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Pearson Edexcel
International
Advanced Level

Centre Number	Candidate Number
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Chemistry
Advanced
Unit 6: Chemistry Laboratory Skills II

Sample Assessment Material Time: 1 hour 15 minutes	Paper Reference WCH06/01
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Candidates may use a calculator.

Total Marks

Instructions

- Use **black** ink or 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.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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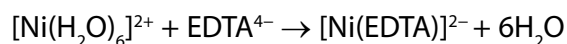
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Answer ALL the questions. Write your answers in the spaces provided.

- 1 (a) Compound **Z** is a crystalline solid that contains a nickel cation and one type of anion. Complete the table below.

Test	Observation	Inference
(i) Add dilute sulfuric acid to compound Z	Bubbles of a colourless gas are released. The gas turns limewater milky and a coloured solution is formed	Name of gas released is Formula of anion in Z is Formula of the complex ion formed is $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}(\text{aq})$
(ii) Add concentrated hydrochloric acid to the solution containing $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$ ions	Yellow-brown solution forms	Formula of the complex ion formed is (1)
(iii) Add a few drops of dilute aqueous ammonia to the solution containing $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$ ions	Green precipitate forms	Formula of the precipitate formed is (1)
(iv) Add excess dilute aqueous ammonia to the solution containing $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$ ions until no further change is observed	Formula of the complex ion formed is $[\text{Ni}(\text{NH}_3)_6]^{2+}$ (1)

- (b) A 10.0 cm³ sample of a solution containing [Ni(H₂O)₆]²⁺ ions was titrated with a solution of concentration 0.010 mol dm⁻³ with respect to the ligand EDTA⁴⁻ ions. The equation for the reaction is



- (i) The mean titre of the solution containing EDTA⁴⁻ ions was 24.20 cm³. Use this information, and the equation above, to calculate the concentration in mol dm⁻³ of the solution containing [Ni(H₂O)₆]²⁺ ions.

(2)

- (ii) Assuming the total error in the measurement of the mean titre is ±0.10 cm³, calculate the percentage error in this titre.

(1)

- (iii) A similar solution, containing the same concentration of [Ni(H₂O)₆]²⁺ ions, also contained a small amount of an impurity, copper(II) sulfate.

Suggest what effect this impurity would have on the titre. Justify your answer.

(2)

(Total for Question 1 = 11 marks)

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2 A colourless liquid, compound **X**, was extracted from raspberries. **X** has the molecular formula $C_{10}H_{12}O_2$ and contains a benzene ring.

(a) What would you expect to see if a sample of compound **X** was burned in air?

(1)

(b) A series of tests was carried out on compound **X**. In each test, state what you can deduce about the structure of compound **X** from the results described.

(i) **X** forms a white precipitate with aqueous bromine solution.

(1)

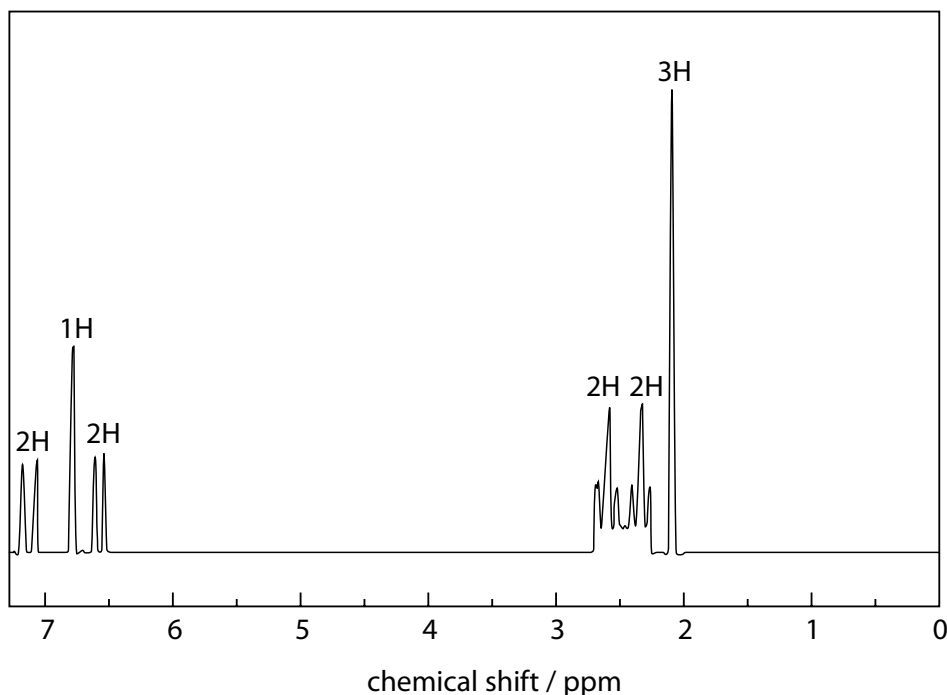
(ii) **X** forms an orange precipitate with 2,4-dinitrophenylhydrazine.

(1)

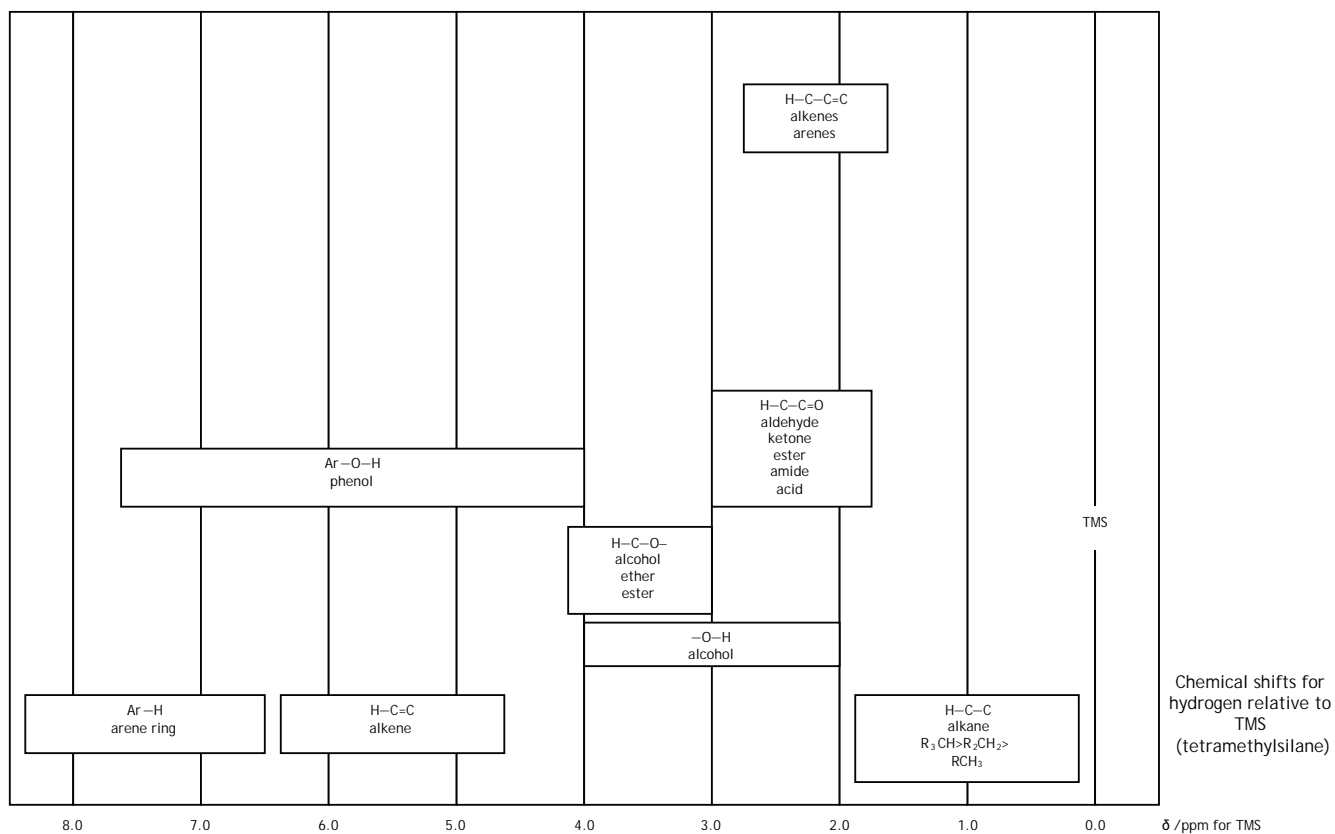
(iii) Fehling's (or Benedict's) solution remains blue when warmed with compound **X**.

(1)

- (c) The high resolution proton nmr spectrum of compound **X** is shown below. This spectrum shows that there are six different proton environments in the molecule of **X**. The relative number of hydrogen atoms in each environment is indicated on the spectrum. Use this spectrum, the data below and your answers to (a) and (b) to help answer the questions that follow.



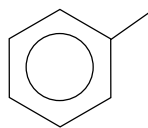
Nuclear Magnetic Resonance



- (i) Which hydrogen atoms in compound **X** are most likely to have caused the peaks at 6.5 ppm and 7.2 ppm?

(1)

- (ii) Compound **X** has a side chain containing four carbon atoms attached to the benzene ring. Show all the atoms on this side chain and label each hydrogen environment on the side chain with its splitting pattern.



(3)

- (iii) Suggest the structural formula of **X**.

(1)

(d) Compound **X** can be extracted from raspberries by steam distillation. Draw a labelled diagram of the apparatus you could use to carry out this steam distillation.

(3)

(Total for Question 2 = 12 marks)

- 3** Glucose can be oxidized using acidified potassium manganate(VII). The kinetics of the reaction can be studied using the procedure outlined below.
1. Measured volumes of glucose solution, sulfuric acid and water were added to a conical flask.
 2. A measured volume of potassium manganate(VII) solution was added to the flask. The mixture was gently swirled and a stopwatch started.
 3. The time taken for the mixture in the flask to change colour was recorded and the initial rate of the reaction was then calculated.
 4. The experiment was repeated using different volumes of the solutions.

The results of the experiments are shown in the table below.

Experiment	Glucose / cm ³	Sulfuric acid / cm ³	Potassium manganate(VII) / cm ³	Water / cm ³	Initial rate / mol dm ⁻³ s ⁻¹
A	20.0	20.0	10.0	0.0	1.0×10^{-5}
B	20.0	20.0	5.0	5.0	5.0×10^{-6}
C	10.0	20.0	10.0	10.0	9.8×10^{-6}
D	10.0	10.0	10.0	20.0	4.9×10^{-6}

- (a) (i) Which piece of equipment should be used to measure out the volumes used in each experiment? Justify your choice.

(2)

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(ii) What colour change would you see in step 3?

(2)

From to

(iii) Explain why water was added to the flask in experiments B, C and D.

(1)

(iv) Suggest a technique that could be used to continuously monitor the change in concentration of potassium manganate(VII) during the reaction.

(1)

(v) State the order with respect to glucose, sulfuric acid and potassium manganate(VII) and hence write the rate equation for the reaction.

(3)

- (b) Experiment A was repeated at different temperatures and the time taken for the potassium manganate(VII) to change colour was recorded. The results were processed to find values of $1/\text{temperature}$ and $\ln(\text{rate constant})$ and these are shown in the table below.

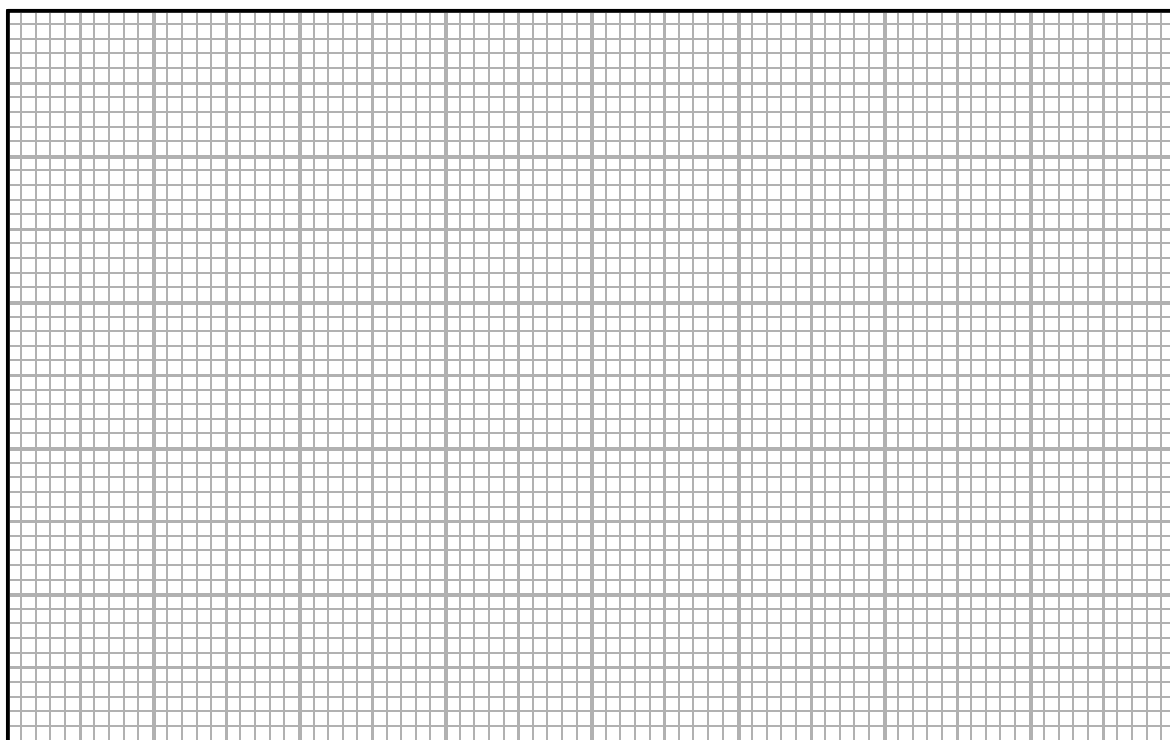
Experiment	$1 / \text{temperature} / \text{K}^{-1}$	$\ln(\text{rate constant})$
E	3.00×10^{-3}	-1.60
F	3.10×10^{-3}	-2.60
G	3.21×10^{-3}	-3.75
H	3.35×10^{-3}	-5.20

- (i) Plot a graph of $\ln(\text{rate constant})$ against $1 / \text{temperature}$ on the axes below.

(3)

$1 / \text{temperature} / \text{K}^{-1}$

$\ln(\text{rate constant})$



- (ii) Calculate the gradient of the graph.

(1)

(iii) Use your answer to (ii) and the relationship below to calculate the activation energy, E_a , for this reaction. Include a sign and units in your answer.

$$\text{Gradient} = \frac{-E_a}{R}$$

$$R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$$

(2)

(Total for Question 3 = 15 marks)

- 4** The procedure outlined below can be used to extract caffeine from tea.
1. Add 25 g of tea, 10 g of calcium carbonate and 250 cm³ of water to a large beaker.
 2. Gently boil the mixture for 15 minutes.
 3. While the mixture is still warm, filter using suction filtration.
 4. Transfer the filtrate to a separating funnel and separate the caffeine from the aqueous mixture using solvent extraction, with dichloromethane as the solvent.
 5. Dry the extract.
 6. Remove the solvent.

[Density of dichloromethane = 1.32 g cm⁻³]

- (a) (i) Outline how to carry out the solvent extraction in **step 4**, to obtain a solution of caffeine dissolved in dichloromethane.

(3)

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(ii) How would you dry the extract in **step 5**? Include the name of a suitable drying agent in your answer.

(2)

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(b) (i) The solvent dichloromethane is harmful and can enter the body through inhalation and skin absorption. Suggest a possible way to minimise each of these risks when using dichloromethane.

(2)

Inhalation

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Skin absorption

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(ii) Suggest a suitable way to remove the solvent in **step 6**.

(1)

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(c) The extraction can also be carried out using liquid carbon dioxide. Suggest an advantage of using this rather than dichloromethane.

(1)

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(d) A student carrying out this extraction obtained 85 mg of caffeine. Calculate the percentage by mass of caffeine obtained from the sample of tea used.

(2)

(e) Caffeine obtained in this way is often a pale green solid, due to impurities. State the name of another technique you could use to further purify the caffeine.

(1)

(Total for Question 4 = 12 marks)

TOTAL FOR PAPER = 50 MARKS

