Centre No.						Paper Reference							Surname	Initial(s)
Candidate No.						6	2	5	6	/	0	1	Signature	

Paper Reference(s)

6256/01

Edexcel GCE

Chemistry (Nuffield)

Advanced Level

Unit Test 6 (Synoptic)

Monday 25 June 2007 – Morning

Time: 2 hours

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
Total	

Materials required for examination
Nil

Items included with question papers
Nil

A calculator may be used.

Centre to provide
Nuffield *Students' Book* (fourth edition)
Nuffield Advanced *Science Book of Data*

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initial(s) and your signature.
Answer **ALL** questions. Write your answers in the spaces provided in this question paper.
Some questions must be answered with a cross in a box (☒). If you change your mind about an answer, put a line through the box (☒) and then mark your new answer with a cross (☒).
Final answers to calculations should be given to an appropriate number of significant figures.

Information for Candidates

The marks for individual questions and the parts of questions are shown in round brackets: e.g. **(2)**.
The total mark for this paper is 60. There are 16 pages in this paper. All blank pages are indicated.

Advice to Candidates

You may use the Nuffield *Students' Book* and the *Book of Data* in answering this paper.
The time allowed to answer this paper means that you do not have time to look up all the information you may wish to refer to in your answers. You should plan to restrict your use of the *Students' Book* to relevant passages of background reading or for confirmation of data or equations.
You will be assessed on your ability to organise and present information, ideas, descriptions and arguments clearly and logically, taking account of your use of grammar, punctuation and spelling.
Your Quality of Written Communication will be assessed in this paper. To gain full marks you must explain your ideas clearly using equations and diagrams where appropriate. You are advised to show all the steps in any calculations.

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Turn over

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Leave blank

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

1. (a) Construct a Born-Haber cycle for silver chloride, AgCl.

Use it to calculate a value for the lattice energy of silver chloride.
Include a sign and units with your answer, which should be given to **three significant figures**.

(3)

Leave blank

(b) (i) Calculate the standard enthalpy change for solid silver chloride dissolving in water, using data from Tables 5.3 and 5.6 in your *Book of Data*.

$$AgCl(s) \rightarrow Ag^{+}(aq) + Cl^{-}(aq)$$

Hence calculate the standard entropy change of the surroundings at 298 K for this reaction.

(2)

(ii) Calculate the standard entropy change of the system for silver chloride dissolving in water.

(1)

(iii) Calculate the total entropy change for silver chloride dissolving in water at 298 K and comment on the result of your calculation.

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(1)

Leave blank

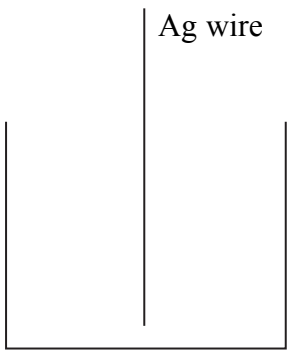
(c) A convenient standard electrode for measuring standard electrode potentials is the silver–silver chloride electrode.

$$\vdots \text{AgCl(s)}, [\text{Ag(s)} + \text{Cl}^-\text{(aq)}] \mid \text{Pt} \quad E^{\ominus} = +0.22 \text{ V}$$

(i) Write the ionic equation for this half-cell.

(1)

(ii) Complete the diagram below to show how you would set up this half-cell, under standard conditions. State the conditions and include the concentrations of any solutions that you use. There is no need to show platinum in your diagram.



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(3)

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(d) (i) Write a cell diagram for the cell that would be used to measure the standard electrode potential for $Cu^{2+}(aq) \mid Cu(s)$ with the silver–silver chloride electrode. The silver–silver chloride electrode should be shown on the **left hand side** of your diagram.

(2)

(ii) Calculate the emf for this cell.

(2)

(iii) State how you would convert emf values measured with the standard silver–silver chloride electrode to those stated in your *Book of Data*, which have been measured with a standard hydrogen electrode.

(1)

(iv) Suggest ONE advantage of the silver–silver chloride electrode over a standard hydrogen electrode.

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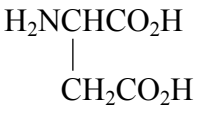
(1)

Q1

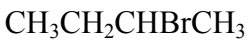
(Total 17 marks)

Leave blank

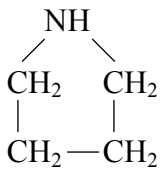
2. The formulae of five organic compounds (A, B, C, D and E) containing four carbon atoms per molecule are shown below:



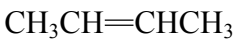
A



B



C



D

E

(a) Which formula represents a secondary amine?

Put a cross in the box (☒) of the correct answer.

A	☒
B	☒
C	☒
D	☒
E	☒

(1)

(b) Which formula represents compounds which are two geometric isomers?

Put a cross in the box (☒) of the correct answer.

A	☒
B	☒
C	☒
D	☒
E	☒

(1)

Leave blank

(c) Which TWO of the formulae, **A** to **E**, represent molecules with chiral centres?

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(1)

(d) This part of the question is concerned with compounds **A**, **B**, **C** and **D** only.

(i) Which compound would give a cream precipitate when hot silver nitrate is added?

Put a cross in the box (☒) of the correct answer.

A	☒
B	☒
C	☒
D	☒

(1)

(ii) Which compound would give a purple colour when ninhydrin solution is added?

Put a cross in the box (☒) of the correct answer.

A	☒
B	☒
C	☒
D	☒

(1)

(iii) Which TWO compounds would react with sodium hydroxide solution?

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(1)

(iv) Which TWO compounds would react with dilute hydrochloric acid to form **salts**?

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(1)

Leave blank

(v) Which TWO compounds react with water, under appropriate conditions, to form alcohols?

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(1)

(e) (i) Name compound **E**.

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(1)

(ii) Write the equation for the formation of compound **E** from ethylamine and another suitable reagent, using structural formulae.

(1)

(f) (i) Compound **A** can react with itself to form a dipeptide under appropriate conditions.

Give the structural formula of this dipeptide.

(1)

(ii) One of the compounds **B** to **E** reacts with itself to form an addition polymer.

Write a balanced equation for the formation of this polymer using structural formulae. State the conditions for this polymerisation.

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(2)

Leave blank

(g) (i) Which of the compounds **A** to **E** has the least number of peaks in the nuclear magnetic resonance (NMR) spectrum?

Put a cross in the box (☒) of the correct answer.

A	☒
B	☒
C	☒
D	☒
E	☒

(1)

(ii) Justify your answer.

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(1)

(h) Which of the compounds **A** to **E** would **not** have an absorption above 3000 cm^{-1} in the infrared spectrum?

Put a cross in the box (☒) of the correct answer.

A	☒
B	☒
C	☒
D	☒
E	☒

(1)

(i) Which of the compounds **A** to **E** would have peaks occurring in pairs in the mass spectrum? Justify your answer.

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(2)

Q2

(Total 18 marks)

Leave blank

3. This question is about the transition element cobalt.

(a) Aqueous solutions of cobalt salts usually contain cobalt(II) ions, Co^{2+}.

Give the electron arrangement for cobalt(II) ions, using the s,p,d notation.

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(1)

(b) An aqueous solution of cobalt(II) chloride is coloured pink due to the presence of the complex ion, hexaaquacobalt(II), $Co(H_2O)_6^{2+}(aq)$.

Draw a diagram of this ion to show its shape.

(1)

(c) When concentrated hydrochloric acid is added to an aqueous solution of cobalt(II) chloride, a blue solution forms due to the presence of the complex ion, tetrachlorocobalt(II).

(i) What is the ligand in this complex ion?

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(1)

(ii) Write an equation for the formation of tetrachlorocobalt(II) in this reaction.

Use your equation to predict the sign of the entropy change of the system for this reaction. Justify your prediction.

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(2)

Leave blank

(d) (i) Cobalt(II) ions form a green complex with concentrated ammonia solution.
Use Table 6.13 in your *Book of Data* to deduce the formula of this complex ion.

(1)

(ii) Cobalt(II) ions form a pink complex with edta solution.

Describe the changes you would expect to see when concentrated ammonia solution and then edta solution is added to an aqueous solution of cobalt(II) ions.

Justify your predictions by referring to the appropriate stability constants in Table 6.13 in your *Book of Data*.

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(3)

Leave blank

(e) The oxidation of tartrate ions by hydrogen peroxide in aqueous solution is catalysed by the presence of a few drops of cobalt(II) chloride solution.

(i) Explain why cobalt(II) chloride is classified as a homogeneous catalyst.

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(1)

(ii) During this catalysed reaction, the mixture turns green, due to the presence of cobalt(III) ions, returning to pink at the end of the reaction.

Suggest how the reaction is catalysed by the presence of cobalt ions.

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(2)

(iii) Draw the displayed formula of a tartrate ion, systematic name, 2,3-dihydroxybutanedioate ion.

(1)

Q3

(Total 13 marks)

Leave blank

4. A gaseous hydrocarbon, **W**, is a product formed in the cracking of eicosane, $C_{20}H_{42}$. **W** decolourises bromine, forming compound **X**.

When **X** is reacted with aqueous potassium hydroxide, compound **Y** is formed.

When a solution of **Y** is refluxed with an excess of acidified potassium dichromate(VI), compound **Z** is formed.

Compound **Z** contains carbon, hydrogen and oxygen only.

(a) (i) On complete combustion, 0.10 g of **Z** produced 53 cm^3 of carbon dioxide and 0.020 g of water at room temperature and pressure.

Calculate the empirical formula of compound **Z**.
[Molar volume of a gas is 24 000 cm^3 mol^{-1} at room temperature and pressure]

(3)

(ii) The molar mass of **Z** is 90 g mol^{-1}. Find the molecular formula of **Z**.

(1)

Leave blank

(iii) A solution made by dissolving 0.900 g of compound **Z** in water is titrated with sodium hydroxide solution. 20.0 cm^3 of sodium hydroxide solution of concentration 1.00 mol dm^{-3} is required for complete neutralisation.

Deduce the structural formula of compound **Z**.

(2)

(iv) Deduce the structural formulae of compounds **W**, **X**, and **Y**.

(3)

(v) Suggest a balanced equation for the cracking of eicosane.

(1)

Leave blank

(b) Compound **Y** can be made in one step from compound **W**.

State the reagents needed for this reaction.

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(2)

Q4

(Total 12 marks)

TOTAL FOR PAPER: 60 MARKS

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