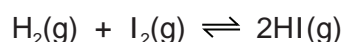
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(ii) Explain the variation you have outlined in (i).

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[3]

Hydrogen iodide can be made by heating together hydrogen gas and iodine vapour. The reaction is incomplete.



(b) Write an expression for K_c and state the units.

$K_c =$ units [2]

(c) For this equilibrium, the numerical value of the equilibrium constant K_c is 140 at 500K and 59 at 650 K.

Use this information to state and explain the effect of the following changes on the equilibrium position.

(i) increasing the pressure applied to the equilibrium

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.....

(ii) decreasing the temperature of the equilibrium

.....
.....

[4]

- (d) A mixture of 0.02 mol of hydrogen and 0.02 mol of iodine was placed in a 1 dm³ flask and allowed to come to equilibrium at 650 K.

Calculate the amount, in moles, of each substance present in the equilibrium mixture at 650 K.

	H ₂ (g)	I ₂ (g)	⇌	2HI(g)
initial moles	0.02	0.02		0

[4]

[Total: 13]

- 3 (a) Write down what you would see, and write equations for the reactions that occur, when

magnesium chloride, aluminium chloride and silicon tetrachloride are separately mixed with water.

magnesium chloride

.....
.....

aluminium chloride

.....
.....

silicon tetrachloride

.....
.....

[5]

- (b) Sodium chloride is traditionally added to a particular meat product. In response to the evidence that sodium chloride can lead to high blood pressure, the manufacturers have replaced the sodium chloride with a mixture of sodium and potassium chlorides. 100 g of the meat product usually contains about 2 g of the chloride mixture. A particular meat product contains 1.10 g of sodium chloride and 0.90 g potassium chloride in 100 g.

- (i) Calculate the number of moles of chloride ions in 100 g of this meat product.

The amount of chloride in the meat product can be found by titration with silver nitrate solution.

- (ii) Write the ionic equation, including state symbols, for the reaction between aqueous sodium chloride and aqueous silver nitrate.

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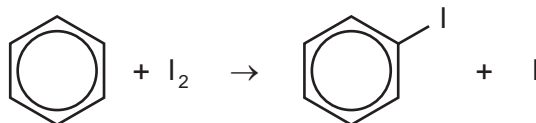
The chlorides from 100 g meat product are extracted into water and the solution made up to 1000 cm³ in a volumetric flask. A 10.0 cm³ portion of this solution is then titrated with 0.0200 mol dm⁻³ silver nitrate solution to precipitate the chloride.

- (iii) Calculate the volume of 0.0200 mol dm⁻³ silver nitrate solution that would be required if this titration were carried out on 100 g of the particular meat product described above.

[5]

(c) The iodination of benzene requires the presence of nitric acid.

- (i) Using bond enthalpies from the *Data Booklet*, calculate the enthalpy change for the following reaction.



- (ii) Nitric acid reacts with hydrogen iodide according to the following unbalanced equation.



Balance this equation, and describe how the oxidation numbers of nitrogen and iodine have changed during the reaction.

nitrogen

iodine

[4]

[Total: 14]

4 (a) The reaction producing tri-iodomethane (iodoform) can be used as a test for the presence of certain groups within a molecule.

(i) State the reagents and conditions used for this reaction.

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(ii) Write the structural formula of **one** functional group that would give a positive result with this iodoform reaction.

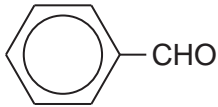
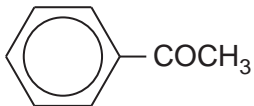
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(iii) What do you observe in a positive test?

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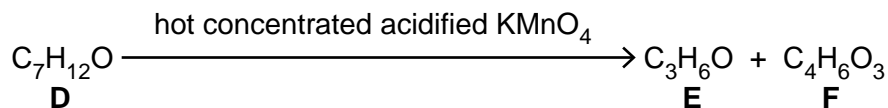
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(iv) In the following table place a tick (✓) in the column against each compound that would give a positive result with this test, and a cross (✗) against each compound that would give a negative result.

compound	result
CH ₃ OH	
CH ₃ CH ₂ OH	
CH ₃ CHO	
CH ₃ CO ₂ H	
 -CHO	
 -COCH ₃	

- (b) The iodoform test can be used, along with other reactions, to work out the structures of unknown compounds.

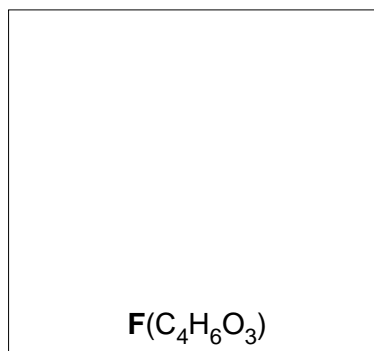
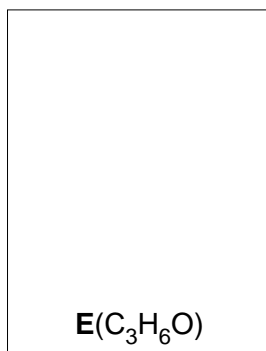
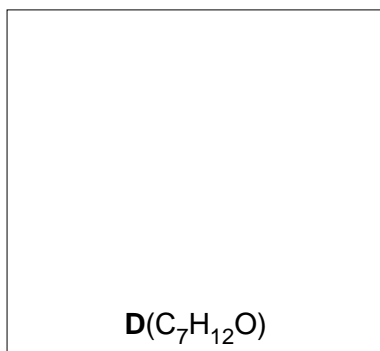
Use the information in the table below to deduce the structures of the compounds in the following scheme, and draw these structures in the boxes provided.



Results of tests (✓ indicates a positive result; ✗ indicates a negative result)

test	results of tests with each compound		
	D	E	F
iodoform	✗	✓	✓
Fehling's solution	✓	✗	✗
2,4-dinitrophenyl-hydrazine reagent	✓	✓	✓
Na ₂ CO ₃ (aq)	✗	✗	✓

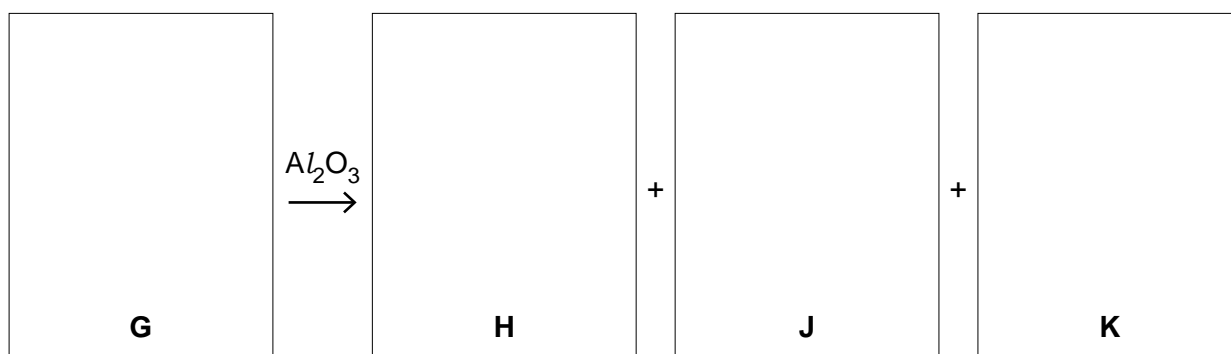
structures



[3]

- (c) Treatment of compound **F** with NaBH₄ gives compound **G**, C₄H₈O₃. Heating **G** with Al₂O₃ gives a mixture of three isomeric unsaturated carboxylic acids **H**, **J** and **K**, C₄H₆O₂, two of which are stereoisomers of each other.

Suggest structures for **G**, **H**, **J**, and **K**, and name the type of stereoisomerism shown.



type of stereoisomerism [5]

[Total: 14]