Centre No.						Paper Reference							Surname	Initial(s)
Candidate No.						6	2	5	4	/	0	1	Signature	

Paper Reference(s)

6254/01

Edexcel GCE

Chemistry (Nuffield)

Advanced

Unit Test 4

Monday 23 January 2006 – Morning

Time: 1 hour 30 minutes

Materials required for examination
Nil

Items included with question papers
Nil

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** the questions in the spaces provided in this question paper.
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 12 pages in this paper. All blank pages are indicated.

Advice to Candidates

You are advised to show all steps in any calculations.
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.

Printer's Log. No.
N23441A
W850/R6254/57570 7/7/7/4/

N 2 3 4 4 1 A 0 1 1 2

Turn over

edexcel

Leave blank

Answer ALL questions in the spaces provided.

1. Potassium hydroxide solution, KOH(aq), is used to peel peaches commercially. The peaches are placed in a 7% solution (7.00 g per 100 cm^3 of solution) for 3 minutes. The peaches are then washed, cut in half and frozen.

(a) (i) Calculate the concentration, in mol dm^{-3}, of the potassium hydroxide solution.

(2)

(ii) Calculate the pH of this solution.
[$K_w = 1.00 \times 10^{-14}$ mol^2 dm^{-6}]

(2)

(b) The concentration of the potassium hydroxide solution must not fall below 1.00 mol dm^{-3}. This is checked at intervals by the titration of 25.0 cm^3 of the solution with 0.750 mol dm^{-3} sulphuric acid.

(i) Write a balanced equation for the complete neutralisation of sulphuric acid with potassium hydroxide.

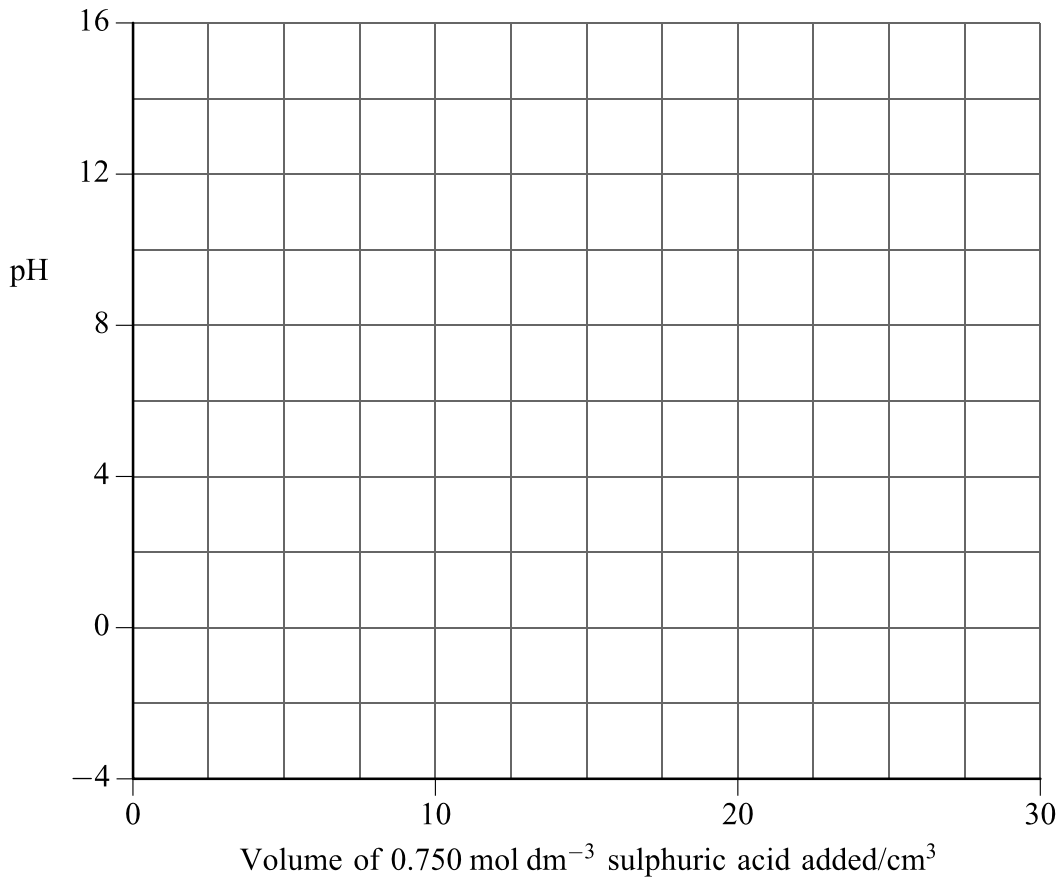
(1)

(ii) Calculate the lowest acceptable titration value before more potassium hydroxide must be added to the solution.

(2)

Leave blank

(iii) Sketch a graph showing how the pH changes when 30 cm^3 (an excess) of 0.750 mol dm^{-3} sulphuric acid is added to 25.0 cm^3 of 1.00 mol dm^{-3} potassium hydroxide.



(4)

(iv) Suggest a suitable indicator to use for this titration. Use your graph to justify your choice.

.....

.....

.....

.....

(2)

(c) Suggest a safety check that should be made before the peaches are frozen. Why is this check necessary?

.....

.....

.....

.....

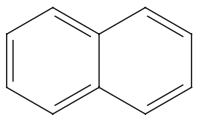
(2)

(Total 15 marks)

Q1

Leave blank

2. This question is about the arene, naphthalene. The structure of naphthalene can be shown as

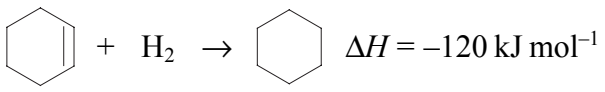


(a) What is the molecular formula of naphthalene?

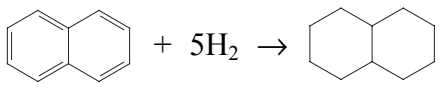
.....

(1)

(b) The enthalpy change, ΔH, for the addition of hydrogen to cyclohexene to form cyclohexane is -120 kJ mol^{-1}.



(i) Calculate the enthalpy change of the hydrogenation reaction shown below.



ΔH = ... kJ mol^{-1}

(1)

(ii) Experimental work shows that ΔH for the hydrogenation of naphthalene is actually -333 kJ mol^{-1}. What does this suggest about the stability and structure of naphthalene?

.....

.....

.....

.....

(2)

(iii) Would you expect naphthalene to decolorise bromine solution? Justify your answer.

.....

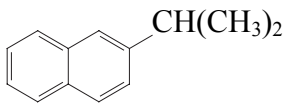
.....

.....

(1)

Leave blank

(c) The Friedel-Crafts reaction enables an alkyl group to be attached to an arene ring.

(i) Suggest the reagent and catalyst you would need to make 

from naphthalene.

Reagent .....

Catalyst .....

(2)

(ii) Name the type of reaction and its mechanism.

.....

(2)

(Total 9 marks)

Q2

Leave blank

3. One step in the manufacture of nitric acid is the reaction between nitrogen(II) oxide and oxygen to form nitrogen(IV) oxide.

$$2NO(g) + O_2(g) \rightleftharpoons 2NO_2(g) \qquad \Delta H = -114\ kJ\ mol^{-1}$$

(a) (i) Use the equation to suggest the sign of ΔS_{system} for the forward reaction. Justify your answer.

.....

.....

.....

(2)

(ii) What is the sign of $\Delta S_{surroundings}$ for the forward reaction? Justify your answer.

.....

.....

.....

.....

(2)

(b) (i) Write the expression for K_p for this reaction.
What are the units of K_p in this reaction?

Units .....

(2)

Leave blank

(ii) Suggest how the temperature and pressure could be altered to make nitrogen(IV) oxide more economically. Justify your suggestions by considering both yield and rate.

Temperature

.....

.....

.....

Pressure

.....

.....

.....

.....

.....

(4)

(c) (i) What property would allow you to follow the progress of this reaction? Justify your answer.

.....

.....

.....

.....

.....

(2)

Leave blank

(ii) In a series of experiments, the following results were obtained.

Experiment	[NO(g)] /mol dm^{-3}	[O_2(g)] /mol dm^{-3}	Initial rate /mol dm^{-3} s^{-1}
1	1.0×10^{-3}	1.0×10^{-3}	8.0×10^{-6}
2	2.0×10^{-3}	1.0×10^{-3}	3.2×10^{-5}
3	2.0×10^{-3}	2.0×10^{-3}	6.4×10^{-5}

- What is the order of the reaction with respect to NO(g)? Justify your answer.

.....

.....

.....

(2)

- What is the order of the reaction with respect to O_2(g)?

.....

(1)

(iii) What is the rate equation for this reaction?

(1)

(iv) What is the overall order for this reaction?

.....

(1)

(v) Calculate the rate constant, *k*, for this reaction. Include units with your answer.

(2)

(d) Suggest why this reaction takes place quickly at room temperature and pressure.

.....

(1)

(Total 20 marks)

Q3

Leave blank

4. This question is about compounds with the molecular formula C_4H_8O.

(a) (i) Draw the displayed formulae of TWO isomers, **A** and **B**, which are both aldehydes. Give their systematic names.

A **B**

Name ....

(4)

(ii) Suggest an instrumental method by which these isomers, **A** and **B**, could be distinguished.

Outline how the results would differ.

.....

.....

.....

(2)

(b) Substance **C**, butanone, is another isomer of C_4H_8O.

(i) Name a reagent which results in the same observation when it reacts with all three isomers, **A**, **B** and **C**.

Reagent .....

.....

Observation .....

.....

.....

(2)

Leave blank

(ii) Name a reagent where the resulting observation for **C** would be different from that for **A** and **B**.

Reagent .....

.....

.....

Observation with **C** .....

.....

.....

Observation with **A** and **B** .....

.....

.....

(3)

Leave blank

(c) (i) Suggest structural formulae for TWO more isomers of C_4H_8O, **D** and **E**, which are cyclic and react with sodium to give off hydrogen.

D **E**

(2)

(ii) Both **A** and **B** can be oxidised to carboxylic acids. These acids will then react with either of the isomers **D** or **E** in the presence of a strong acid as a catalyst.

What is the name given to the products of this type of reaction?

.....

(1)

(iii) For one of the carboxylic acids formed from **A** or **B** and one of the isomers **D** or **E**, draw a displayed formula of the product formed when they react together.

(2)

Q4

(Total 16 marks)

TOTAL FOR PAPER: 60 MARKS

END

THE PERIODIC TABLE

Period	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 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)