Paper Reference(s)

6242/01

Edexcel GCE

Chemistry

Advanced Subsidiary

Unit Test 2

Wednesday 8 June 2005 – Morning

Time: 1 hour

Materials required for examination
Nil

Items included with question papers
Nil

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initial(s) and signature.
Answer **ALL** the questions in the spaces provided in this question paper.
You may use a calculator. **Show all the steps in any calculations and state the units.**

Information for Candidates

The total mark for this paper is 60. The marks for individual questions and parts of questions are shown in round brackets: e.g. (**2**). There are 16 pages in this question paper. All blank pages are indicated.
A Periodic Table is printed on the back cover of this booklet.

Advice to Candidates

You are reminded of the importance of clear English and careful presentation in your answers.
You will be assessed on your Quality of Written Communication in this paper.

Turn over

edexcel

BLANK PAGE

Answer ALL questions in the spaces provided.

1. Aluminium is made from bauxite, which contains hydrated aluminium oxide. One of the main impurities in bauxite is iron(III) oxide.

   During the purification of bauxite, 10% sodium hydroxide solution is added.

   (a) (i) State, with a reason, what happens to the aluminium oxide when the sodium hydroxide solution is added.

   ....

   ....

   ....

   (2)

   (ii) State, with a reason, what happens to the iron(III) oxide when the sodium hydroxide solution is added.

   ....

   ....

   ....

   (2)

   (b) After purification, the aluminium oxide is dissolved in molten cryolite. The mixture is electrolysed.

   (i) Why is it necessary to use cryolite?

   ....

   (1)

   (ii) From what material is the anode made?

   ....

   (1)

   (iii) Write the ionic equation for the reaction that takes place at the cathode.

   ....

   (1)

   (iv) State the major cost in the extraction of aluminium.

   ....

   (1)

   Q1

   (Total 8 marks)

2. (a) There are two isomers of molecular formula C_3H_8O that are alcohols.

(i) Draw the full structural formulae of these isomers and name them.

Isomer 1   Isomer 2

Name   Name

....

(4)

(ii) When heated under reflux with potassium dichromate(VI) in dilute sulphuric acid, one of the isomers can be oxidised to give a compound $C_3H_6O_2$. Draw the full structural formula of this compound, $C_3H_6O_2$. State the colour change you would see during this reaction.

Structural formula

Colour change

....

(2)

(b) (i) Both isomeric alcohols can be converted to bromoalkanes of molecular formula C_3H_7Br. Give the reagents needed for this change.

....

....

(1)

(ii) One of the bromoalkanes, **X**, reacts with potassium cyanide to produce a compound with molecular formula $CH_3CH(CN)CH_3$.

Identify **X**.

....

(1)

(iii) **X** reacts differently with potassium hydroxide in aqueous solution than in ethanolic solution.

Give the structural formula of the product formed when the reaction is carried out

in aqueous solution

in ethanol.

(2)

(Total 10 marks)

3. The Contact Process is used to manufacture sulphuric acid. During this process, sulphur dioxide is mixed with excess air and passed over a heated catalyst. The following reaction occurs:

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g) \qquad \Delta H = -197 \, \text{kJ mol}^{-1}$$
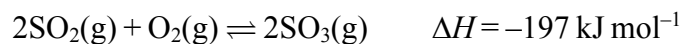
(a) Identify the catalyst used in this process.

....

(1)

(b) (i) State the temperature used in this process.

....

(1)

(ii) State and explain the effect on the **rate** of reaction of using a higher temperature than you suggested in (i).

....

....

....

....

....

....

....

(4)

(iii) State, with a reason, the effect on the **yield** of sulphur trioxide of using a higher temperature than you suggested in (i).

....

....

....

....

....

(2)

(c) (i) State the pressure used in the Contact Process.

....

(1)

(ii) Justify the use of this pressure.

....

....

....

....

....

....

(3)

(d) Describe how sulphur trioxide is converted into sulphuric acid.

....

....

....

....

(2)

(e) Sulphuric acid reacts with ammonia to make the fertiliser ammonium sulphate. Write the equation to represent this reaction.

....

(1)

(f) State ONE other important use of sulphuric acid.

....

(1)

Q3

(Total 16 marks)

4. But-1-ene undergoes the following reactions:

$$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3 \xleftarrow{\text{Reaction 1}} \text{CH}_3\text{CH}_2\text{CH}{=}\text{CH}_2 \xrightarrow{\text{Reaction 2}} \text{Compound A}$$

but-1-ene (major product)

Reaction 3 ↓

$$\text{CH}_3\text{CH}_2\text{CH(OH)CH}_2\text{OH}$$
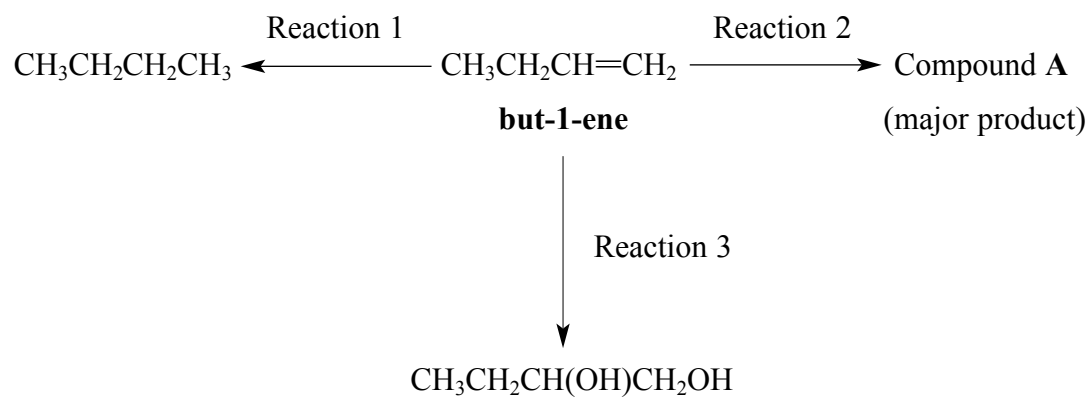
(a) State the reagent and conditions needed for **Reaction 1**.

Reagent ....

Conditions ....

(3)

(b) (i) The reagent in **Reaction 2** is gaseous hydrogen bromide.

Draw the full structural formula of compound **A**.

(1)

(ii) What type of reagent is hydrogen bromide in this reaction?

....

(1)

8

N 2 1 4 4 8 A 0 8 1 6

Leave blank

(c) Identify the reagent needed for **Reaction 3**.

....

(1)

(d) But-1-ene can be used to make an addition polymer.

Draw the repeating unit of the polymer.

(2)

(Total 8 marks)

Q4

5. (a) Enthalpy changes can be calculated using average bond enthalpy data.

(i) The enthalpy change to convert methane into gaseous atoms is shown below.

$$CH_4(g) \rightarrow C(g) + 4H(g) \qquad \Delta H = +1664 \text{ kJ mol}^{-1}$$
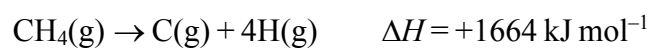
Calculate the average bond enthalpy of a C—H bond in methane.

(1)

(ii) Use the data in the table below and your answer to (a)(i) to calculate the enthalpy change for

$$2C(g) + 2H_2(g) + Br_2(g) \rightarrow CH_2BrCH_2Br(g)$$
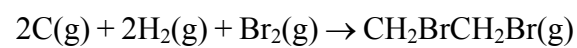
Bond	Average bond enthalpy / kJ mol^{-1}	Bond	Average bond enthalpy / kJ mol^{-1}
C—C	+348	H—H	+436
Br—Br	+193	C—Br	+276

(3)

(b) The standard enthalpy of formation of 1,2-dibromoethane, CH_2BrCH_2Br, is $-37.8 \, kJ \, mol^{-1}$.

Suggest the main reason for the difference between this value and your calculated value in (a)(ii).

....

....

....

(1)

(Total 5 marks)

Turn over

6. (a) 2,2,4-trimethylpentane, C_8H_{18}, is one of the hydrocarbons present in petrol.

(i) Draw the structural formula of 2,2,4-trimethylpentane.

(1)

(ii) To which homologous series does 2,2,4-trimethylpentane belong?

....

(1)

(b) (i) Define the term **standard enthalpy of combustion**.

....

....

....

....

....

(3)

(ii) Write the equation to represent the complete combustion of butane, C_4H_{10}.

....

(2)

(c) The enthalpies of combustion of some compounds in kJ g^{-1} and kJ cm^{-3} are given below.

Compound	ΔH_c / kJ g^{-1}	ΔH_c / kJ cm^{-3}
Butane, C$_4$H$_{10}$(g)		−0.12
Ethanol, C$_2$H$_5$OH(l)	−30	−21
2,2,4-trimethylpentane, C$_8$H$_{18}$(l)	−48	−33

(i) The standard enthalpy of combustion of butane is −2877 kJ mol^{-1}.

Calculate the enthalpy of combustion of butane in kJ g^{-1}.

(2)

(ii) Use the information in the table to compare the advantages and disadvantages of these three compounds as fuels for a motor vehicle.

....

....

....

....

....

....

....

....

....

....

(4)

Q6

(Total 13 marks)

TOTAL FOR PAPER: 60 MARKS

END

BLANK PAGE

BLANK PAGE

THE PERIODIC TABLE

Group

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

Key

Molar mass g mol⁻¹
Symbol
Name
Atomic number

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