Paper Reference(s)

6251/01

Edexcel GCE

Chemistry (Nuffield)

Advanced Subsidiary

Unit Test 1

Wednesday 18 January 2006 – Morning

Time: 1 hour 15 minutes

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 your signature.
Answer **ALL** the questions. Write your answers 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 16 pages in this paper. Any 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 account of your use of grammar, punctuation and spelling.

Turn over

edexcel

Answer ALL questions in the spaces provided.

SECTION A

1. When a solution of copper(II) nitrate, $Cu(NO_3)_2(aq)$, is added to a solution of sodium carbonate, $Na_2CO_3(aq)$, a greenish-blue precipitate is seen in a colourless solution.

   (a) Complete and balance the equation for the reaction. Include state symbols.

   $Cu(NO_3)_2(aq) + Na_2CO_3(aq) \rightarrow$ .... + ...

   (2)
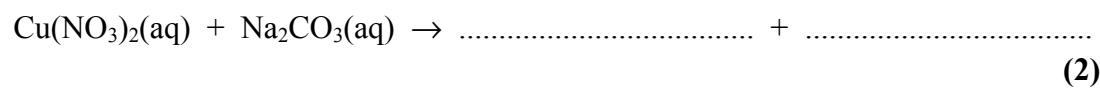
   (b) A flame test is carried out on a sample of the colourless solution. What flame colour would be seen?

   ....

   (1)

   (c) Identify the blocks of the Periodic Table (s, p, d or f) to which these elements belong.

   Copper .... Sodium ....

   (1)

   (Total 4 marks)

Q1

2. (a) Calculate the number of atoms in 3.50 g of lithium.

   Use the Periodic Table as a source of data.

   [The Avogadro constant, $L = 6.02 \times 10^{23} \, mol^{-1}$]

   (2)

(b) The equation for the reaction of lithium with hydrochloric acid is shown below.

$$2Li(s) + 2HCl(aq) \rightarrow 2LiCl(aq) + H_2(g)$$
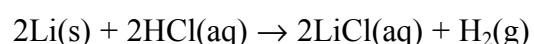
(i) Rewrite this equation as an ionic equation, omitting the spectator ions.

(1)

(ii) Draw a 'dot and cross' diagram of lithium chloride showing **all** the electrons. Indicate charges clearly on your diagram.

(2)

(iii) The value of the standard enthalpy change for the reaction, $\Delta H^{\ominus}$, is $-557\,kJ\,mol^{-1}$. State TWO of the reaction conditions necessary for this enthalpy change to be **standard**.

....

....

....

....

....

(2)

Q2

(Total 7 marks)

3. (a) Name the homologous series to which the organic compound $CH_2=CHCH_3$ belongs.

....

(1)

(b) Write the structural formula of a member of the series named in (a) which contains four carbon atoms.

....

(1)

Q3

(Total 2 marks)

TOTAL FOR SECTION A: 13 MARKS

SECTION B

4. This question is about iron and some of its compounds.

   (a) Name the type of bonding in iron and draw a labelled diagram to illustrate it.

   Name ....

   (2)

   (b) A student investigated the reaction of iron with sulphuric acid to find out which of two possible equations is followed.

   Equation 1 $Fe(s) + H_2SO_4(aq) \rightarrow FeSO_4(aq) + H_2(g)$

   Equation 2 $2Fe(s) + 3H_2SO_4(aq) \rightarrow Fe_2(SO_4)_3(aq) + 3H_2(g)$
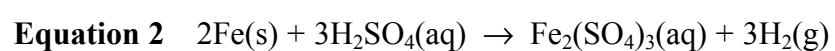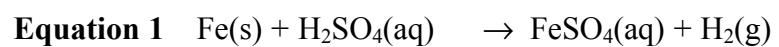
   (i) Deduce the formula of the iron ions in

   $FeSO_4(aq)$ .... $Fe_2(SO_4)_3(aq)$ ....

   (1)

   (ii) Explain why both equations represent oxidation of iron.

   ....

   ....

   (1)

(iii) In the investigation, 0.500 g of iron was reacted with 10.0 cm³ of sulphuric acid of concentration $2.00\ mol\ dm^{-3}$.

Calculate the number of moles of each substance. Use the Periodic Table as a source of data.

Iron, Fe

Sulphuric acid, H_2SO_4

(2)

(iv) The total volume of hydrogen produced, measured at room temperature and pressure, was 214 cm³.

Calculate the number of moles of hydrogen molecules in this volume. Hence show that **Equation 1** is followed.

[The molar volume of a gas is 24 000 cm³ at room temperature and pressure]

(2)

(v) Why was an excess of sulphuric acid used in this reaction?

....

....

(1)

(c) The solution of iron sulphate, $FeSO_4$, made in this reaction was then mixed with a solution of ammonium sulphate to make the double salt called Mohr's salt, with the formula $(NH_4)_2SO_4.FeSO_4.6H_2O$.

(i) The ammonium sulphate solution was made by adding an excess of aqueous ammonia to sulphuric acid.

Name an indicator, other than Universal Indicator, which would change colour when an excess of aqueous ammonia reacts with sulphuric acid. State the colours you would see.

Indicator ....

Colour in sulphuric acid ....

Colour when excess ammonia is added ....

(2)

(ii) This mixture was then boiled to drive off excess ammonia. This produced a solution of ammonium sulphate which was mixed with the iron sulphate solution.

What steps would be taken to produce dry crystals of Mohr's salt from the mixture?

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....

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....

(2)

Q4

(Total 13 marks)

5. Butan-1-ol is a primary alcohol with the formula $CH_3CH_2CH_2CH_2OH$.

(a) Butan-1-ol can be converted into an aldehyde.

(i) What type of reaction is this?

....

(1)

(ii) Give the names or formulae of the TWO reagents you would mix with butan-1-ol to carry out this reaction.

....

....

(2)

(iii) What colour change would you see when the reaction occurs?

From .... to ....

(1)

(iv) Draw a labelled diagram showing the apparatus you would use to carry out this reaction and collect the product.

(2)

Leave blank

(v) Draw the **displayed** formula of the aldehyde that forms.

(1)

(vi) An isomer of butan-1-ol produces butanone if treated as in (ii).

How would you distinguish the aldehyde from butanone?
Name the reagent you would use and state your observation with each compound.

Reagent ....

Observation with aldehyde ....

Observation with butanone ....

(3)

(b) Draw the **displayed** formula of another **primary** alcohol which is an isomer of butan-1-ol, and name it.

Name ....

(2)

(Total 12 marks)

Q5

N 2 3 4 3 9 A 0 9 1 6

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6. (a) An atom of argon has mass number 40. Complete the table below showing the composition of this argon atom.

Use the Periodic Table as a source of data.

Protons	
Electrons	
Neutrons	

(2)

(b) An atom of potassium has mass number 39. Explain, in terms of atomic structure, why argon comes before potassium in the Periodic Table.

....

....

....

....

(1)

(c) A sample of argon contains a mixture of isotopes as shown below.

Calculate the relative atomic mass of argon in the sample. Give your answer to **three** significant figures.

Isotopic mass	% abundance
36.0	1.34
38.0	0.160
40.0	98.5

(2)

(d) Write the electron configuration of argon in s, p notation.

....

(1)

(e) The chart shows the first ionisation energy of some elements in the third period of the Periodic Table.

1st ionisation energy /kJ mol^{-1}

2000
1500
1000
500
0

P   S   Cl   Ar   K
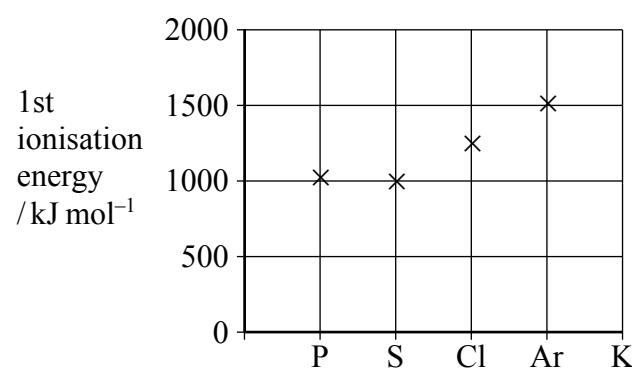
(i) Write the chemical equation, with state symbols, which corresponds to the first ionisation energy of argon.

....

(1)

(ii) On the chart, add a cross to show the first ionisation energy of potassium. Justify your choice of the position of the cross.

....

....

....

....

....

(2)

(iii) Explain why there is a small decrease in first ionisation energy going from phosphorus to sulphur.

....

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....

....

(2)

(iv) Explain why there is an increase in first ionisation energy going from sulphur to chlorine.

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....

(2)

(f) Suggest why argon is used to fill some types of light bulbs.

....

....

(1)

(Total 14 marks)

7. (a) The equation below shows a reaction of magnesium nitrate.

$$2Mg(NO_3)_2(s) \xrightarrow{\text{heat}} 2MgO(s) + 4NO_2(g) + O_2(g)$$
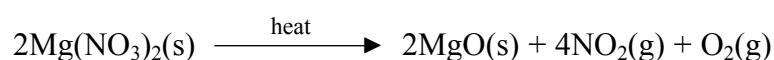
What type of reaction is taking place?

....

(1)

(b) The Hess cycle below can be used to find the enthalpy change for the reaction in (a), ΔH_r, using enthalpy changes of formation.

$2Mg(NO_3)_2(s)$	$\xrightarrow{\Delta H_r}$	$2MgO(s) + 4NO_2(g) + O_2(g)$

ΔH_1 ΔH_2
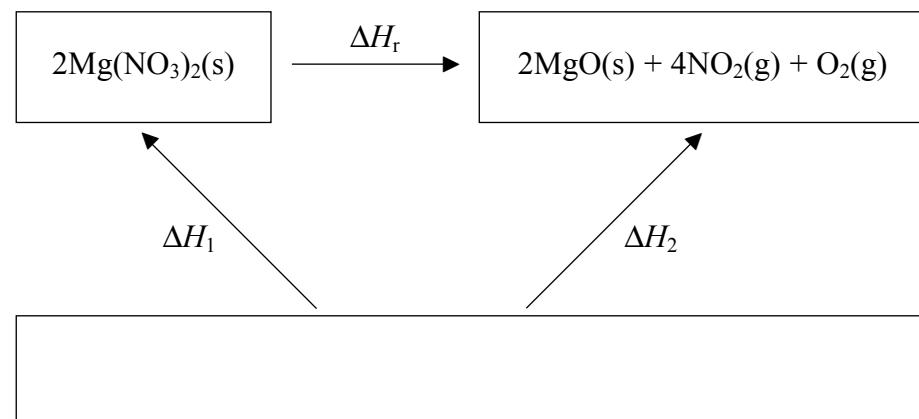
(i) Complete the empty box in the cycle.

(2)

(ii) Use the cycle and the data below to calculate the enthalpy change of the reaction, ΔH_r.

	ΔH_f /kJ mol^{-1}
$Mg(NO_3)_2$	-790.7
MgO	-601.7
NO_2	$+33.2$

(3)

(c) Magnesium oxide is a basic oxide which produces an alkaline solution with water. Write an equation to show how the oxide ion, O^{2-}, acts as a base in the reaction with water.

....

(1)

(d) Nitrogen dioxide reacts with water to form a solution containing a mixture of two acids.

$$2NO_2(g) + H_2O(l) \rightarrow HNO_2(aq) + HNO_3(aq)$$
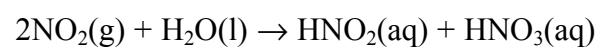
Would you expect the solution to conduct electricity? Explain your answer.

....

....

(1)

Q7

(Total 8 marks)

TOTAL FOR SECTION B: 47 MARKS
TOTAL FOR PAPER: 60 MARKS

END

THE PERIODIC TABLE

Group

Period	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** Unni- quadium (261)	105 **Unp** Unni- pentium (262)	106 **Unh** Unni- 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)