Paper Reference(s) **WCH03/01**

Pearson Edexcel
International Advanced Level

Chemistry
Advanced Subsidiary
Unit 3: Chemistry Laboratory Skills I

Friday 18 January 2019 – Afternoon

Time: 1 hour 15 minutes plus your additional time allowance

INSTRUCTIONS TO CANDIDATES
Write your centre number, candidate number, surname, other names and your signature in the boxes below. Check that you have the correct question paper.

Centre No.							
Candidate No.							
Surname							
Other names							
Signature							
Paper Reference	W	C	H	0	3	/	0	1

- Use BLACK ink or BLACK ball-point pen.
- Answer ALL questions.
- Answer the questions in the spaces provided – there may be more space than you need.

MATERIALS REQUIRED FOR EXAMINATION

Scientific calculator

ITEMS INCLUDED WITH QUESTION PAPERS

Periodic Table

INFORMATION FOR CANDIDATES

- 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.

ADVICE TO CANDIDATES

- 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.

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 marks)

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 _____ _____

(Question continues on next page)

(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 mark)

Observation	Inference
Cream precipitate formed	The precipitate is _____ _____

(Question continues on next page)

(ii) Write the IONIC equation, including state symbols, for the formation of the cream precipitate in (b)(i). (2 marks)

(Question continues on next page)

(iii) Describe how you would confirm the identity of the ANION in the cream precipitate formed in (b)(i). (2 marks)

(TOTAL FOR QUESTION 1 = 7 MARKS)

(Questions continue on next page)

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.

(Question continues on next page)

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.

(3 marks)

B _____

C _____

D _____

E _____

(Question continues on next page)

(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 marks)

(Question continues on next page)

(ii) State the flame colours produced by barium nitrate and sodium carbonate. (2 marks)

Barium nitrate _____

Sodium carbonate _____

(TOTAL FOR QUESTION 2 = 8 MARKS)

(Questions continue on next page)

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.

$$ClO^- + 2I^- + 2H^+ \longrightarrow I_2 + Cl^- + H_2O$$

The iodine was then titrated with sodium thiosulfate.

$$2S_2O_3^{2-} + I_2 \longrightarrow 2I^- + S_4O_6^{2-}$$

PROCEDURE

1. A burette was filled with $0{\cdot}0600\,mol\,dm^{-3}$ sodium thiosulfate solution.

2. $10{\cdot}0\,cm^3$ of bleach was pipetted into a $250{\cdot}0\,cm^3$ 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. $25{\cdot}0\,cm^3$ of this solution was pipetted into a conical flask and titrated with the sodium thiosulfate solution using a suitable indicator.

(Question continues on next page)

(a) State the indicator used and give the colour change at the end-point. (2 marks)

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

(b) (i) Complete the table of results. (1 mark)

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				

(Question continues on next page)

(ii) State with a reason which results should be used to calculate the mean titre value. (2 marks)

(iii) Calculate the mean titre. (1 mark)

(iv) Calculate the number of moles of sodium thiosulfate in this mean titre. (1 mark)

(Question continues on next page)

(v) Calculate the number of moles of iodine in 25·0 cm^3 of the diluted solution. (1 mark)

(vi) Calculate the number of moles of sodium chlorate(I) in the 250·0 cm^3 volumetric flask. (1 mark)

(vii) Calculate the concentration of sodium chlorate(I) in the UNDILUTED bleach in $mol\,dm^{-3}$. (1 mark)

(Question continues on next page)

(c) The 0·0600 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 marks)

(TOTAL FOR QUESTION 3 = 13 MARKS)

(Questions continue on next page)

4 Hydrogen peroxide, H_2O_2, decomposes according to the equation

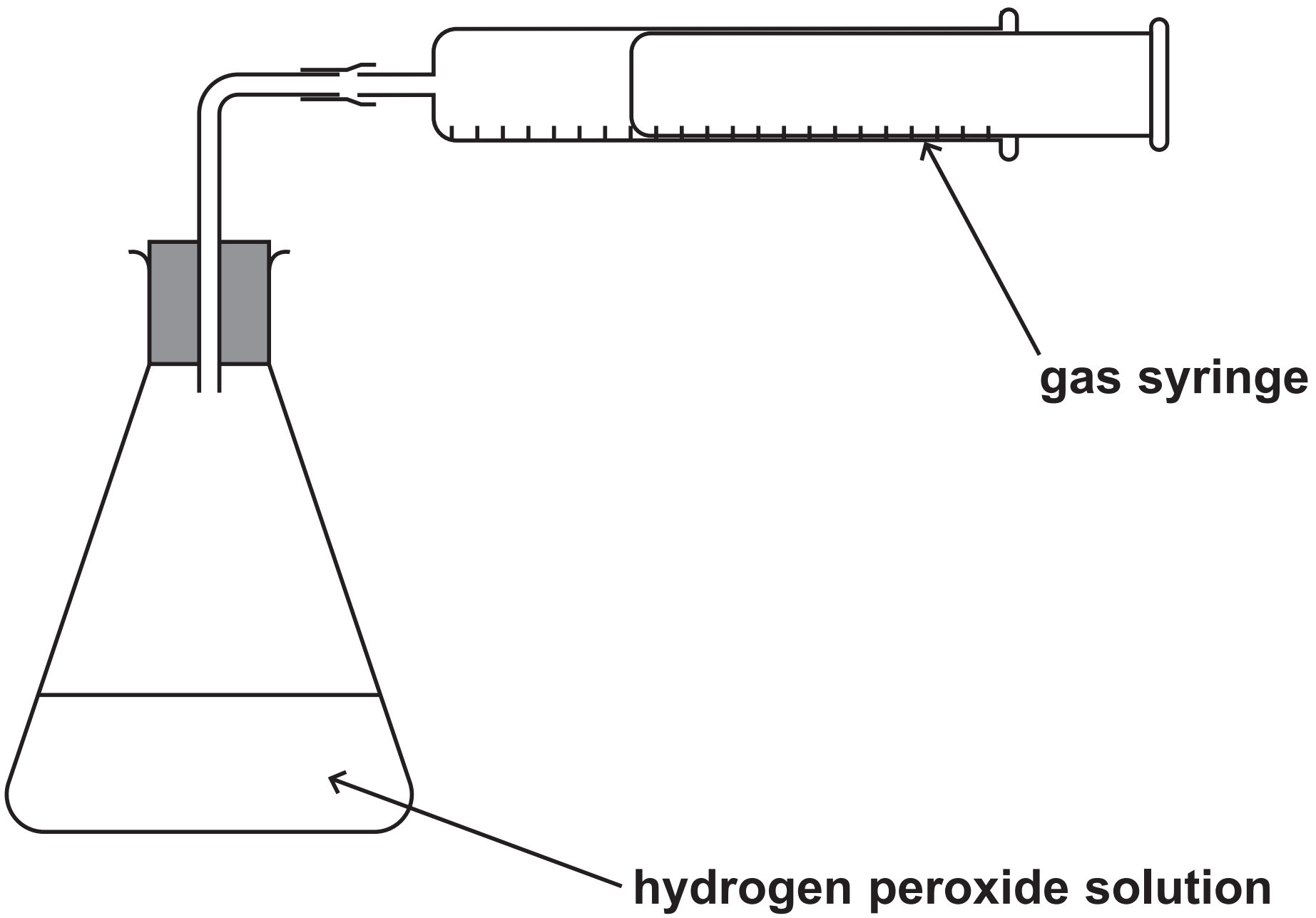
$$2H_2O_2 \longrightarrow 2H_2O + O_2$$

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.



(Question continues on next page)

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.

(Question continues on next page)

(a) **Suggest THREE things you would do to ensure that the metal oxides are compared fairly, when using this procedure. (3 marks)**

1 _____

_____

_____

_____

2 _____

_____

_____

_____

3 _____

_____

_____

_____

_____

(Question continues on next page)

(b) State the measurements the student should make to determine which is the best catalyst. (2 marks)

(Question continues on next page)

(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 mark)

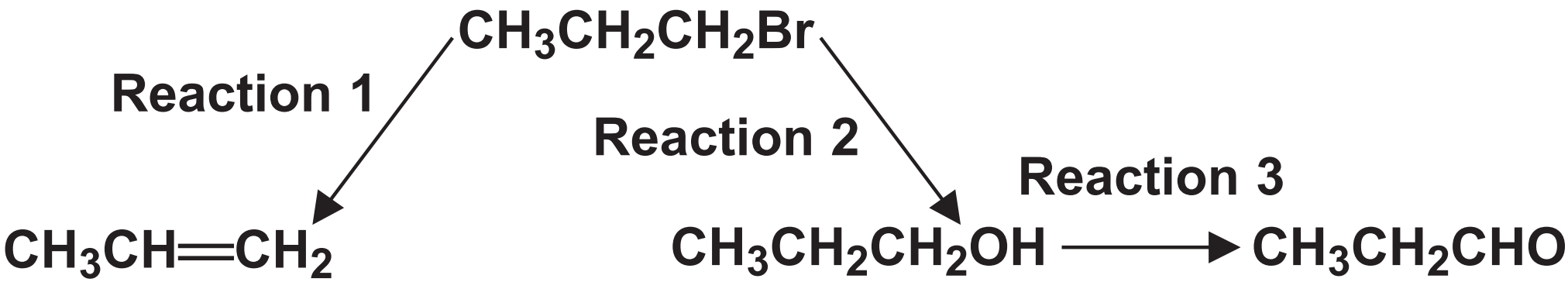
(Question continues on next page)

(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 marks)

(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 marks)

(b) (i) Give a chemical test and its positive result to show the presence of the double bond in $CH_3CH{=}CH_2$. (2 marks)

(ii) Give the structure of the organic product of the test in (b)(i). (1 mark)

(Question continues on next page)

(Turn over)

(c) A student added phosphorus(V) chloride, PCl_5, to the product of Reaction 2, $CH_3CH_2CH_2OH$. Hydrogen chloride was formed.

(i) State the observation the student would be expected to make. (1 mark)

(Question continues on next page)

(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 marks)

Chemical	Hazard	Safety precaution
PCl_5		
$CH_3CH_2CH_2OH$		
HCl		

(Question continues on next page)

(d) In Reaction 3, $CH_3CH_2CH_2OH$ is oxidised to CH_3CH_2CHO using aqueous potassium dichromate(VI) acidified with sulfuric acid.

(i) State the colour CHANGE that occurs during this oxidation reaction. (1 mark)

(Question continues on next page)

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

(Question continues on next page)

(iii) Explain how infrared spectroscopy could be used to confirm that ALL the $CH_3CH_2CH_2OH$ has been oxidised to CH_3CH_2CHO in Reaction 3.
You are not expected to give specific wavenumbers. (1 mark)

(TOTAL FOR QUESTION 5 = 14 MARKS)

TOTAL FOR PAPER = 50 MARKS