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

Paper Reference(s)

6242/01

Edexcel GCE

Chemistry

Advanced Subsidiary

Unit Test 2

Friday 16 January 2009 – Morning

Time: 1 hour

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

Candidates may use a calculator.

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initial(s) and your signature.
Check that you have the correct question paper. The paper reference is shown above.
Answer **ALL** the questions. Write your answers in the spaces provided in this question paper.
Do not use pencil. Use black or blue ink.
Show all the steps in any calculations and state the units.

Information for Candidates

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

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.

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Leave blank

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

1. This question is about the manufacture of ammonia. The equation for the formation of ammonia is

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

The standard enthalpy of formation of ammonia is –46.2 kJ mol^{-1}.

(a) (i) By reference to ammonia, define the term **standard enthalpy of formation**.

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.....

(3)

(ii) Use the standard enthalpy of formation of ammonia to calculate the enthalpy change for the reaction shown in the equation above.

(1)

(iii) Use the bond enthalpies below to calculate another value for the enthalpy change for the reaction shown in the equation above.

[Bond enthalpies / kJ mol^{-1}: N≡N = +944; H—H = +436; N—H = +388]

(3)

Leave blank

(iv) Suggest why the two values obtained for the enthalpy change that you have calculated in parts (a)(ii) and (iii) are different, even though the data in both cases are measured under standard conditions.

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(2)

(b) (i) State the conditions normally used in the manufacture of ammonia.

Temperature .....

Pressure .....

Catalyst .....

(3)

(ii) Ammonia plants use high pressures even though the cost is high and it does not alter the rate of reaction.

State TWO factors which cause high pressure plants to be expensive.

State and explain ONE advantage of using high pressure in the manufacture of ammonia.

Factor 1 .....

.....

Factor 2 .....

.....

Advantage and explanation .....

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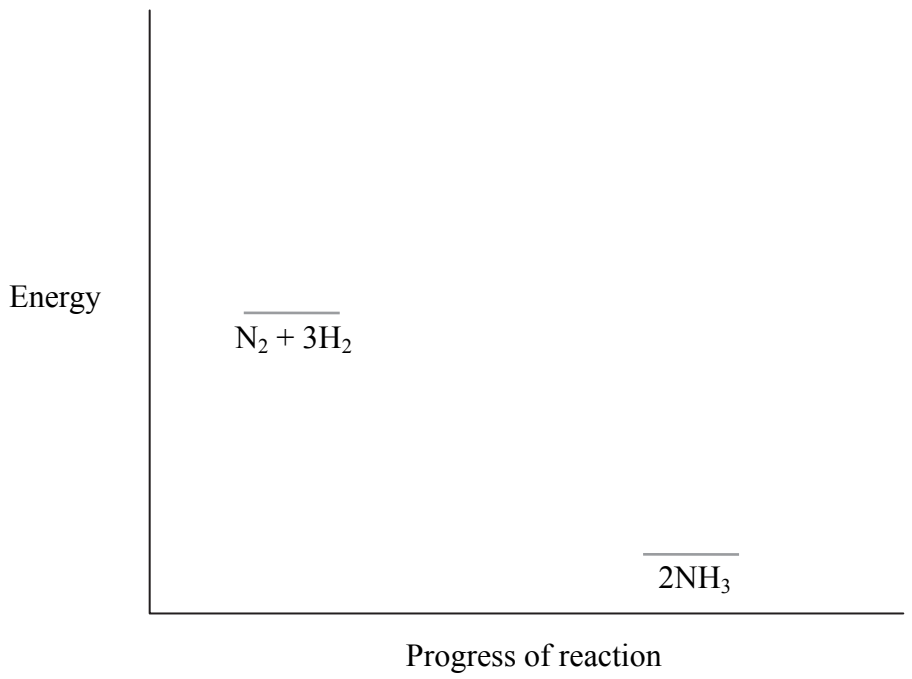
(4)

Leave blank

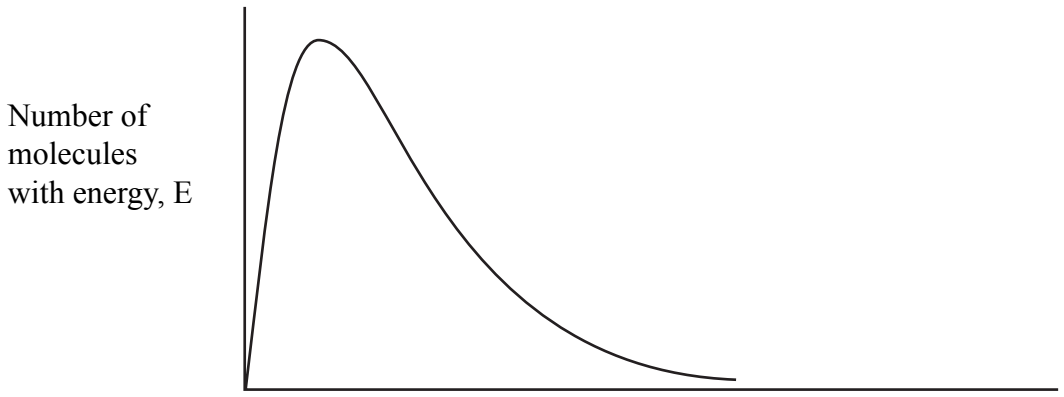
(iii) On the energy level diagram below, sketch and label the reaction pathways for the reaction with **and** without the catalyst.



(3)

Leave blank

(iv) The graph below is a Maxwell-Boltzmann distribution of molecular energies in a gas at a specified temperature.



On the graph clearly indicate the activation energy of the catalysed **and** of the uncatalysed reactions.

Hence explain the effect of the catalyst on the rate of reaction.

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(3)

Q1

(Total 22 marks)

Leave blank

2. **W** is an alcohol which resists oxidation even on prolonged heating with an oxidising agent. Heating **W** with concentrated sulphuric acid at 180 °C produces an alkene **X** with molecular formula C_4H_8.

(a) (i) Analysis of **W** gave the following composition by mass:

Carbon 64.9%; Oxygen 21.6%; Hydrogen 13.5%.

Show that the empirical formula of **W** is $C_4H_{10}O$.

(2)

(ii) Draw the structural formula of **W**. Explain your choice.

Explanation .....

.....

(2)

Leave blank

(b) (i) Draw the structural formulae of the **structural** isomers of the three alkenes with the formula C_4H_8. Geometric (cis-trans) isomers are **not** required here.

(3)

(ii) Identify the alkene **X** and give a reason for your choice.

Identification .....

Reason .....

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.....

(2)

Leave blank

(c) One of the alkenes C_4H_8 exists as a pair of geometric (cis-trans) isomers.

(i) Draw the structures of these two geometric isomers.

(2)

(ii) Explain why this alkene shows geometric isomerism.

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(2)

Leave blank

(d) **Y**, an isomer of the alcohol **W**, also reacts with concentrated sulphuric acid to form **X**.

Prolonged treatment of **Y** with an oxidising agent results in the formation of a compound, **Z**, with formula $C_4H_8O_2$.

Draw the structural formulae of **Y** and **Z**.

Y

Z

(2) **Q2**

(Total 15 marks)

Leave blank

3. Some polymerisation reactions are initiated by free radicals.

(a) (i) Explain the term **free radical**.

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.....

(1)

(ii) Free radicals are also involved in the substitution reactions of alkanes with chlorine. State the condition essential for these reactions.

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(1)

(b) (i) Write an equation for the polymerisation of propene to form poly(propene). Use structural formulae and show the repeating unit of the polymer.

(3)

Leave blank

(ii) By considering the nature and strength of the bonds broken and formed in the polymerisation, explain why the reaction is exothermic.

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(3)

(iii) Explain why an initiator is needed for the polymerisation to occur, even though the reaction is energetically favourable.

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(1)

Q3

(Total 9 marks)

Leave blank

4. Aluminium is extracted by the electrolysis of aluminium oxide. The overall equation for the reaction is

$$2Al_2O_3 \rightarrow 4Al + 3O_2$$

The main aluminium-containing ore is bauxite which typically contains between 45% and 60% aluminium oxide.

(a) (i) Calculate the minimum mass of aluminium oxide required to produce 1.5 tonne (1.5×10^6 g) of aluminium.

(3)

(ii) A sample of bauxite contains 54% aluminium oxide. Calculate the minimum mass of bauxite required to produce 1.5 tonne (1.5×10^6 g) of aluminium.

(1)

(b) (i) State the solvent used to dissolve the pure aluminium oxide and the operating temperature used in the electrolysis.

Solvent .....

Temperature .....

(2)

(ii) Explain why pure aluminium oxide is **not** used as the electrolyte.

.....

.....

(1)

Leave blank

(iii) Write an ionic half-equation for the formation of aluminium at the cathode.
State symbols are **not** required.

.....

(2)

(iv) Write an ionic half-equation for the formation of oxygen at the anode.
State symbols are **not** required.

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(2)

(v) Explain, with the aid of a chemical equation, why the anodes need to be replaced regularly.

Explanation.....

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Equation.....

(2)

(vi) Replacement of the anodes is one major cost in the production of aluminium. State the other major cost.

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(1)

Q4

(Total 14 marks)

TOTAL FOR PAPER: 60 MARKS

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THE PERIODIC TABLE

Period	1	2	Group										3	4	5	6	7	0
1	1 H Hydrogen 1																	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