OCR
Oxford Cambridge and RSA

AS Level Chemistry B (Salters)

H033/02 Chemistry in depth

Practice Question Paper

Date – Morning/Afternoon

Time allowed: 1 hour 30 minutes

You must have:
- the Data Sheet for Chemistry B (Salters)

You may use:
- a scientific calculator
- a ruler (cm/mm)

First name									
Last name									
Centre number						**Candidate number**				

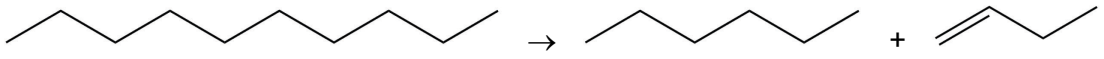
INSTRUCTIONS
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided.
- Additional paper may be used if required but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION
- The total mark for this paper is **70**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended responses will be assessed in questions marked with an asterisk (*).
- This document consists of **16** pages.

Answer **all** the questions.

1 Long chain alkanes are cracked in the petroleum industry to provide better fuels.

An equation for a cracking reaction is shown below.



Compound A **Compound B** **Compound C**

(a) Name compound **C** and give a test to distinguish it from compound **B**.

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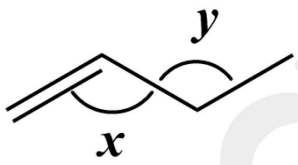
..... **[2]**

(b) Give the values of the bond angles marked in the molecule of compound **C** and explain your answers.



angle ***x*** = ... angle ***y*** = ...

explanation: .....

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..... **[3]**

(c) Some molecules with double bonds show *E*/*Z* isomerism.

Explain what causes *E*/*Z* isomerism, and discuss whether or not compound **C** can show *E*/*Z* isomerism.

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..... **[2]**

(d)* Compound **B** is a liquid alkane.

Describe how a value for the enthalpy change of combustion of compound **B** could be determined experimentally.

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..... **[6]**

(e) The value for the enthalpy change of combustion determined experimentally is frequently much less exothermic than the value found in data books.

One reason for this is heat loss.

Suggest **two** other reasons.

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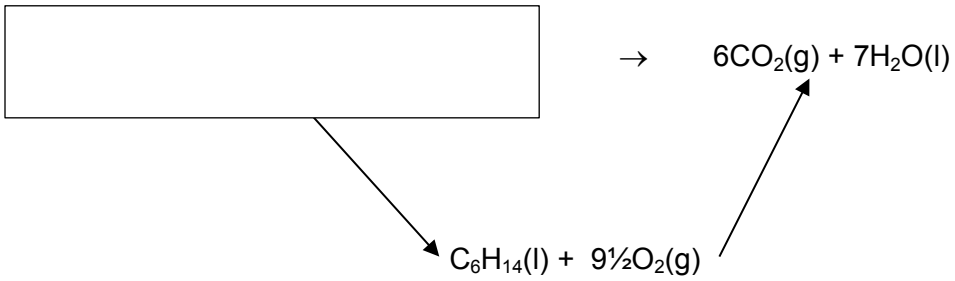
..... **[2]**

(f) **(i)** Complete the enthalpy cycle below.



[1]

(ii) Use the cycle to calculate the standard enthalpy change of formation of hexane, C_6H_{14}, using the following standard enthalpy changes of combustion.

Standard enthalpy change of combustion, $\Delta_c H^\ominus$	**Enthalpy / kJ mol^{-1}**
carbon, C(s)	–393
hydrogen, H_2(g)	–286
hexane, C_6H_{14}(l)	–4163

$\Delta_f H^\ominus$ (C_6H_{14}) = ... kJ mol^{-1}

[2]

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Turn over for the next question

2 (a) Limestone is used to make cement. Samples of limestone from different quarries contain different amounts of calcium carbonate.

A technician heats different powdered limestone samples so they undergo thermal decomposition and collects the carbon dioxide produced.

Describe and explain how the results from the experiments could be used to indicate which sample is the purest. Assume that the limestone contains no other carbonates.

Include a labelled diagram to show how the equipment could be set up.

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..... **[4]**

(b) In a separate experiment a sample of the limestone produced 9.00 dm^3 carbon dioxide at a temperature of 850 °C and pressure of 105 kPa.

(i) Find the amount (in mol) of CO_2 produced.

amount of CO_2 = ... mol **[2]**

(ii) This sample of limestone weighed 15.0 g.

Use your answer to **(i)** to find what percentage of the limestone was calcium carbonate. Assume none of the impurities were other carbonates.

Give your answer to an **appropriate** number of significant figures.

percentage purity = ... % **[2]**

(c) Magnesium carbonate decomposes in the same way as calcium carbonate.

(i) Explain why magnesium and calcium compounds might be expected to react in a similar way.

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..... **[1]**

(ii) How does the thermal decomposition of magnesium carbonate differ from that of calcium carbonate? Explain why they differ, in terms of the ions involved.

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..... **[2]**

(d) An impurity sometimes found in limestone is Epsom salts. Epsom salts are hydrated magnesium sulfate, $MgSO_4 \cdot xH_2O$.

25.00 g of Epsom salts are heated and 12.22 g of solid remain on cooling.

Calculate the value of *x* in the formula above. Show your working.

x = ... **[3]**

(e) A student looks up the first ionisation enthalpies of magnesium and sulfur.

Write an equation for the first ionisation enthalpy of sulfur.

How does the first ionisation enthalpy of sulfur compare with that of magnesium? Explain your answer in terms of atomic structure.

equation:

explanation: .....

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.....

[4]

3 Chlorine is an important industrial chemical used to make bleach.

$$Cl_2 + 2OH^- \rightleftharpoons Cl^- + ClO^- + H_2O \quad \textbf{Equation 3.1}$$

(a) **Equation 3.1** is an example of a dynamic equilibrium.

Give **two** characteristics of a dynamic equilibrium.

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..... **[2]**

(b) A student says 'adding more sodium hydroxide makes the bleach more effective'.

Is the student correct or not? Explain your answer using **equation 3.1**.

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..... **[1]**

(c) The numerical value for the equilibrium constant, K_c, for **equation 3.1** is 3.10×10^{10}.

What does this tell you about the position of equilibrium?

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..... **[1]**

(d) Chlorine is mixed with sodium hydroxide.

At equilibrium the concentration of OH^- is 1.00×10^{-5} mol dm^{-3} and the concentration of Cl_2 is 1.24×10^{-6} mol dm^{-3}.

Find the concentration of Cl^- ions.

The concentration of water is not included in the expression for K_c.

$[Cl^-]$ = ... mol dm^{-3} **[2]**

(e) Sodium chlorate(I), NaC*l*O, is used to kill bacteria in swimming pool water. Unfortunately the C*l*O$^-$ ions decompose to form oxygen in sunlight.

(i) Suggest the equation for the decomposition of C*l*O$^-$ ions to form oxygen.

..... **[1]**

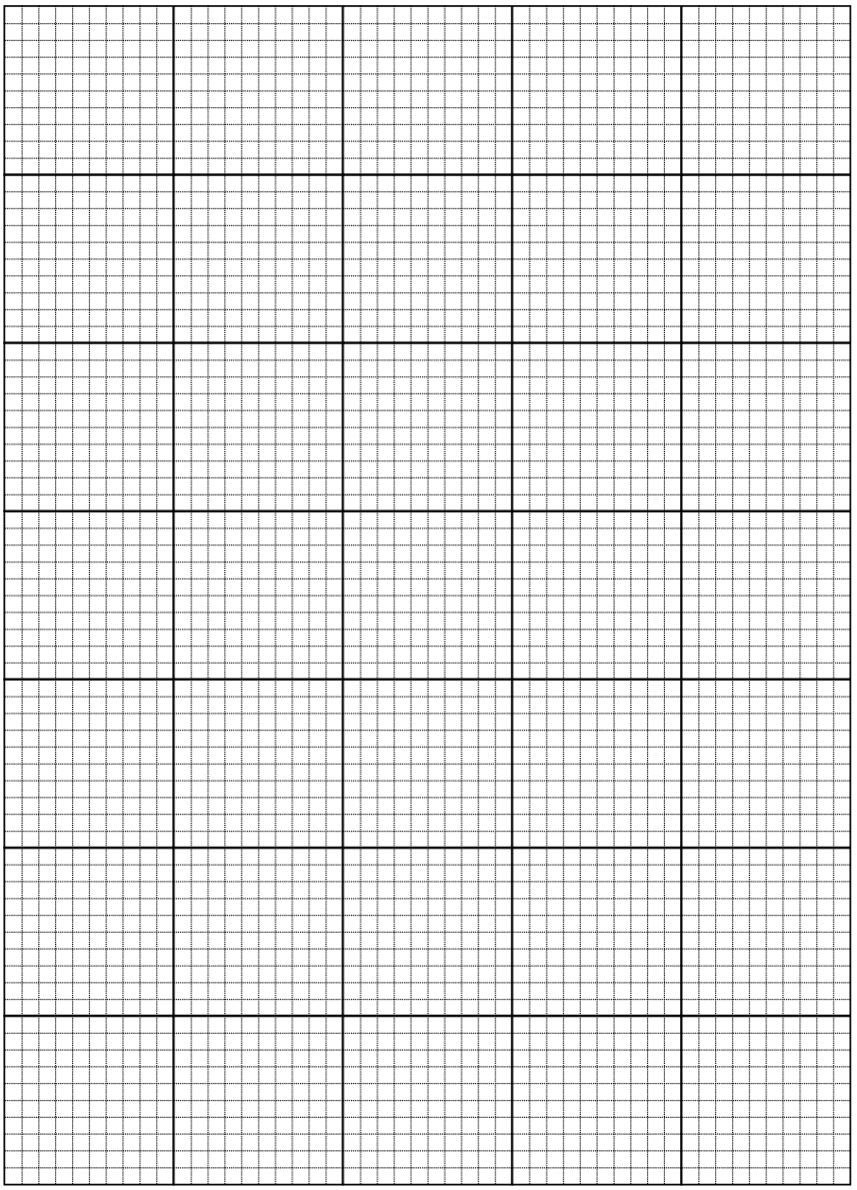
(ii) The concentration of NaC*l*O as % by mass (number of grams per 100 g of water) was monitored over several days and the results are shown in the table below.

Time / days	**Concentration of NaC*l*O / % by mass**
0	30.00
3	27.43
6	27.07
9	23.43
12	21.83
15	20.44
18	19.21
21	18.13

Plot the results on the grid shown opposite.

Draw a line of best fit and use your graph to estimate the concentration of NaC*l*O after 14 days.

[NaC*l*O] after 14 days = **.....** % by mass **[4]**



(iii) To provide effective protection the concentration of NaC*l*O should not fall below 3 mol dm^{-3}.

Use your answer to show whether the NaC*l*O added is still effective after 14 days.

[2]

(f)* Organochlorine compounds can make their way into the stratosphere. Here chlorine radicals act as catalysts in the breakdown of ozone molecules.

Explain what you understand by the term 'catalyst' and the type of catalysis happening in the stratosphere.

In your answer, use equations to show how chlorine radicals are formed in the stratosphere and how they interact with ozone.

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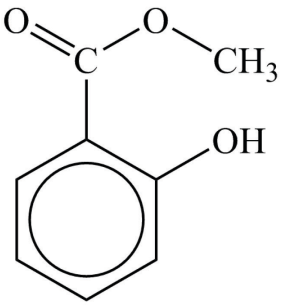
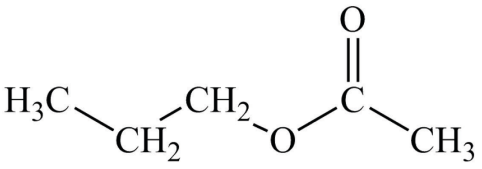
..... **[6]**

4 This question is about two liquid esters, **D** and **E**.



Ester D



Ester E

Ester **D** can be used to flavour chewing gum and in mouthwashes. Ester **E** is used as a pear flavouring.

(a) Give a chemical test that would allow you to distinguish between the two esters.

test: .....

results:.....

.....

[2]

(b) A student prepares ester **E** by reacting an alcohol and a carboxylic acid.

Give the conditions and an equation for the reaction.

conditions: .....

equation:

[3]

(c) After the reaction, the student pours the reaction mixture into a separating funnel. The student then separates and purifies the organic layer containing the ester.

Name the process by which ester **E** may be isolated from the purified organic layer.

..... **[1]**

(d) Other alcohols can produce different esters.

Alcohols **F** and **G** have branched chains and the formula $C_4H_{10}O$.

Complete the table below for alcohols **F** and **G**.

	Alcohol F	**Alcohol G**
Skeletal formula		
Systematic name		
Observation on heating with acidified potassium dichromate(VI).		

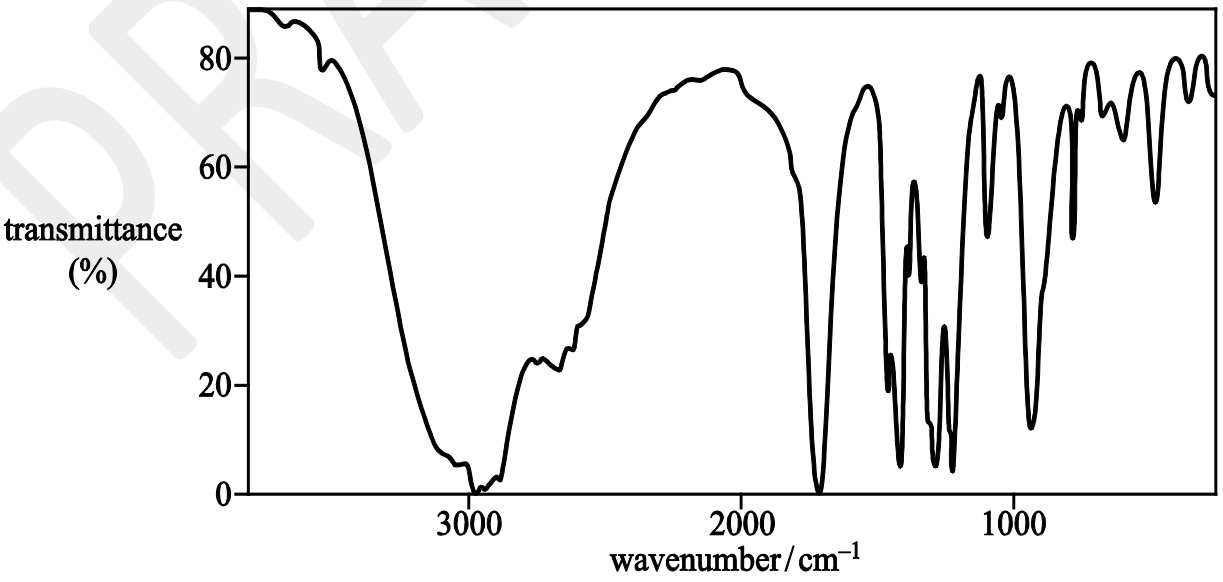
[4]

(e) Another alcohol, **H**, also has molecular formula $C_4H_{10}O$.

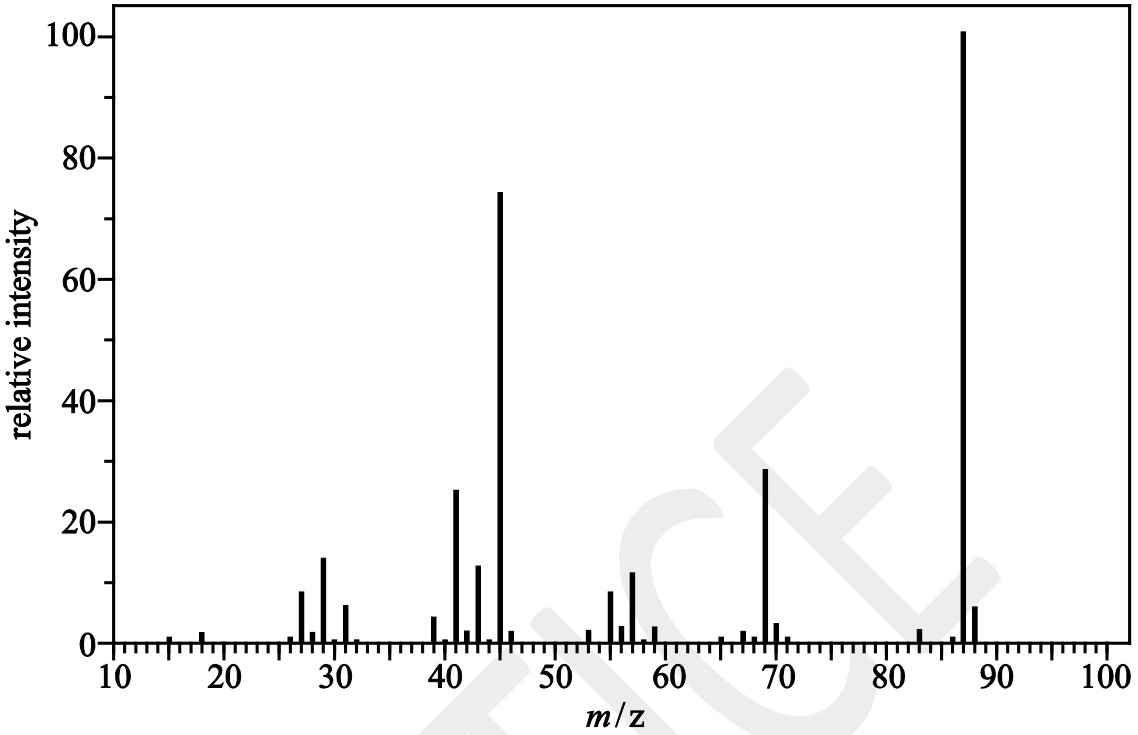
Alcohol **H** is reacted with acidified potassium dichromate(VI) to form organic compound **J**.

The infrared and mass spectra of compound **J** are shown below.

Infrared spectrum



Mass spectrum



Use the spectra to identify the organic product **J**, giving your reasoning.

Name alcohol **H**. Suggest the conditions under which the reaction was carried out.

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..... **[5]**

END OF QUESTION PAPER