

Please check the examination details below before entering your candidate information

Candidate surname

Other names

Pearson Edexcel
International
Advanced Level

Centre Number

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Candidate Number

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Friday 18 January 2019

Afternoon (Time: 1 hour 15 minutes)

Paper Reference **WCH03/01**

Chemistry

Advanced

Unit 3: Chemistry Laboratory Skills I

Candidates must have: Scientific calculator

Total Marks

Instructions

- Use **black** ink or **black** ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
– *there may be more space than you need.*

Information

- The total mark for this paper is 50.
- The marks for **each** question are shown in brackets
– *use this as a guide as to how much time to spend on each question.*
- You will be assessed on your ability to organise and present information, ideas, descriptions and arguments clearly and logically, including your use of grammar, punctuation and spelling.
- A Periodic Table is printed on the back cover of this paper.

Advice

- Read each question carefully before you start to answer it.
- Show all your working in calculations and include units where appropriate.
- Check your answers if you have time at the end.

Turn over ►

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Pearson

Answer ALL the questions. Write your answers in the spaces provided.

1 A white solid **A** contains one cation and one anion.

- (a) A small amount of solid **A** was placed in a test tube and aqueous sodium hydroxide added. The mixture was warmed gently. Complete the inference column in the table.

(2)

Observation	Inference
A pungent smelling gas was evolved that turned damp red litmus paper blue	The gas formed is The formula of the cation in A is

- (b) (i) An aqueous solution of **A** was placed in a test tube and acidified with dilute nitric acid. A few drops of silver nitrate solution were added. Complete the inference column in the table.

(1)

Observation	Inference
Cream precipitate formed	The precipitate is

- (ii) Write the **ionic** equation, including state symbols, for the formation of the cream precipitate in (b)(i).

(2)

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(iii) Describe how you would confirm the identity of the **anion** in the cream precipitate formed in (b)(i).

(2)

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(Total for Question 1 = 7 marks)

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2 (a) A student was provided with aqueous solutions of four compounds:

barium nitrate

hydrochloric acid

sodium carbonate

sulfuric acid

Four bottles, labelled **B**, **C**, **D** and **E**, each contained one of the solutions. The student mixed pairs of the solutions to determine which solution was in each bottle.

The results are shown.

Solutions mixed	Observations
B and C	Effervescence with bubbles of a colourless gas given off
B and D	No visible change
B and E	A white precipitate formed which did not dissolve on the addition of dilute nitric acid
C and D	Effervescence with bubbles of a colourless gas given off
C and E	A white precipitate formed which dissolved with effervescence on the addition of dilute nitric acid
D and E	No visible change

Use the observations in the table to deduce the identity of the compound in each bottle. Identify each compound by name or formula.

B

C

D

E

(3)



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(b) (i) The identity of the **cations** present in barium nitrate and sodium carbonate can be confirmed with a flame test on the solid compounds.

Describe how you would carry out a flame test.

(3)

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(ii) State the flame colours produced by barium nitrate and sodium carbonate.

Barium nitrate

Sodium carbonate

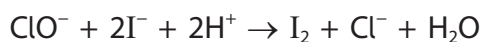
(2)

(Total for Question 2 = 8 marks)

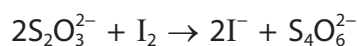


- 3 Chlorine-based bleaches contain sodium chlorate(I), NaClO, as the active ingredient. The concentration of NaClO in bleach was determined by a titration method using sodium thiosulfate.

Sodium chlorate(I) reacted with potassium iodide in acidic solution to produce iodine.



The iodine was then titrated with sodium thiosulfate.



Procedure

1. A burette was filled with $0.0600 \text{ mol dm}^{-3}$ sodium thiosulfate solution.
2. 10.0 cm^3 of bleach was pipetted into a 250.0 cm^3 volumetric flask and excess potassium iodide and sulfuric acid were added to release iodine. The volume was made up to the mark with distilled water.
3. 25.0 cm^3 of this solution was pipetted into a conical flask and titrated with the sodium thiosulfate solution using a suitable indicator.

- (a) State the indicator used and give the colour change at the end-point.

(2)

Indicator	Colour change at the end-point
.....	From to



(b) (i) Complete the table of results.

(1)

Number of titration	1	2	3	4
Burette reading (final) / cm ³	23.65	46.45	24.40	47.10
Burette reading (start) / cm ³	0.00	23.65	1.20	24.40
Titre / cm ³				

(ii) State with a reason which results should be used to calculate the mean titre value.

(2)

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(iii) Calculate the mean titre.

(1)

(iv) Calculate the number of moles of sodium thiosulfate in this mean titre.

(1)

(v) Calculate the number of moles of iodine in 25.0 cm³ of the diluted solution.

(1)

(vi) Calculate the number of moles of sodium chlorate(I) in the 250.0 cm³ volumetric flask.

(1)

(vii) Calculate the concentration of sodium chlorate(I) in the **undiluted** bleach in mol dm⁻³.

(1)

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(c) The $0.0600 \text{ mol dm}^{-3}$ sodium thiosulfate solution used in this titration is known as a standard solution.

Describe the steps you would take to prepare this standard solution as accurately as possible. You are supplied with the appropriate mass of sodium thiosulfate and the usual laboratory glassware, including a volumetric flask.

No calculations are required.

(3)

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(Total for Question 3 = 13 marks)



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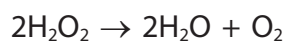
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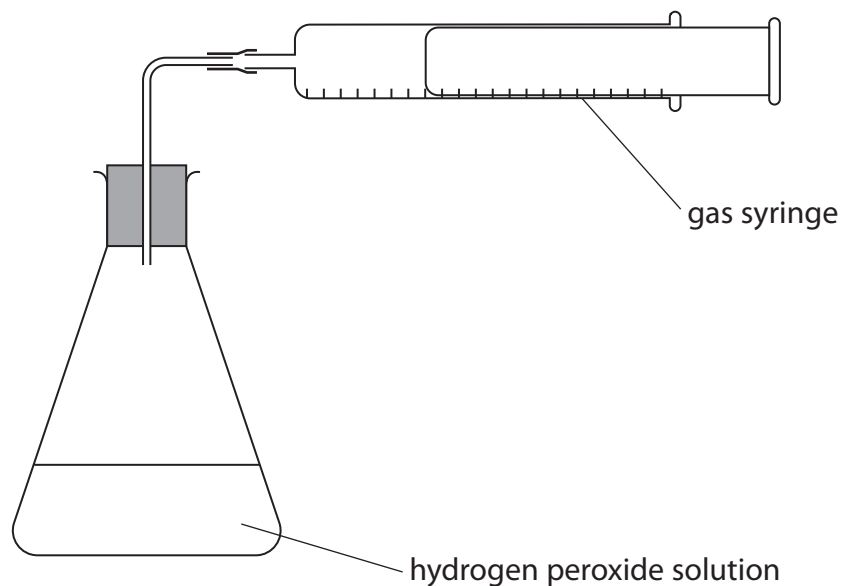
4 Hydrogen peroxide, H_2O_2 , decomposes according to the equation



The rate of decomposition is increased by a catalyst.

A student tested three metal oxides to determine which was the best catalyst. The oxides were manganese(IV) oxide, iron(III) oxide and lead(IV) oxide. They are all solids.

The student used the following apparatus and experimental procedure.



Procedure

1. Hydrogen peroxide solution was poured into the conical flask.
2. Solid manganese(IV) oxide was added.
3. The bung was quickly replaced to connect the gas syringe to the conical flask.
4. The procedure was repeated using iron(III) oxide and lead(IV) oxide.



(a) Suggest **three** things you would do to ensure that the metal oxides are compared fairly, when using this procedure.

(3)

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2

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3

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(b) State the measurements the student should make to determine which is the best catalyst.

(2)

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(c) The student thought that some of the gas escaped from the conical flask before the bung had been replaced.

Suggest how this experiment could be modified to prevent this loss.

(1)

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(d) Another student thought that some of the oxygen produced may have come from the decomposition of the metal oxide.

Suggest how this idea could be tested.

(2)

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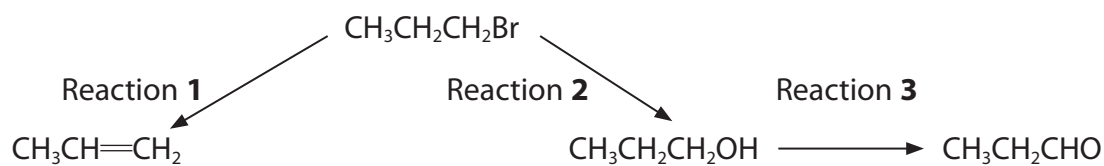
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(Total for Question 4 = 8 marks)



5 Some organic reactions are shown.



(a) Reaction 1 and Reaction 2 use the same reagent but require different conditions.

Identify the reagent and give the conditions needed for Reaction 1.

(2)

(b) (i) Give a chemical test and its positive result to show the presence of the double bond in $\text{CH}_3\text{CH}=\text{CH}_2$.

(2)

(ii) Give the structure of the organic product of the test in (b)(i).

(1)



(c) A student added phosphorus(V) chloride, PCl_5 , to the product of Reaction 2, $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$. Hydrogen chloride was formed.

(i) State the observation the student would be expected to make.

(1)

(ii) Complete the table to show the hazard and the appropriate safety precaution for each chemical.

Do not include the wearing of eye protection and a laboratory coat.

(3)

Chemical	Hazard	Safety precaution
PCl_5		
$\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$		
HCl		

(d) In Reaction 3, $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ is oxidised to $\text{CH}_3\text{CH}_2\text{CHO}$ using aqueous potassium dichromate(VI) acidified with sulfuric acid.

(i) State the colour **change** that occurs during this oxidation reaction.

(1)



(ii) Draw a labelled diagram of the apparatus you would use to carry out Reaction 3 and collect the product.

(3)

(iii) Explain how infrared spectroscopy could be used to confirm that **all** the $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ has been oxidised to $\text{CH}_3\text{CH}_2\text{CHO}$ in Reaction 3. You are not expected to give specific wavenumbers.

(1)

(Total for Question 5 = 14 marks)

TOTAL FOR PAPER = 50 MARKS

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The Periodic Table of Elements

1 2 3 4 5 6 7 0 (8) (18)

1.0	H	hydrogen	1
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Key

relative atomic mass
atomic symbol
name
atomic (proton) number

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)																										
6.9 Li lithium 3	9.0 Be beryllium 4	23.0 Na sodium 11	24.3 Mg magnesium 12	39.1 K potassium 19	40.1 Ca calcium 20	85.5 Rb rubidium 37	87.6 Sr strontium 38	132.9 Cs caesium 55	137.3 Ba barium 56	[223] Fr francium 87	[226] Ra radium 88	[227] Ac* actinium 89	[227] La* lanthanum 57	[261] Rf rutherfordium 104	[262] Db dubnium 105	[266] Sg seaborgium 106	[277] Hs hassium 108	[268] Mt meitnerium 109	[271] Ds darmstadtium 110	[272] Rg roentgenium 111	10.8 B boron 5	12.0 C carbon 6	27.0 Al aluminium 13	28.1 Si silicon 14	69.7 Ga gallium 31	72.6 Ge germanium 32	114.8 In indium 49	118.7 Sn tin 50	127.6 Te tellurium 52	157.3 Xe xenon 54	162.0 Ne neon 10	19.0 F fluorine 9	35.5 Cl chlorine 17	39.9 Ar argon 18	79.9 Br bromine 35	79.0 Se selenium 34	126.9 I iodine 53	127.6 Te tellurium 52	207.2 Pb lead 82	204.4 Tl thallium 81	209.0 Po polonium 84	210 At astatine 85	[222] Rn radon 86

Elements with atomic numbers 112-116 have been reported but not fully authenticated

140	141	144	150	152	157	163	165	167	169	173	175
Ce cerium 58	Pr praseodymium 59	Nd neodymium 60	Sm samarium 62	Eu europium 63	Gd gadolinium 64	Dy dysprosium 66	Ho holmium 67	Er erbium 68	Tm thulium 69	Yb ytterbium 70	Lu lutetium 71
232	[231]	238	[242]	[243]	[247]	[251]	[254]	[253]	[256]	[254]	[257]
Th thorium 90	Pa protactinium 91	U uranium 92	Pu plutonium 94	Am americium 95	Cm curium 96	Cf californium 98	Es einsteinium 99	Fm fermium 100	Md mendelevium 101	No nobelium 102	Lr lawrencium 103

* Lanthanide series

* Actinide series

