Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Time 1 hour 20 minutes

Paper reference **WCH13/01**

Chemistry

International Advanced Subsidiary/Advanced Level
UNIT 3: Practical Skills in Chemistry I

You must have:
Scientific calculator, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **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.
- Try to answer every question.
- 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 student is asked to identify an organic liquid **P** and an inorganic solid **Q**.

(a) **P** has the molecular formula C_6H_{12}. **P** is a straight-chain molecule that contains **one** functional group.

Bromine water is decolourised when shaken with **P**.

Identify the functional group present in **P**, giving a possible name for the compound.

(2)

Functional group

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Name

.....

(b) **Q** is a Group **1** halide which produces a lilac colour in a flame test.

When a few drops of dilute nitric acid and aqueous silver nitrate are added to a solution of **Q**, a yellow precipitate is formed.

Identify, by name or formula, the ions present in **Q**.

(2)

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(c) When a few drops of dilute bromine water are added to an aqueous solution of **Q**, a red-brown solution is formed.

(i) Give an ionic equation for this reaction. Include state symbols.

(2)

(ii) A portion of the organic liquid **P** is added to the red-brown aqueous solution formed in (c)(i).
The mixture is shaken and then allowed to stand for several minutes.

State what **observations** would be expected, including any changes in colour.

(3)

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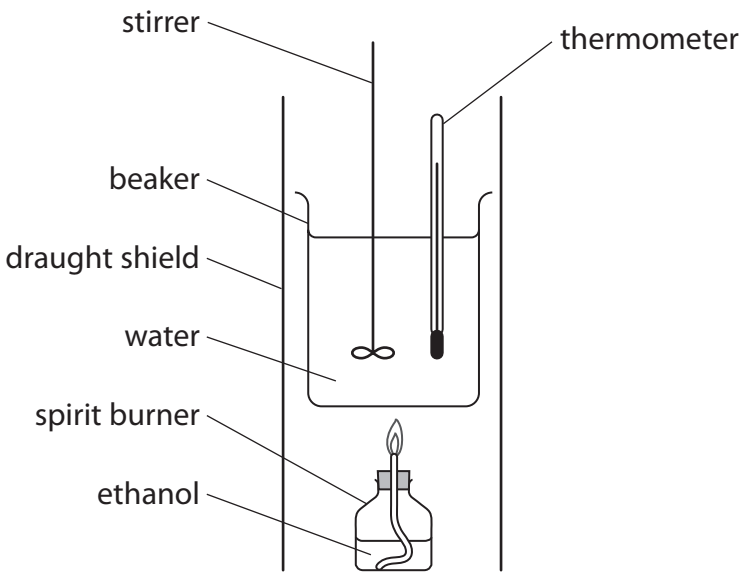
(Total for Question 1 = 9 marks)

2 In an experiment to measure the enthalpy change of combustion of ethanol, a student uses the apparatus shown.



(a) (i) Give a reason why it is important to shield the apparatus from draughts.

(1)

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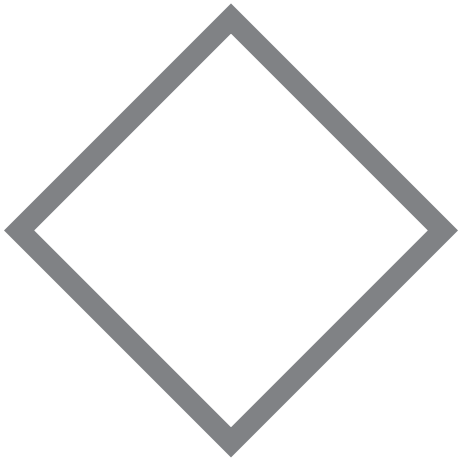
(ii) Draw the hazard symbol which should be on a bottle of ethanol.

(1)



(b) A student devised the procedure shown to determine the enthalpy change of combustion for ethanol.

- 150 cm^3 of water is placed in the beaker and its temperature recorded
- the burner containing ethanol is weighed, placed under the beaker of water and then lit
- after 5 minutes the burner is removed
- the temperature of the water in the beaker is recorded again
- the flame is extinguished, and the burner and its contents are reweighed.

(i) The student's results are shown.

Quantity	Value
Final water temperature / °C	29.1
Initial water temperature / °C	21.8
Temperature change / °C	
Mass of burner + ethanol before burning / g	158.13
Mass of burner + ethanol after burning / g	157.81
Mass of ethanol burned / g	

Complete the table.

(1)

(ii) Calculate the enthalpy change of combustion of ethanol in $kJ\,mol^{-1}$, using the student's results.

Give your answer to an appropriate number of significant figures and include a sign.

Data

Specific heat capacity of water = $4.18\,J\,g^{-1}\,°C^{-1}$
Density of water = $1.00\,g\,cm^{-3}$
Molar mass of ethanol = $46.0\,g\,mol^{-1}$

(3)

(iii) In this procedure, after removing the burner there is a delay before the flame is extinguished.

Explain the effect of this delay on the value of the enthalpy change of combustion of ethanol determined in the experiment.

(2)

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(iv) The uncertainty in each reading of the thermometer was ±0.1°C.

Calculate the percentage uncertainty in the temperature **change** in the student's experiment.

(1)

(c) The student repeated the experiment using the same apparatus, in an attempt to improve its accuracy. The water was heated for 15 minutes before measuring the final temperature and reweighing the burner.

The data book value for the standard enthalpy change of combustion of ethanol is $-1367\ kJ\ mol^{-1}$.

The teacher said that the changes would improve the percentage uncertainty in the measurement of mass and temperature but have little effect on the accuracy of the value obtained.

(i) State how the changes in the experiment improve the percentage uncertainties in the measurement of mass and temperature. No calculation is required.

(1)

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(ii) Explain how the difference between uncertainty and accuracy led the teacher to make this statement.

(2)

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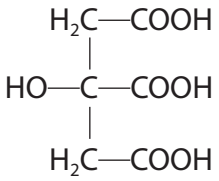
(Total for Question 2 = 12 marks)

3 Citric acid is used as a descaler to remove limescale from kettles and coffee machines.



citric acid

A student determined the concentration of a citric acid descaler, labelled solution **A**, which had a stated concentration of 200 g dm^{-3}.

(a) Solution **A** was diluted by a factor of 10 and then used in a titration with a solution of sodium hydroxide of concentration 0.267 mol dm^{-3}.

Procedure

Step **1** Using a pipette, 25.0 cm^3 of solution **A** was transferred to a 250.0 cm^3 volumetric flask. The solution was then made up to the mark with deionised water, inverted several times and labelled solution **B**.

Step **2** A clean pipette was used to transfer a 25.0 cm^3 portion of solution **B** to a conical flask.

Step **3** A few drops of phenolphthalein indicator were added to the conical flask and the contents titrated with the sodium hydroxide solution. This step was repeated until concordant results were obtained.

(i) In Step **1**, the student rinsed both the pipette and the volumetric flask with deionised water before transferring 25.0 cm^3 of solution **A**.

State the effect, if any, of these changes in procedure on the concentration of solution **B**.

(2)

Pipette

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Volumetric flask

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(ii) Give a reason why the student inverted the volumetric flask several times in Step **1**.

(1)

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(iii) The sodium hydroxide solution was labelled with the hazard label.

The student wore safety glasses and placed the burette below head height while filling it with sodium hydroxide solution.

State why the student took these precautions.

(2)

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(iv) State the colour change of the phenolphthalein indicator at the end-point of the titration in Step **3**.

(2)

From ..... to .....

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(v) The results of the student's experiment are shown.

Titration	Trial	1	2	3	4
Final volume / cm^3	29.25	33.25	32.00	29.50	28.90
Initial volume / cm^3	0.00	4.50	3.15	0.80	0.00
Volume added / cm^3	29.25	28.75			28.90

Complete the table and calculate the mean titre, using all concordant values.

(1)

(vi) Give a reason why the student did not need to carry out titrations 3 and 4.

(1)

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(vii) Give a reason why solution **A** was diluted before titrating it with this sodium hydroxide solution.

(1)

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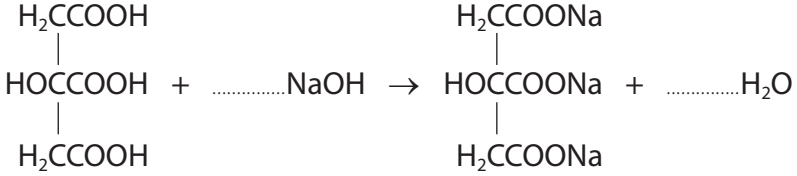
(b) (i) The unbalanced equation for the reaction between citric acid and sodium hydroxide is shown.



Complete the equation. State symbols are not required.

(1)

(ii) Calculate the concentration of citric acid in solution **A** in g dm^{-3}, using the equation from (b)(i) and the results from (a)(v).
Give your answer to **three** significant figures.

Data

Concentration of the sodium hydroxide solution = 0.267 mol dm^{-3}
Molar mass of citric acid = 192 g mol^{-1}

(5)

(iii) Using the result of the experiment, the student concluded that the stated concentration of the descaler (200 g dm^{-3}) was incorrect.

State whether or not this difference in concentration would affect the use of the descaler solution to remove limescale in kettles and coffee machines.
Justify your answer.

(2)

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(Total for Question 3 = 18 marks)

4 The alcohols **K, L** and **M** are isomers of butan-1-ol, C_4H_9OH.

(a) Give a chemical test, with the expected result, which would show the presence of the –OH group in **any** alcohol.

(2)

Test

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Result

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(b) (i) A sample of butan-1-ol is warmed with a solution of potassium dichromate(VI) in dilute sulfuric acid.

State the colour **change** which would be observed.

(2)

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(ii) The three isomers **K**, **L** and **M** are warmed separately with portions of a solution of potassium dichromate(VI) in dilute sulfuric acid.
No colour change is observed with isomer **K**.

Identify isomer **K** by name or formula.

(1)

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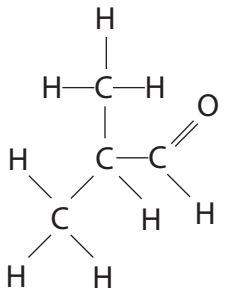
(iii) The other isomers **L** and **M** are oxidised when warmed with a solution of potassium dichromate(VI) in dilute sulfuric acid.

Complete the table to show the displayed formulae of these two isomers and the product of this oxidation reaction of isomer **L**.

(3)

Isomer	Displayed formula of isomer	Displayed formula of a product of the oxidation reaction
L		
M		

(iv) Give one **chemical** test, with the expected results, which would distinguish these oxidation products of isomers **L** and **M**.

(3)

Test

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Result for oxidation product of isomer **L**

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Result for oxidation product of isomer **M**

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(Total for Question 4 = 11 marks)

TOTAL FOR PAPER = 50 MARKS