Surname	Centre Number	Candidate Number
Other Names		2

GCE A LEVEL – NEW

1410U50-1E

S17-1410U50-1E

CHEMISTRY – A2 unit 5
Practical Methods and Analysis Task

FRIDAY, 5 MAY 2017 – MORNING

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**14**	
2.	**8**	
3.	**8**	
Total	**30**	

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ADDITIONAL MATERIALS

In addition to this examination paper, you will need a:
- calculator, pencils and ruler;
- **Data Booklet** supplied by WJEC.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions in the spaces provided.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

The maximum mark for this paper is 30.

Your answers must be relevant and must make full use of the information given to be awarded full marks for a question.

If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

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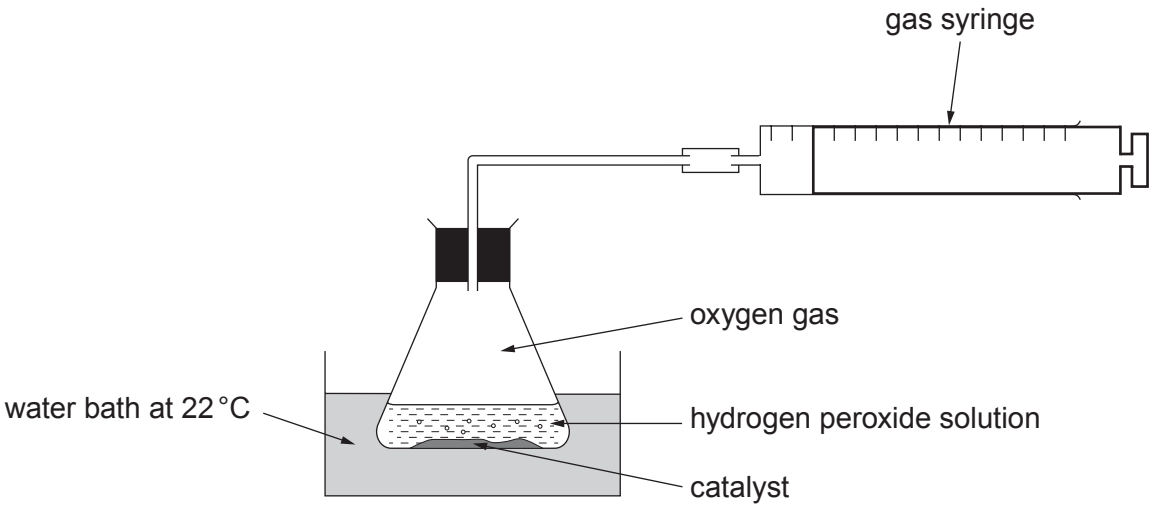
Answer **all** *questions.*

1. The apparatus shown below was used to measure the rate of formation of oxygen gas during the decomposition of a given volume of hydrogen peroxide solution of concentration 0.306 mol dm^{-3}. A catalyst of powdered manganese(IV) oxide was used.

$$2H_2O_2(aq) \longrightarrow 2H_2O(l) + O_2(g)$$



The oxygen gas was collected at a pressure of 1 atm and temperature of 22 °C. The volume collected over time was as follows.

Time / minutes	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
Volume / cm^3	0	22	42	62	71	80	88	91	92	93	93

(a) Calculate the volume of hydrogen peroxide solution used in this experiment. Include the appropriate **unit** in your answer. [3]

Volume = ...

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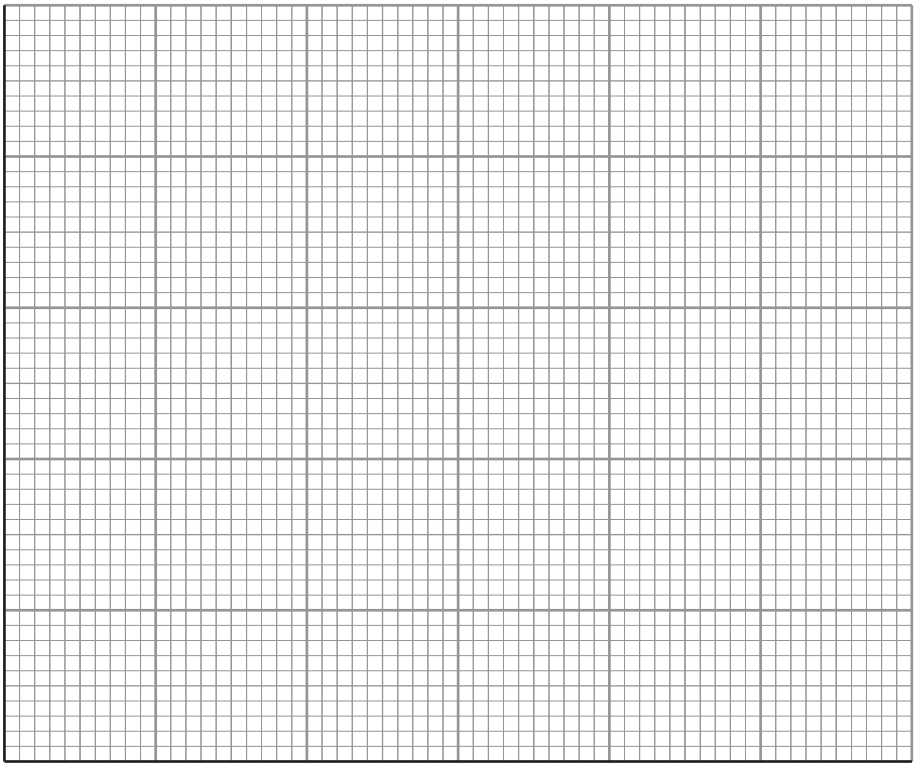
(b) (i) Plot the data given opposite on the grid below. Use the graph to calculate the initial rate of formation of oxygen in **$dm^3 s^{-1}$**. Give your answer in standard form.

You **must** show clearly how you obtained your answer. [5]



Initial rate = ... $dm^3 s^{-1}$

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(ii) Using the equation for the decomposition of hydrogen peroxide and the value calculated in part (i), deduce the initial rate of decomposition of hydrogen peroxide. Explain your reasoning. [2]

Rate of decomposition = ... $dm^3 s^{-1}$

.....

.....

(c) The rate equation for the decomposition of hydrogen peroxide is as follows.

$$\text{rate} = k\,[H_2O_2]^1$$

Explain how you could use the same apparatus to confirm experimentally that the decomposition of hydrogen peroxide follows first order kinetics.

Include an outline of the practical details and state how the data would confirm first order kinetics. [3]

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(d) Give an alternative method for following the rate of this reaction and state why this method would be suitable. [1]

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2. Hydrated chromium chloride has a molecular formula of $CrCl_3H_{12}O_6$ and a molar mass of 266.6 g mol^{-1}. It has the somewhat unusual property of existing in a number of octahedral isomers. These isomers differ in terms of the number of chloride ions and water molecules that are acting as ligands in the complex ion, and the number of chloride ions and water molecules that are not part of the complex ion.

Four possible isomers are

$\left[Cr(H_2O)_6 \right] Cl_3$ **I**

$\left[Cr(H_2O)_5Cl \right] Cl_2.H_2O$ **II**

$\left[Cr(H_2O)_4Cl_2 \right] Cl.2H_2O$ **III**

$\left[Cr(H_2O)_3Cl_3 \right].3H_2O$ **IV**

A chemist was provided with a solid compound, **W**, which is known to exist as one of the chromium chloride isomers shown above. After analysis the following results were obtained.

Method of analysis	Results
Method 1 Dissolve a small amount of compound **W** in water and add aqueous sodium hydroxide, initially drop by drop and then in excess.	• Green solution formed on dissolving in water • A grey/green gelatinous precipitate was formed on addition of a few drops of aqueous sodium hydroxide • The precipitate dissolved in excess aqueous sodium hydroxide to form a dark green solution
Method 2 Dissolve 13.33 g of compound **W** in water and add excess aqueous silver nitrate. Filter the silver chloride that is precipitated, wash with a small volume of water to remove surface impurities and heat to constant mass.	• 7.18 g of silver chloride were obtained

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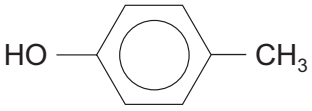
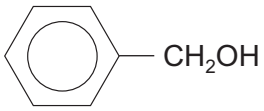
Use **all** this information to identify compound **W** and hence draw a structure for the octahedral complex ion.

In your answer you should make it clear how your explanation is linked to the results and give **ionic** equations for the reactions taking place. [8]

3. You are asked to distinguish between the following four pairs of compounds. The compounds in each pair are isomeric.

Pair	Compounds
1	$CH_3CH=CHCH_2OH$ and $CH_3COCH_2CH_3$
2	$CH_3CH_2CH_2CO_2H$ and $CH_3CH_2COOCH_3$
3	 and 
4	$CH_3CH_2CH_2CO_2H$ and $CH_3COCH(OH)CH_3$

You have access to the following reagents **only** and each reagent may be used to distinguish between **one pair** of compounds **only**.

Reagents	
2,4-dinitrophenylhydrazine (2,4-DNPH)	$Br_2(aq)$
$I_2(aq)$ / NaOH(aq) or KI(aq) / NaClO(aq)	$Na_2CO_3(s)$

For each pair, identify the reagent(s) you would use and the observations that you would make for **both** compounds. [8]

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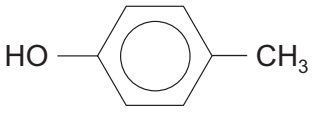
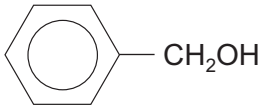
Pair	Compound	Reagent(s)	Observation
1	$CH_3CH=CHCH_2OH$		
	$CH_3COCH_2CH_3$		
2	$CH_3CH_2CH_2CO_2H$		
	$CH_3CH_2COOCH_3$		
3			
			
4	$CH_3CH_2CH_2CO_2H$		
	$CH_3COCH(OH)CH_3$		

END OF PAPER

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