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

Paper Reference(s)

6252/01

Edexcel GCE

Chemistry (Nuffield)

Advanced Subsidiary

Unit Test 2

Thursday 18 January 2007 – Morning

Time: 1 hour 30 minutes

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
Total	

Materials required for examination	Items included with question papers
Nil	Passage for Section B

A calculator may be used.

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initial(s) and your signature.
Answer ALL questions in Section A and Section B in the spaces provided in this question paper.
The passage for Section B is provided on a separate sheet.
Final answers to calculations should be given to an appropriate number of significant figures.

Information for Candidates

A Periodic Table is printed on the back cover of this paper.
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. Any blank pages are indicated.

Advice to Candidates

You are advised to show all steps in any calculations.
You should aim to spend no more than 55 minutes on Section A and 35 minutes on Section B.
You will be assessed on your ability to organise and present information, ideas, descriptions and arguments clearly and logically, taking into account your use of grammar, punctuation and spelling.
Up to 2 marks will be awarded for the Quality of Written Communication used in Section B.

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SECTION A

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

You should aim to spend no more than 55 minutes on this section.

1. (a) Hydrogen chloride can be prepared by reacting concentrated sulphuric acid with solid sodium chloride.

(i) Write an equation for the reaction which occurs. State symbols are **not** required.

(2)

(ii) Hydrogen chloride reacts with ammonia fumes.

What would you **see** if you carried out this reaction?

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(1)

(iii) An unknown gas was tested with ammonia fumes. The result showed that it might be hydrogen chloride, but the test did not confirm that hydrogen chloride was definitely present. Explain the reason for this.

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(1)

Leave blank

(b) When concentrated sulphuric acid is added to solid sodium bromide, the products of the reaction include sulphur dioxide and bromine.

$$2H_2SO_4 + 2NaBr \rightarrow Br_2 + SO_2 + 2H_2O + Na_2SO_4$$

Sulphur and bromine change oxidation number in this reaction.

(i) Write the oxidation numbers at the start and the end of the reaction.

Sulphur changes from ..... to .....

(1)

Bromine changes from ..... to .....

(1)

(ii) Explain why the numbers in the balanced equation are consistent with the changes in oxidation number.

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(2)

Leave blank

(c) The boiling points of three hydrogen halides are shown below

Hydrogen halide	Boiling point /K
Hydrogen chloride	188
Hydrogen bromide	206
Hydrogen iodide	238

(i) Explain the trend in boiling point of the three hydrogen halides.

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(2)

(ii) Predict a value for the boiling point of hydrogen fluoride. Explain your reason for choosing this value.

Predicted value .....

Explanation

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(3)

(Total 13 marks)

Q1

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2. This question is about the chemistry of propane, C_3H_8.

Propane is sold for use as a fuel for camping stoves. On complete combustion it forms carbon dioxide and water.

(a) The enthalpy change of combustion of propane, ΔH_c, can be measured by burning a known mass of propane below a container of water and measuring the temperature rise of the water.

The heat capacity of the apparatus (the energy required to raise the temperature of the apparatus by 1 °C) is found by calibrating it with a fuel with known enthalpy change of combustion.

The results of an experiment are shown below.

Mass of propane burned	0.500 g
Temperature of water at start	21.0 °C
Final temperature of water	39.0 °C
Heat capacity of apparatus	1.35 kJ °C^{-1}

(i) Calculate the number of kilojoules of energy transferred when the 0.500 g sample of propane burns in this experiment.

(1)

(ii) Use your answer to (i) to calculate ΔH_c for propane in kJ mol^{-1}. Give your answer to **three significant figures**.

Use the Periodic Table as a source of data.

(2)

(iii) The *Book of data* gives the value of ΔH_c for propane as –2220 kJ mol^{-1}.

Calibrating the apparatus means that the answer you calculated in (ii) allows for errors due to heat loss.

Suggest the other main source of error which makes the experimental result different from the data book value.

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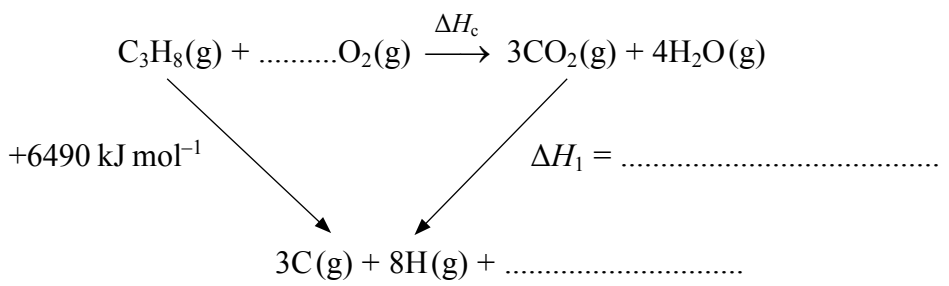
(1)

Leave blank

(b) A value of ΔH_c for propane can be calculated using mean bond energies and the Hess cycle below.

(i) Complete the Hess cycle, and use the mean bond energies to calculate ΔH_1. Hence calculate ΔH_c.

	Mean bond energies / kJ mol^{-1}
C═O	805
H─O	464



ΔH_c = ...

(3)

(ii) Give ONE reason why the value you calculated in (b)(i) also differs from the value for the heat of combustion of propane in the *Book of data*.

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(1)

Leave blank

(c) When propane reacts with chlorine in the presence of ultraviolet light one of the products is 2-chloropropane.

(i) Name the mechanism and type of this reaction.

Mechanism .....

Type .....

(2)

(ii) In this reaction a small quantity of an alkane, C_6H_{14}, is produced.

Explain how this occurs. Include an equation in your answer.

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(2)

(d) 2-Chloropropane and 2-iodopropane are both colourless liquids at room temperature. They can be distinguished by their reactions with aqueous silver nitrate.

(i) What would you see when the reaction is carried out with each halogenoalkane?

2-chloropropane .....

2-iodopropane .....

(2)

(ii) Write an ionic equation showing how silver ions react in the mixture made from 2-iodopropane and aqueous silver nitrate. Include state symbols in your answer.

(2)

(iii) Both 2-chloropropane and 2-iodopropane form the same organic product in the reaction with aqueous silver nitrate.

Name, or give the structural formula of, this organic product.

.....

(1)

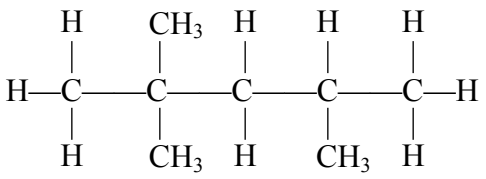
Q2

(Total 17 marks)

Leave blank

3. This question is about some of the chemicals used in car engines and their reactions.

(a) Compound **X**, shown below, is one component of petrol.



(i) Name **X**.

.....

(1)

(ii) Give the **empirical** formula of **X**.

.....

(1)

(iii) **X** can be made by cracking decane, $C_{10}H_{22}$.

Assuming only one other product forms in a cracking reaction, deduce the **molecular** formula of this other product.

(1)

(iv) What is the sign of the enthalpy change for the reaction in which decane is cracked? Give a reason for your answer.

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(1)

(v) If the air supply in a car engine is poor, there is not enough air for carbon dioxide to be produced.

Use this information to suggest ONE possible equation for the combustion of **X** in this engine. Use the molecular formula of **X** in your equation.

(2)

Leave blank

(b) When air enters a car engine, as well as the fuel burning, nitrogen and oxygen can react to form nitrogen(II) oxide.

$$N_2(g) + O_2(g) \rightleftharpoons 2NO(g) \qquad \Delta H = +180 \text{ kJ mol}^{-1}$$

(i) What, if any, is the effect on the percentage of nitrogen(II) oxide in an equilibrium mixture of these three gases if the pressure and temperature are increased? Explain your answers.

Increase in pressure

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Increase in temperature

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(2)

(ii) In a car exhaust pipe, nitrogen(II) oxide passes over a catalytic converter. The following reaction occurs.

$$2NO(g) + 2CO(g) \rightarrow N_2(g) + 2CO_2(g) \qquad \Delta H = -746 \text{ kJ mol}^{-1}$$

Explain why this reaction speeds up when the car engine has been running for a few minutes.

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(1)

(iii) A textbook says "The catalytic converter converts the gases coming out of the engine into less harmful ones".

State, with a reason, which of the four gases in the equation in (ii) you consider to be **least** harmful.

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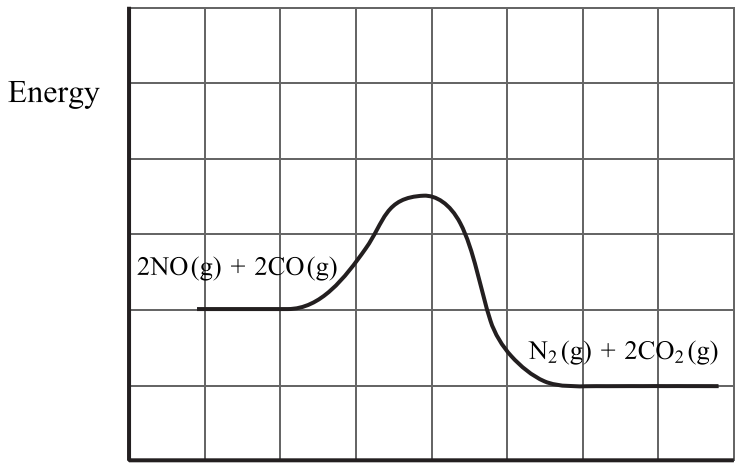
(1)

Leave blank

(iv) The diagram below shows the reaction profile for the change which occurs in the catalytic converter.



On the diagram, show the activation energy, E_A.

Add a line showing the reaction profile if no catalyst is present.

(2)

(c) The lengths of the bonds between carbon and oxygen are different in carbon monoxide and carbon dioxide.

Draw 'dot and cross' diagrams of both oxides and use them to explain the difference in bond lengths.

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(3)

Q3

(Total 15 marks)

TOTAL FOR SECTION A: 45 MARKS

Leave blank

SECTION B

You should aim to spend no more than 35 minutes on this section. The passage needed for this section is provided on a separate sheet.

4. Read the passage on **BONE MAKERS** straight through, and then more carefully, in order to answer the following questions.

(a) Poly(ethene) is non-toxic. Suggest ONE other property of poly(ethene) which makes it tolerated in the body.

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.....

(1)

(b) Explain why a high temperature is required to turn poly(ethene) into a liquid.

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(2)

(c) Suggest why adding supercritical carbon dioxide ($scCO_2$) to a polymer makes it easier to turn it into a liquid.

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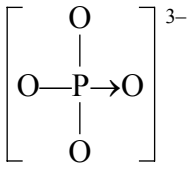
(1)

(d) A diagram of a phosphate ion, PO_4^{3-}, is shown below.



Suggest, with a reason, a value for the OPO bond angle.

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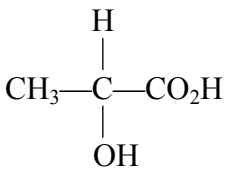
(1)

Leave blank

(e) Draw a section of the polymer poly(propenoic acid) showing TWO monomer units.

(1)

(f) The formula of lactic acid is



Which term below describes the type of reaction which occurs when propenoic acid is converted to lactic acid?

A oxidation B reduction

C hydration D hydrolysis

E hydrogenation

Answer .....

(1)

(g) Write a summary in no more than 110 words, giving details of the materials which are, or have been, used to repair bone damage. Give the advantages and disadvantages of each as stated in the passage.

(8)

You are not asked to summarise the whole passage. At the end of your summary state the number of words you have used.

Credit will be given for answers in good English, using complete sentences and with correct use of technical words. Avoid copying long sections from the original text. Numbers count as one word, as do standard abbreviations, units, formulae and hyphenated words. The abbreviation $scCO_2$, for supercritical carbon dioxide, counts as one word. Any title you give your passage does not count in your word total.

There are penalties for the use of words in excess of 110.

START YOUR SUMMARY ON PAGE 14

Leave blank

Leave blank

Q4

(Total 15 marks)

TOTAL FOR SECTION B: 15 MARKS

TOTAL FOR PAPER: 60 MARKS

END

THE PERIODIC TABLE

Period	1	2	Group										3	4	5	6	7	0
1	1 H Hydrogen 1																	2 He Helium 4
2	3 Li Lithium 7	4 Be Beryllium 9											5 B Boron 11	6 C Carbon 12	7 N Nitrogen 14	8 O Oxygen 16	9 F Fluorine 19	10 Ne Neon 20
3	11 Na Sodium 23	12 Mg Magnesium 24											13 Al Aluminium 27	14 Si Silicon 28	15 P Phosphorus 31	16 S Sulphur 32	17 Cl Chlorine 35.5	18 Ar Argon 40
4	19 K Potassium 39	20 Ca Calcium 40	21 Sc Scandium 45	22 Ti Titanium 48	23 V Vanadium 51	24 Cr Chromium 52	25 Mn Manganese 55	26 Fe Iron 56	27 Co Cobalt 59	28 Ni Nickel 59	29 Cu Copper 63.5	30 Zn Zinc 65.4	31 Ga Gallium 70	32 Ge Germanium 73	33 As Arsenic 75	34 Se Selenium 79	35 Br Bromine 80	36 Kr Krypton 84
5	37 Rb Rubidium 85	38 Sr Strontium 88	39 Y Yttrium 89	40 Zr Zirconium 91	41 Nb Niobium 93	42 Mo Molybdenum 96	43 Tc Technetium (99)	44 Ru Ruthenium 101	45 Rh Rhodium 103	46 Pd Palladium 106	47 Ag Silver 108	48 Cd Cadmium 112	49 In Indium 115	50 Sn Tin 119	51 Sb Antimony 122	52 Te Tellurium 128	53 I Iodine 127	54 Xe Xenon 131
6	55 Cs Caesium 133	56 Ba Barium 137	57 ► La Lanthanum 139	72 Hf Hafnium 178	73 Ta Tantalum 181	74 W Tungsten 184	75 Re Rhenium 186	76 Os Osmium 190	77 Ir Iridium 192	78 Pt Platinum 195	79 Au Gold 197	80 Hg Mercury 201	81 Tl Thallium 204	82 Pb Lead 207	83 Bi Bismuth 209	84 Po Polonium (210)	85 At Astatine (210)	86 Rn Radon (222)
7	87 Fr Francium (223)	88 Ra Radium (226)	89 ►► Ac Actinium (227)	104 Unq Unnil-quadium (261)	105 Unp Unnil-pentium (262)	106 Unh Unnil-hexium (263)												

Key

Atomic Number
Symbol
Name
Molar mass in g mol^{-1}

► Lanthanide elements	58 Ce Cerium 140	59 Pr Praseo-dymium 141	60 Nd Neodymium 144	61 Pm Promethium (147)	62 Sm Samarium 150	63 Eu Europium 152	64 Gd Gadolinium 157	65 Tb Terbium 159	66 Dy Dysprosium 163	67 Ho Holmium 165	68 Er Erbium 167	69 Tm Thulium 169	70 Yb Ytterbium 173	71 Lu Lutetium 175
►► Actinide elements	90 Th Thorium 232	91 Pa Protactinium (231)	92 U Uranium 238	93 Np Neptunium (237)	94 Pu Plutonium (242)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (245)	98 Cf Californium (251)	99 Es Einsteinium (254)	100 Fm Fermium (253)	101 Md Mendelevium (256)	102 No Nobelium (254)	103 Lr Lawrencium (257)