Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Monday 22 January 2024

Afternoon (Time: 1 hour 20 minutes)

Paper reference **WCH13/01**

Chemistry

International 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.*
- Show all your working in calculations and include units where appropriate.

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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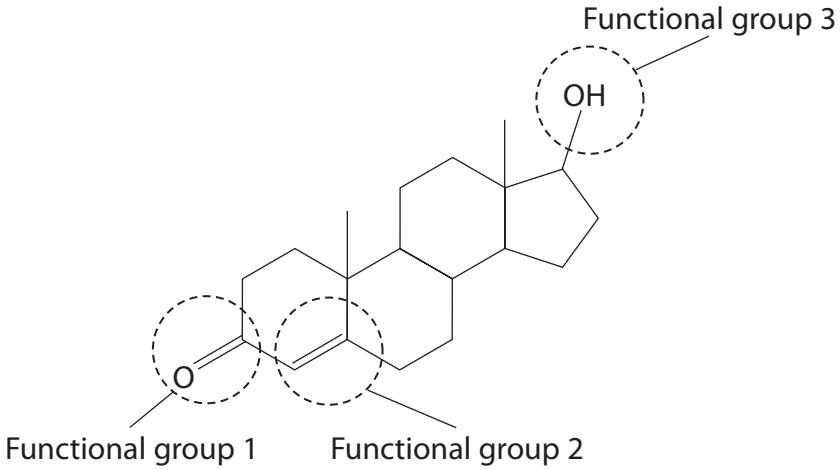
P 7 5 5 9 3 A 0 1 2 0

Pearson

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

1 This question is about the hormone testosterone, the structure of which is shown.



(a) Give the **name** of each of the three circled functional groups.

(3)

Functional group 1

.....

Functional group 2

.....

Functional group 3

.....

(b) Describe a chemical test and the expected positive result for both functional group 2 and functional group 3.

(4)

Functional group 2

Test

.....

.....

Result

.....

.....

Functional group 3

Test

.....

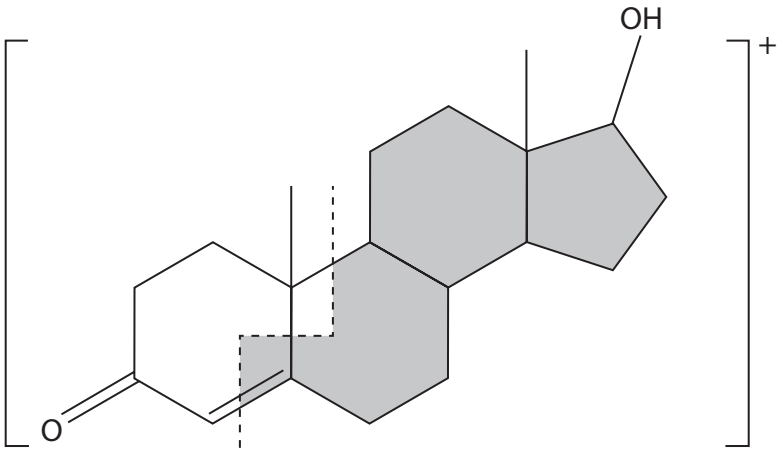
.....

Result

.....

.....

(c) In a mass spectrometer, the molecular ion formed can break apart into smaller fragments. One way the molecular ion can fragment is shown by the dashed line.



(i) Deduce the *m*/*z* ratio of the fragment shown by the **unshaded** area, assuming it forms a singly charged ion.

(1)

.....

(ii) When molecular ions fragment, they form a smaller ion and another type of particle.

State the other type of particle formed.

(1)

.....

(Total for Question 1 = 9 marks)

2 An experiment was carried out to determine the concentration of citric acid in lemon juice using a titration.

Three students used the following procedure.

Procedure

Step **1** Add 24.0 g of lemon juice to a 250 cm^3 volumetric flask.

Step **2** Make up the volume of the lemon juice to 250 cm^3 using deionised water and mix thoroughly.

Step **3** Pipette 25.0 cm^3 of the diluted lemon juice into a conical flask and add a few drops of phenolphthalein indicator.

Step **4** Titrate the diluted lemon juice with standardised sodium hydroxide of concentration 0.103 mol dm^{-3}.

Student **A** obtained the results shown.

Titration	Rough	1	2	3
Burette reading (final) / cm^3	24.60	48.90	23.80	48.00
Burette reading (initial) / cm^3	0.00	24.60	0.00	23.80
Titre / cm^3	24.60	24.30	23.80	24.20

(a) Draw a circle around the concordant results in the table.

(1)

(b) Calculate the mean titre, using your answer from (a).

(1)

(c) The equation for the reaction between citric acid and sodium hydroxide solution is shown.

$$C_6H_8O_7(aq) + 3NaOH(aq) \rightarrow Na_3C_6H_5O_7(aq) + 3H_2O(l)$$

(i) State the colour change that occurs at the end-point of the titration.

(1)

.....

(ii) Calculate the percentage by mass of citric acid in the lemon juice, using your mean titre from (b).
Give your answer to **two** significant figures.

[Concentration of NaOH(aq) = 0.103 mol dm^{-3} M_r of citric acid = 192]

(5)

(d) Suggest a possible reason why the value obtained in (c) is valid, even though lemon juice also contains some ascorbic acid and malic acid.

(1)

.....

.....

(e) Two other students, **B** and **C**, also followed the procedure to find the concentration of citric acid in similar samples of lemon juice.

(i) Student **B** added too much deionised water in Step **2**.

State how Student **B** should correct this mistake.

(1)

.....

.....

.....

(ii) Student **C** used sodium hydroxide solution labelled 0.103 mol dm^{-3} that had been made up several months ago and stored since then.

Explain what effect this would have on the mean titre, compared to Student **A**.

(2)

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(Total for Question 2 = 12 marks)

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3 Seaweeds absorb iodide compounds from seawater. If seaweeds are dried and heated strongly, iodine can be obtained from the ash produced.

Procedure

Step **1** Heat the dried seaweed strongly to burn off any organic material.

Step **2** Add the ash produced in Step **1** to 25 cm^3 of deionised water and boil for 5 minutes.

Step **3** Filter off the remaining solid, collecting the colourless filtrate containing iodide ions.

Step **4** Add 2 cm^3 of dilute sulfuric acid, followed by 10 cm^3 of '20 volume' hydrogen peroxide solution, $H_2O_2(aq)$.

Step **5** Extract the iodine formed in Step **4** using cyclohexane as the solvent.

Step **6** Allow the cyclohexane to evaporate to leave behind iodine crystals.

(a) Suggest why the iodine-containing compounds do not burn off in Step **1**.

(1)

.....

.....

(b) '20 volume' hydrogen peroxide solution means that 1 dm^3 of the solution produces 20 dm^3 of oxygen gas when it decomposes completely.

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

Calculate the concentration of '20 volume' hydrogen peroxide solution in mol dm^{-3}.

[Molar volume of a gas at room temperature and pressure (r.t.p.) = 24 dm^3 mol^{-1}]

(2)

(c) In Step **4**, the iodide ions in the filtrate are oxidised to form iodine.
The reaction takes place under acidic conditions and the hydrogen peroxide is reduced to form a single product, water.

(i) Write half-equations for each of these changes.
State symbols are not required.

(2)

Oxidation of iodide ions:

Reduction of hydrogen peroxide under acidic conditions:

(ii) Write the overall equation for the reaction between iodide ions and hydrogen peroxide solution under acidic conditions.
State symbols are not required.

(1)

(iii) State the colour of the aqueous iodine solution formed in Step **4**.

(1)

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(d) Describe how to carry out Step **5**, using a separating funnel.

[Density of cyclohexane = 0.78 g cm^{-3}]

(4)

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DO NOT WRITE IN THIS AREA

(e) The hazard symbols for cyclohexane are shown.

Symbol **1** Symbol **2** Symbol **3**

(i) State what is meant by Symbol **3**.

(1)

.....

.....

(ii) Give **two** safety precautions that should be taken to reduce the risk in Step **5**.

Assume eye protection, gloves and a laboratory coat are being worn.

(2)

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.....

.....

(Total for Question 3 = 14 marks)

4 This question is about experiments involving ethanol.

(a) Ethanol and water mix in all proportions. The percentage of ethanol by volume in ethanol-water mixtures can be found by comparing the density of the mixture to the densities of ethanol-water mixtures of known composition, at a constant temperature.

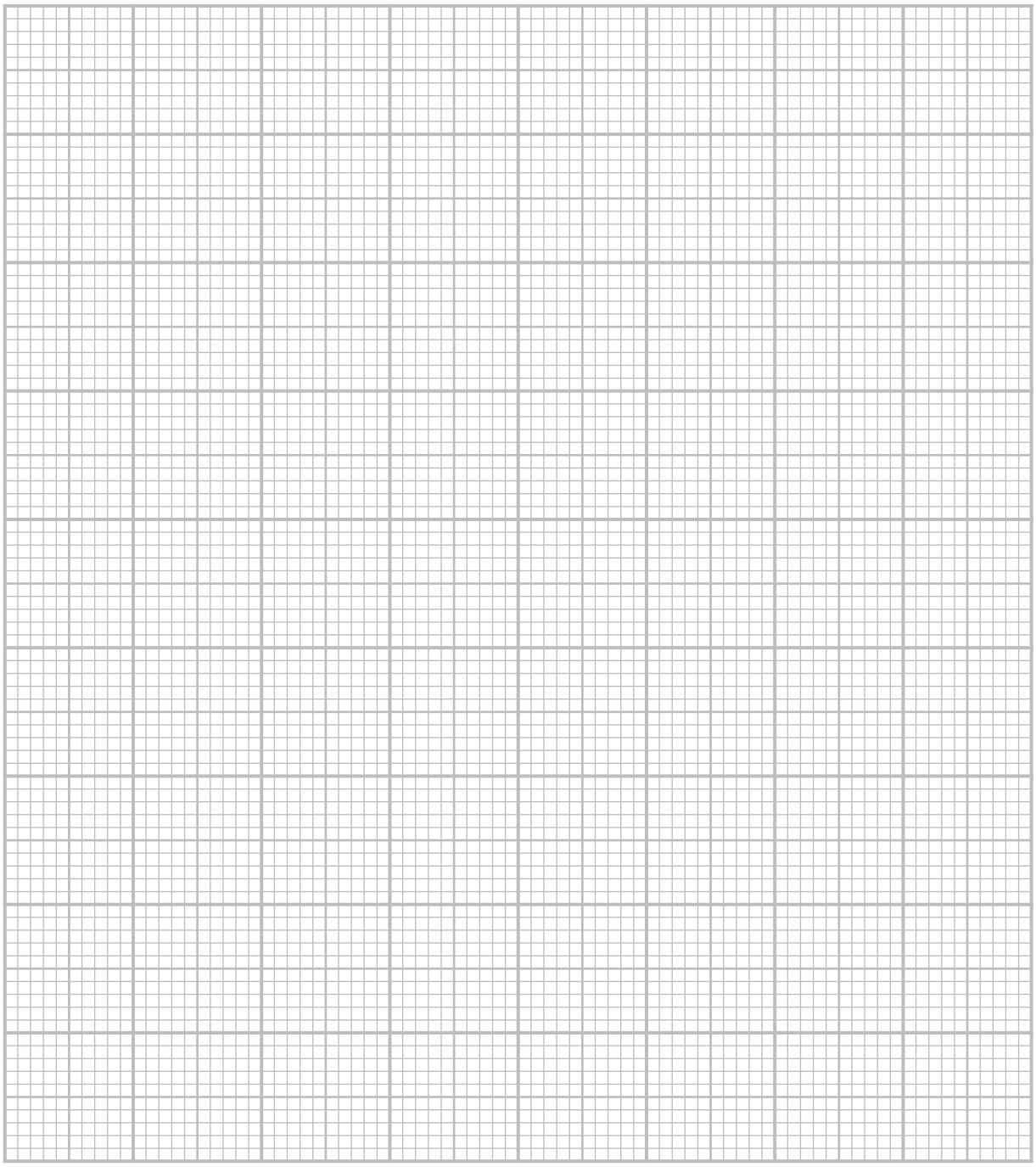
Percentage of ethanol in mixture	Density / g cm^{-3}
30	0.962
45	0.940
55	0.920
70	0.886
85	0.845
95	0.811

(i) Calculate the density of an ethanol-water mixture, sample **A**, 5.00 cm^3 of which has a mass of 4.75 g.

(1)

(ii) Plot a graph of density against the percentage of ethanol by volume.

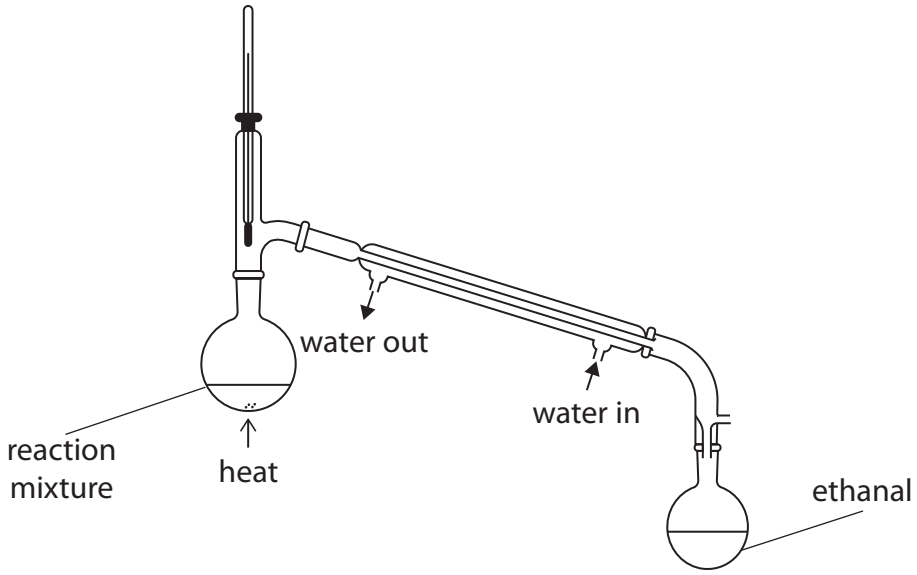
(3)



(iii) Determine the percentage of ethanol by volume in sample **A** using your answer to (a)(i) and the graph in (a)(ii). Show your working on the graph.

(1)

(b) Ethanal can be prepared by heating ethanol with acidified sodium dichromate(VI) in the apparatus shown.



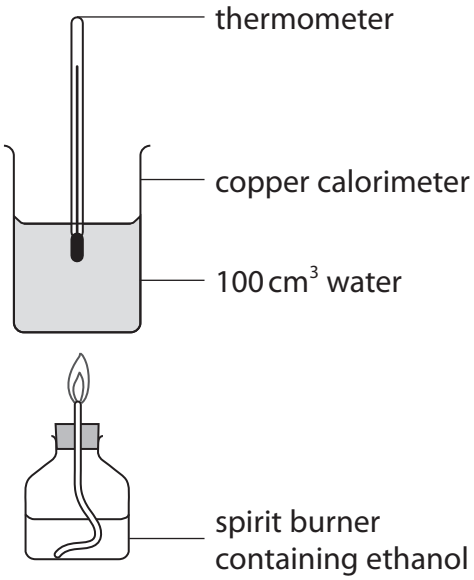
(i) Explain why the reaction mixture is heated as shown, instead of heating under reflux.

(2)

(ii) Explain why the water is passed through the condenser in the direction shown.

(2)

(c) A student determined a value for the enthalpy change of combustion of ethanol, using the apparatus shown.



Data

M_r of ethanol = 46.0

Density of water = 1.00 g cm^{-3}

Specific heat capacity of water = 4.18 J g^{-1} °C^{-1}

Mass of ethanol burnt = 0.650 g

Temperature of water before heating = 20.0°C

Temperature of water after heating = 57.9°C

(i) Calculate the energy transferred to the water.

(1)

(ii) Calculate the amount of ethanol burnt in moles.

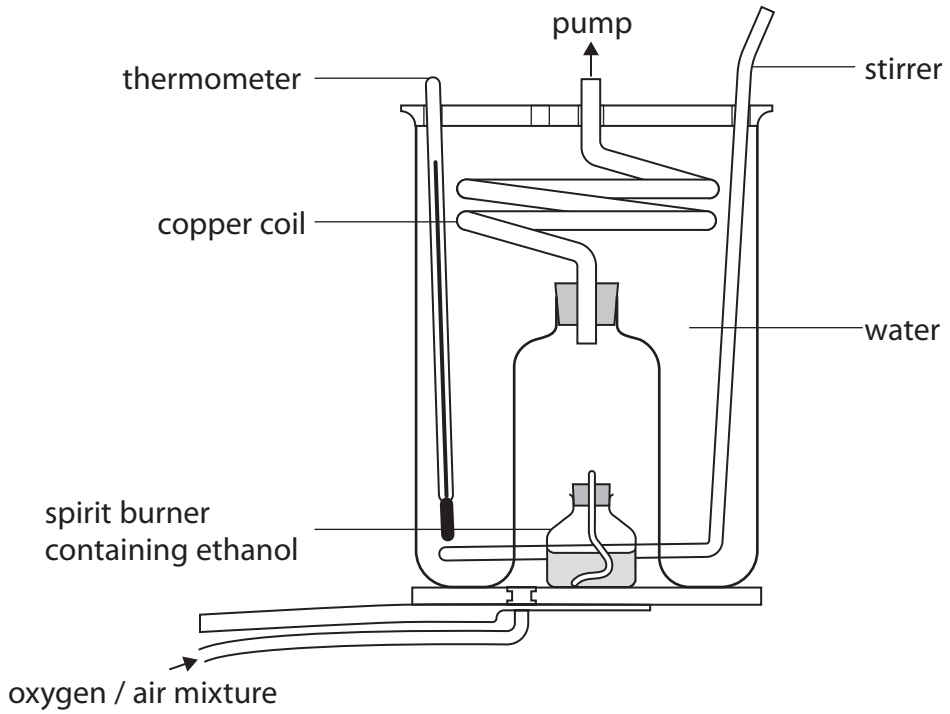
(1)

(iii) Calculate the enthalpy change of combustion of ethanol in kJ mol^{-1}, using your answers to (c)(i) and (c)(ii).

Give your answer to an appropriate number of significant figures.

(1)

(d) Whilst evaluating the method used in (c), the student found a diagram of an alternative apparatus as shown.



Explain two reasons why this apparatus is likely to give a more accurate value for the enthalpy change of combustion of ethanol.

(3)

(Total for Question 4 = 15 marks)

TOTAL FOR PAPER = 50 MARKS