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

Wednesday 8 June 2005 – Morning

Time: 1 hour 30 minutes

Materials required for examination
Nil

Items included with question papers
Passage for Section B

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
Total	

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.
Calculators may be used.
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. All 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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Answer ALL questions in the spaces provided.

SECTION A

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

1. (a) A few crystals of potassium iodide were put into a test tube with a similar quantity of phosphoric acid, H_3PO_4. The mixture was warmed. Misty white fumes were seen at the mouth of the test tube.

(i) Give the name **or** formula of the misty white fumes which formed in this reaction.

.....

(1)

(ii) Write a balanced equation for the reaction. State symbols are **not** required.

$$H_3PO_4 + \quad KI \rightarrow \quad +$$

(2)

(iii) A sample of the misty white fumes was collected and dissolved in water.

What reagent would be used to confirm the identity of the halide ion present in the solution? State what you would expect to **see** when it is used.

Reagent .....

Observation .....

(2)

(b) If potassium iodide crystals are reacted with concentrated sulphuric acid, a complicated reaction occurs in which a mixture of gases is produced.

(i) What would you **see**, other than misty white fumes, when this reaction occurs? Give ONE observation.

.....

.....

(1)

Leave blank

(ii) One of the gases in the mixture is hydrogen sulphide, H_2S. It can be identified by holding a piece of filter paper soaked in a solution of lead nitrate, $Pb(NO_3)_2$, or lead ethanoate, $(CH_3CO_2)_2Pb$, in the gas.

What would be observed if hydrogen sulphide is present?

.....

.....

(1)

(iii) Suggest the name of the lead compound which forms in this reaction, using Stock notation.

.....

(1)

(iv) The equation below shows how hydrogen sulphide could be produced from sulphuric acid in a redox reaction.

$$9H_2SO_4 + 8KI \rightarrow H_2S + 8KHSO_4 + 4H_2O + 4I_2$$

Which element is oxidised in the reaction and which is reduced? Justify your answer by calculating oxidation numbers.

Element **oxidised** .....

Initial oxidation number ..... Final oxidation number .....

Element **reduced** .....

Initial oxidation number ..... Final oxidation number .....

(3)

Leave blank

(c) An experiment was carried out to measure the purity of a sample of potassium iodide.

1.75 g of impure potassium iodide was dissolved in water, and excess chlorine was passed through the solution. The following reaction occurred.

$$Cl_2(g) + 2KI(aq) \rightarrow I_2(aq) + 2KCl(aq)$$

The solution was warmed to drive off the excess chlorine and was then made up to 250 cm^3 in a volumetric flask. A titration was used to measure the concentration of iodine in the solution.

(i) What solution could be used in a titration to measure the concentration of iodine?

.....

(1)

(ii) Name a suitable indicator and state the colour change at the end-point of this titration.

Indicator .....

Colour change from ..... to .....

(2)

(iii) A titration showed that the solution contained 4.8×10^{-4} moles of iodine, I_2, in a 25 cm^3 sample. Calculate the number of moles of potassium iodide, KI, which were in the original impure sample.

(1)

(iv) Calculate the percentage purity of the potassium iodide.

Use the Periodic Table as a source of data.

(2) **Q1**

(Total 17 marks)

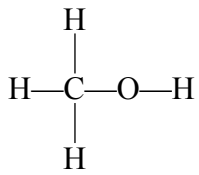
Leave blank

2. This question is about the chemistry of methanol, CH_3OH.

(a) (i) Draw a 'dot and cross' diagram for methanol, showing outer shell electrons only.

(1)

(ii) Textbooks show the displayed formula of methanol as follows



However, this is not a true representation of the shape of the molecule.

Explain why the shape of methanol is **not** as shown above.
Label the correct value of ONE bond angle on the displayed formula.

.....

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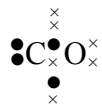
.....

.....

(2)

(b) When methanol burns in a poor supply of air, one of the products is carbon monoxide. A 'dot and cross' diagram of carbon monoxide is shown below.



(i) Draw the **displayed** formula for carbon monoxide. Show the TWO types of bond which are present.

(1)

Leave blank

(ii) The length of the bond between carbon and oxygen in methanol is 0.143 nm.

Would you expect the length of the bond between carbon and oxygen in carbon monoxide to be longer, the same or shorter than this? Explain your answer.

.....

.....

.....

(2)

(c) The energy of the bond between carbon and oxygen in methanol (the C—O bond) can be calculated from data on enthalpy changes of atomisation.

(i) Write an equation, including state symbols, for the atomisation of one mole of methanol vapour.

(1)

(ii) Use the data below to calculate the energy of the C—O bond in methanol.

standard enthalpy change of atomisation of methanol vapour, $\Delta H_{at}^{\ominus} = +2039$ kJ mol^{-1}
energy of C—H bond, E(C—H) = +413 kJ mol^{-1}
energy of O—H bond, E(O—H) = +464 kJ mol^{-1}

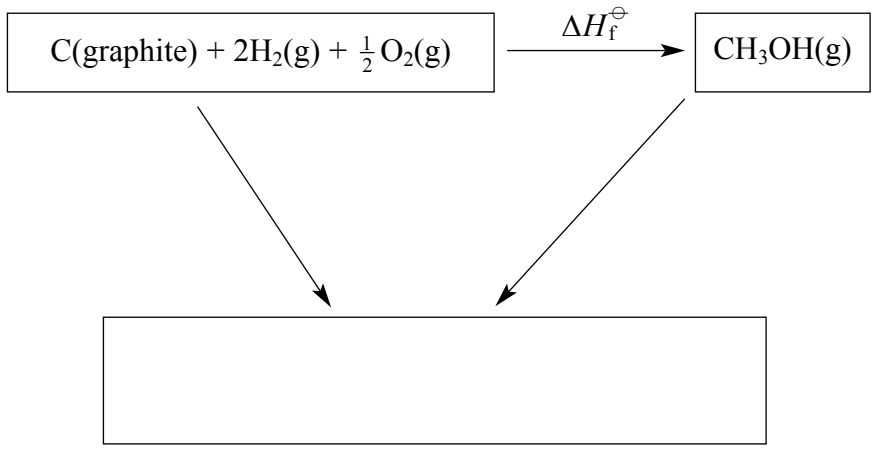
(2)

Leave blank

(iii) Complete a balanced Hess cycle which you can use to calculate the standard enthalpy change of formation of methanol vapour, $\Delta H_f^{\ominus}$.

You should use the value of the standard enthalpy change of atomisation of methanol vapour, $\Delta H_{at}^{\ominus}$, given in (ii) and the data on enthalpy changes given below. Write the correct numerical data beside the arrows in the cycle.

Equation	Enthalpy change of atomisation /kJ mol^{-1}
C(graphite) $\rightarrow$ C(g)	+716.7
$\frac{1}{2}$ $O_2(g)$ $\rightarrow$ O(g)	+249.2
$\frac{1}{2}$ $H_2(g)$ $\rightarrow$ H(g)	+218.0



Use your cycle to calculate the value of $\Delta H_f^{\ominus}$ for methanol vapour.

(3)

Leave blank

(iv) Methanol is a liquid at room temperature. Would you expect the standard enthalpy change of formation of liquid methanol to be more or less negative than the value you calculated in (iii)? Justify your answer.

.....

.....

(1)

(v) Methanol is a liquid at room temperature although alkanes with similar molecular mass are gases.

Draw a diagram to show a bond between two methanol molecules that causes it to be a liquid at room temperature.

Give the value of this bond angle on your diagram.

(2)

(d) Methanol can be manufactured in the following reaction.

$$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g) \qquad \Delta H^{\ominus} = -93.3 \text{ kJ mol}^{-1}$$

Decide whether a high or low temperature and a high or low pressure would give the greater proportion of methanol at equilibrium. Justify your choice in each case.

Temperature .....

.....

.....

Pressure .....

.....

.....

(2)

Q2

(Total 17 marks)

Leave blank

3. (a) The table below gives the boiling points of three organic compounds.

Compound	Boiling point / K
chloroethane	285
1-chloropropane	320
2-chloropropane	309

(i) Explain why 1-chloropropane has a higher boiling point than chloroethane.

.....

.....

.....

.....

(2)

(ii) Explain why 1-chloropropane has a higher boiling point than its isomer, 2-chloropropane.

.....

.....

.....

(1)

(b) Both chloroethane and iodoethane react with aqueous potassium hydroxide solution to form ethanol. The hydroxide ions act as nucleophiles.

(i) What is a **nucleophile**?

.....

.....

.....

(1)

(ii) Explain why iodoethane reacts faster than chloroethane with aqueous potassium hydroxide, under the same conditions.

.....

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(1)

Leave blank

(c) (i) Under what conditions does chloroethane react with potassium hydroxide to form ethene rather than ethanol?

.....

.....

(1)

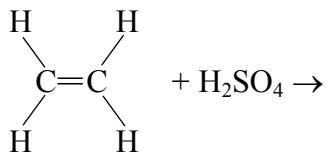
(ii) Name the **type** of reaction in which ethene is formed from chloroethane.

.....

(1)

(d) Ethanol can be produced from ethene in two stages. In the first stage ethene is reacted with concentrated sulphuric acid in an addition reaction.

(i) Complete the equation to show the product of the first stage in the process.



$+ H_2SO_4 \rightarrow$

(1)

(ii) What **type** of addition reaction is occurring?

.....

(1)

(iii) How is the product of this reaction converted to ethanol?

.....

(1)

(e) In industry, ethanol is usually manufactured from ethene, rather than by reacting chloroethane with aqueous potassium hydroxide. Suggest a reason for this.

.....

.....

.....

(1)

Q3

(Total 11 marks)

TOTAL FOR SECTION A: 45 MARKS

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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 **A RADICAL ALTERNATIVE TO IONS** straight through and then more carefully. Answer the following questions.

(a) Explain what is meant by a **free radical**.

.....

.....

(1)

(b) Name the type of bond breaking which occurs when a chlorine molecule forms free radicals.

.....

(1)

(c) Suggest the condition which causes chlorine free radicals to be produced from chlorofluorocarbons in the Earth's atmosphere.

.....

(1)

.....

(1)

(d) Write an equation for the reaction between ethane and chlorine to form a dichloroalkane.

(2)

(e) Tetrafluoroethene is made from an ethene molecule in which each hydrogen atom is replaced by a fluorine atom. Draw a section of the polymer poly(tetrafluoroethene) showing at least two monomer units.

(1)

Leave blank

(f) Propanone, CH_3COCH_3 is an example of a polar solvent. Draw a diagram of a molecule of propanone indicating where it is polar.

(1)

(g) Summarise, in no more than 110 words, the problems and advantages of using radicals in organic synthesis.

You are NOT asked to summarise the whole passage, nor to include equations in your summary. At the end of your summary state the number of words you have used. You should write your summary on the lined pages provided in this question paper.

Credit will be given for answers written in good English, using complete sentences and using technical words correctly and chemical names rather than formulae. Avoid copying long sections from the original text. Numbers count as one word, as do standard abbreviations, units and hyphenated words. Any title you give your passage does not count in your word total.

(8)

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	Group 1	2											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)