Centre No.					
Candidate No.					

Paper Reference (complete below)						
				/		

Surname	Initial(s)
Signature	

Paper Reference(s)

6251/01

Examiner's use only

Team Leader's use only

Edexcel GCE

Chemistry (Nuffield)

Advanced Level/Advanced Subsidiary

Unit Test 1

Friday 12 January 2001 – Morning

Time: 1 hour 20 minutes

Materials required for examination
Nil

Items included with question papers
Nil

Question Number	Leave Blank
Section A	
4	
5	
6	
7	
8	
Total	

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname and initials, the paper reference and your signature. The paper reference is shown above.
Answer ALL questions in the spaces provided in this question paper.
Show all the steps in any calculations. 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**).
There are 8 questions in this question paper. The total mark for this paper is 60.

Advice to Candidates

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

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SECTION A

Leave blank

Answer **ALL** questions in the spaces provided.

1. (a) In some reactions, sulphur atoms are converted into sulphide ions. Draw a 'dot and cross' diagram for a sulphide ion. Show outer shell electrons only and the charge on the ion.

(2)

(b) State which noble gas has the same electronic configuration as a sulphide ion. Use the Periodic Table as a source of data.

.....

(1)

(c) Give the formula for potassium sulphide.

(1)

2. (a) Balance the equation for the action of heat on the nitrate of a Group 2 metal, X.

$$X(NO_3)_2(s) \longrightarrow \quad XO(s) + \quad NO_2(g) + \quad O_2(g)$$

(2)

(b) Describe ONE observation you would expect to make as the reaction takes place.

.....

.....

(1)

(c) Which Group 2 metal forms compounds giving an apple green colour in a flame test?

.....

(1)

Leave blank

3. (a) Write an equation to represent the first ionisation energy of sodium. Include state symbols in your equation.

(2)

(b) Give the full electronic configuration of a nitrogen atom, using the s p d notation.

.....

(1)

(c) Suggest a reason why helium has the highest first ionisation energy of all elements.

.....

.....

.....

.....

(1)

SA

TOTAL FOR SECTION A: 12 MARKS

SECTION B

Leave blank

4. The ages of volcanic rocks can be estimated by analysing the relative abundance of the helium isotopes present.

When volcanic rocks are formed, the isotopes of hydrogen, $^{3}_{1}H$, and helium, $^{4}_{2}He$, are incorporated into the rock. The isotope of hydrogen is radioactive and decays into $^{3}_{2}He$. Both isotopes of helium are stable.

A sample of helium from a volcanic rock was found to have the following percentage composition

$^{3}_{2}He$ 0.99% $^{4}_{2}He$ 99.01%

(a) (i) Explain what is meant by the term **isotope** using helium to illustrate your answer.

.....

.....

.....

(2)

(ii) Complete the table to show the number of each type of subatomic particle present in the atoms of hydrogen and helium shown.

Atom	Number of protons	Number of neutrons	Number of electrons
$^{3}_{1}H$			
$^{3}_{2}He$			

(2)

(iii) In what way are the two atoms, $^{3}_{1}H$ and $^{3}_{2}He$, similar?

.....

(1)

(b) (i) Give the name of the instrument used to measure the relative abundances of isotopes.

Leave blank

.....

(1)

(ii) Use the percentage composition data to calculate the average relative atomic mass of helium in this sample of helium from a volcanic rock. Give your answer to FOUR significant figures.

(2)

(c) Suggest how the ratio of $^{3}_{2}He$ to $^{4}_{2}He$ changes as the volcanic rock becomes older.

.....

.....

(1)

Q4

(Total 9 marks)

Leave blank

5. This question is about organic compounds with the molecular formula C_3H_8O.

(a) (i) Draw the structural formulae of the two isomers with the molecular formula C_3H_8O which are alcohols. Give the names of these alcohols.

ALCOHOL 1 ALCOHOL 2

Structural formula

Name ....

(4)

(ii) What is the molecular formula of the next member of this homologous series of alcohols?

.....

(1)

(b) Primary alcohols can be fully oxidised to carboxylic acids.

(i) Give the name and structural formula of the carboxylic acid formed when the primary alcohol C_3H_8O is fully oxidised.

Name .....

Structural formula

(2)

(ii) Name the two reagents needed for this oxidation.

Reagent 1 .....

Reagent 2 .....

(2)

(iii) What colour change would you observe as the reaction takes place?

From ..... to .....

(2)

(iv) Draw a fully labelled diagram of the apparatus you would use to fully oxidise the alcohol to the carboxylic acid.

Leave blank

(4)

(v) Name the process you would use to separate the carboxylic acid from the reaction mixture.

.....

(1)

Q5

(Total 16 marks)

6. Ammonium nitrate, NH_4NO_3, can be made by reacting ammonia solution with dilute nitric acid.

Leave blank

(a) Write a balanced equation for this reaction. Include state symbols in your equation.

(2)

(b) What type of reaction is this?

.....

(1)

(c) Describe how you would obtain a colourless neutral solution of ammonium nitrate, using this reaction.

.....

.....

.....

.....

.....

(2)

(d) Describe how you would obtain pure dry crystals of ammonium nitrate from the solution in (c).

.....

.....

.....

.....

.....

.....

.....

.....

(4)

Q6

(Total 9 marks)

Leave blank

7. Sprained ankles can be treated with an ice pack. An alternative is to use a divided pack containing ammonium nitrate and water which can be mixed to provide a low temperature.

$$NH_4NO_3(s) + aq \longrightarrow NH_4^+(aq) + NO_3^-(aq) \qquad \Delta H = +25.2\,kJ\,mol^{-1}$$

(a) What would be the enthalpy change in joules if 40 g of ammonium nitrate was dissolved in water? [molar mass of ammonium nitrate = 80 g mol^{-1}]

(1)

(b) Use your answer to (a) to calculate the final temperature if 40 g of ammonium nitrate was dissolved in 200 g of water which was initially at 20 °C.

$$\underset{(J)}{\text{Enthalpy change}} = \underset{(g)}{\text{mass of water}} \times 4.2 \times \underset{(K)}{\text{temperature change}}$$
$$(J\,g^{-1}\,K^{-1})$$

(2)

(c) Suggest TWO advantages of using the ammonium nitrate/water pack over an ice pack for treating injuries in a football match.

Advantage 1 .....

.....

Advantage 2 .....

.....

(2)

Q7

(Total 5 marks)

8. The decomposition of ammonium nitrate can be represented by the following equation

Leave blank

$$2NH_4NO_3(s) \longrightarrow 2N_2(g) + O_2(g) + 4H_2O(g)$$

(a) Show that the molar mass of ammonium nitrate is 80 g mol^{-1}.
Use the Periodic Table as a source of data.

(1)

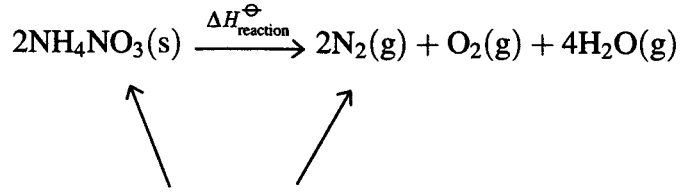
(b) What volume of nitrogen (at room temperature and pressure) would be produced if 20 g of ammonium nitrate was decomposed?

[1 mole of any gas has a volume of 24 dm^3 at room temperature and pressure.]

(2)

(c) (i) Complete the Hess cycle below so that $\Delta H^{\ominus}_{reaction}$ can be calculated using standard enthalpy changes of formation. Include state symbols.

Leave blank



.....

(1)

(ii) Calculate $\Delta H^{\ominus}_{reaction}$ given that

$\Delta H^{\ominus}_{f}[NH_4NO_3(s)] = -365.6 \text{ kJ mol}^{-1}$
$\Delta H^{\ominus}_{f}[H_2O(g)] = -241.8 \text{ kJ mol}^{-1}$

Include a sign and units in your answer.

(3)

(d) Use the equation and your answers to (b) and (c) to suggest TWO reasons why ammonium nitrate makes a good explosive.

Reason 1 .....

.....

Reason 2 .....

.....

(2)

Q8

(Total 9 marks)

TOTAL FOR SECTION B: 48 MARKS

END

THE PERIODIC TABLE

Period	1	2	Group 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)

Centre No.						Paper Reference (complete below)							Surname	Initial(s)
Candidate No.										/			Signature	

Paper Reference(s)

6251/01

Edexcel GCE

Chemistry (Nuffield)

Advanced Level/Advanced Subsidiary

Unit Test 1

Monday 4 June 2001 – Afternoon

Time: 1 hour 20 minutes

Examiner's use only

Team Leader's use only

Materials required for examination
Nil

Items included with question papers
Nil

Question Number	Leave Blank
Section A	
5	
6	
7	
8	
9	
Total	

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Turn over

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SECTION A

Leave blank

Answer **ALL** questions in the spaces provided.

1. (a) Balance the equation.

$$NaHCO_3(s) \longrightarrow Na_2CO_3(s) + CO_2(g) + H_2O(l)$$

(1)

(b) Name the reactant.

.....

(1)

(c) What type of reaction is this?

.....

(1)

2. A sample of lead (atomic number 82) is made up of three isotopes. The sample has the following percentage composition:

Mass number	% composition
206	25.6
207	21.2
208	53.2

(a) What is the maximum number of neutrons in any one atom of lead in this sample?

.....

(1)

(b) What is the average relative atomic mass of lead in this sample? Give your answer to FOUR significant figures.

(2)

(c) Draw a diagram to illustrate the metallic bonding in a typical metal such as lead.

Leave blank

(1)

3. Calcium reacts with water. The balanced equation for the reaction is:

$$Ca(s) + 2H_2O(l) \longrightarrow Ca(OH)_2(aq) + H_2(g)$$

(a) Suggest TWO things you would **see** as the reaction takes place.

.....

.....

.....

.....

(2)

(b) (i) What is the laboratory name given to the solution formed in this reaction?

.....

(1)

(ii) What is this solution used to test for?

.....

(1)

4. Give the names of the two organic compounds which could be produced on oxidising $CH_3CH_2CH_2CH_2OH$ with sodium dichromate and sulphuric acid.

Compound 1 .....

Compound 2 .....

(2)

SA

TOTAL FOR SECTION A: 13 MARKS

SECTION B

Leave blank

5. (a) Ethanol can be converted into ethene.

$$C_2H_5OH(l) \longrightarrow C_2H_4(g) + H_2O(l)$$

(i) Give TWO names which describe this type of reaction.

.....

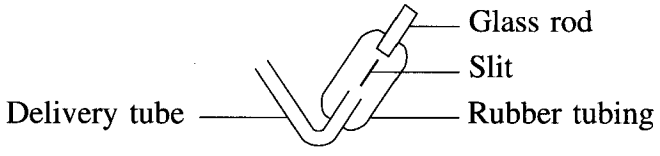
.....

(2)

(ii) Draw a fully labelled diagram of the laboratory apparatus, including the chemicals, you would use to convert ethanol into ethene and to collect the gas.

(4)

(iii) The diagram below shows a Bunsen valve. The valve is often put on the end of a delivery tube when a gas is collected.



Bunsen valve

Why is this valve useful?

.....

.....

(1)

(b) (i) Draw the displayed formula for ethene.

Leave blank

(1)

(ii) The equation for ethene reacting with bromine water is:

$$C_2H_4(g) + Br_2(aq) \longrightarrow C_2H_4Br_2(l)$$

What colour change would you expect to see?

From ..... to .....

(1)

(iii) Draw the displayed formulae for TWO isomers with the molecular formula $C_2H_4Br_2$.

(2)

Q5

(Total 11 marks)

6. Hydrogen peroxide, H_2O_2, is a weak acid.

Leave blank

(a) (i) Give the formula of the ion always present in acidic solutions.

.....

(1)

(ii) Explain what is meant by a **weak** acid.

.....

.....

(2)

(b) You are asked to make 250 cm^3 of a 1 mol dm^{-3} solution of hydrogen peroxide.

(i) Calculate the number of moles of hydrogen peroxide needed.

(1)

(ii) Calculate the mass of hydrogen peroxide, H_2O_2, needed.
Use the Periodic Table as a source of data.

(1)

(iii) Hydrogen peroxide is a liquid at room temperature. It has a density of 1.44 g cm^{-3}. Calculate the volume of liquid hydrogen peroxide needed.

(1)

(iv) What colour would you expect full-range universal indicator solution to turn in a 1.0 mol dm^{-3} solution of hydrogen peroxide?

.....

(1)

Q6

(Total 7 marks)

7. Hydrogen peroxide is an oxidising agent.

Leave blank

Hydrogen peroxide will oxidise an acidified solution of iron(II) sulphate. The equation for the reaction is:

$$2FeSO_4(aq) + H_2O_2(aq) + H_2SO_4(aq) \longrightarrow Fe_2(SO_4)_3(aq) + 2H_2O(l)$$

(a) What is the charge on the iron ion in:

$FeSO_4$ .....

$Fe_2(SO_4)_3$? .....

(1)

(b) Give the formula of the spectator ion in this equation.

.....

(1)

(c) Rewrite this equation as an ionic equation, omitting the spectator ion.

(1)

(d) Explain why the iron is said to be oxidised in this reaction.

.....

.....

(1)

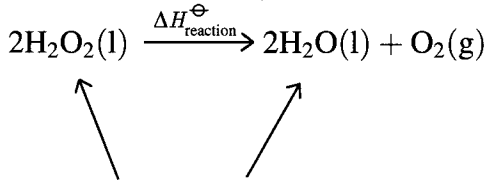
Q7

(Total 4 marks)

8. Hydrogen peroxide can readily decompose into water and oxygen.

Leave blank

(a) Complete the Hess cycle below so that $\Delta H^{\ominus}_{reaction}$ can be calculated using standard enthalpies of formation. Include state symbols.



.....

(1)

(b) Calculate $\Delta H^{\ominus}_{reaction}$ for this reaction given that

$\Delta H^{\ominus}_{f}[H_2O_2(l)] = -187.8 \text{ kJ mol}^{-1}$
$\Delta H^{\ominus}_{f}[H_2O(l)] = -285.8 \text{ kJ mol}^{-1}$

Include a sign and units in your answer.

(3)

(c) What volume of oxygen (at room temperature and pressure) would be produced from the complete decomposition of 17 g of hydrogen peroxide?
[Molar volume is 24 dm^3 mol^{-1} at room temperature and pressure].

(2)

(d) Suggest, with a reason, ONE safety precaution which should be taken when storing hydrogen peroxide. Justify your answer.

.....

.....

.....

(2)

Q8

(Total 8 marks)

9. This question is about the first twelve elements of the Periodic Table, hydrogen to magnesium.

Leave blank

(a) (i) Write an equation to represent the SECOND ionisation energy of beryllium. Include state symbols in the equation.

(2)

(ii) Suggest which one of these twelve elements would have the largest SECOND ionisation energy. Justify your choice.

.....

.....

.....

.....

(2)

(iii) Suggest which atom of these twelve elements would have the largest atomic radius. Justify your choice.

.....

.....

.....

.....

(2)

(b) (i) Give the electronic configuration of an oxide ion, O^{2-}, using s p d notation.

Leave blank

.....

(1)

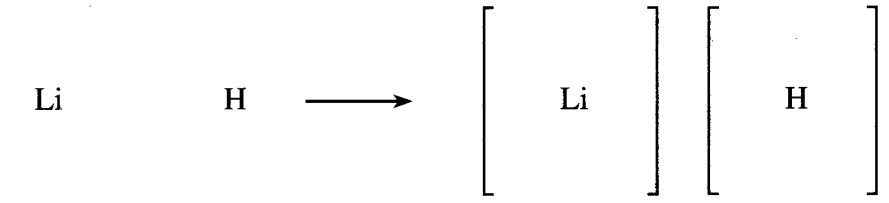
(ii) Give the name and formula of TWO other species (atoms or ions) which have the same electronic configuration as an oxide ion.

Name: ..... Formula: .....

Name: ..... Formula: .....

(2)

(c) Draw a 'dot and cross' diagram to represent the formation of the ionic solid lithium hydride from its elements. Show all the electrons and ionic charges.



Lithium atom

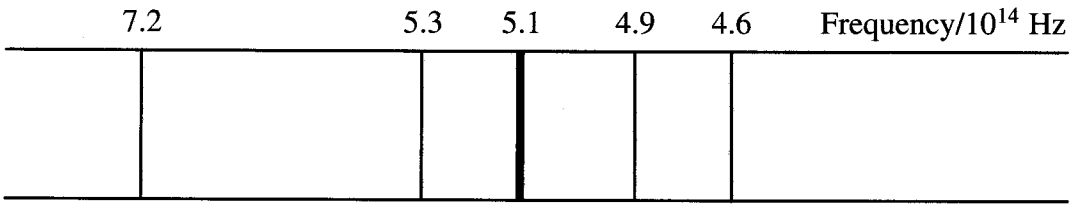
Hydrogen atom

Lithium hydride

(3)

(d) Part of the emission spectrum of sodium is shown below. The most intense line is at 5.1×10^{14} Hz.

Leave blank



(i) Suggest the colour of the emission seen at 5.1×10^{14} Hz.

.....

(1)

(ii) Explain how a line in the emission spectrum arises.

.....

.....

.....

.....

(2)

(iii) Why are there several lines in the emission spectrum?

.....

.....

(1)

(iv) Suggest ONE way in which the emission spectrum of sodium could be of use.

.....

.....

(1)

Q9

(Total 17 marks)

TOTAL FOR SECTION B: 47 MARKS

END

THE PERIODIC TABLE

Period	1	2	Group										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)

Centre No.						Paper Reference (complete below)							Surname	Initial(s)
Candidate No.										/			Signature	

Paper Reference(s)

6251/01

Edexcel GCE

Chemistry (Nuffield)

Advanced Level/Advanced Subsidiary

Unit Test 1

Friday 11 January 2002 – Afternoon

Time: 1 hour 20 minutes

Examiner's use only

Team Leader's use only

Materials required for examination
Nil

Items included with question papers
Nil

Question Number	Leave Blank
Section A	
5	
6	
7	
8	
Total	

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Turn over

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W850/R9087/57570 4/6/6/6/3/4300

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Success through qualifications

Answer ALL the questions in the spaces provided.

Leave blank

SECTION A

1. Write a balanced equation, including state symbols, for the reaction between calcium and water.

(2)

2. (a) Draw a diagram to show the bonding in a metal.

(1)

(b) Explain how the bonding in metals accounts for their high electrical conductivity.

.....

.....

(1)

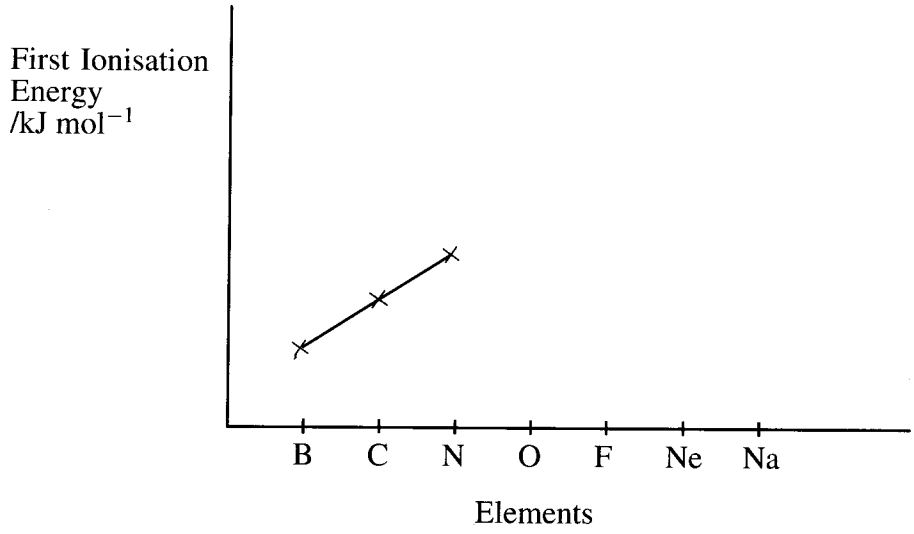
Leave blank

3. (a) Give the electronic arrangement for the element carbon, using the s,p,d notation.

.....

(1)

(b) The sketch graph shows the first ionisation energies for boron, carbon and nitrogen. Continue the sketch to show the first ionisation energies of the next four elements of the Periodic Table.



(3)

4. When carbon dioxide dissolves in water it forms the weak acid, carbonic acid.

(a) Explain what is meant by the term **weak acid**.

.....

.....

(1)

(b) (i) Suggest a simple test to show that carbonic acid is a weak acid.

.....

(1)

(ii) State the result of your test.

.....

(1)

SA

TOTAL FOR SECTION A: 11 MARKS

SECTION B

Leave blank

5. This question is about the metal indium and its compounds.

(a) A sample of the metal indium has two main isotopes, with relative percentage abundances as follows:

$^{115}_{49}In$ 97.31%

$^{113}_{49}In$ 2.69%

(i) Use the information to work out the molar mass of this sample of indium.

Remember to show your working clearly and to include units in your answer which should be given to 4 significant figures.

(2)

(ii) Name the instrument used to measure relative isotopic abundances.

.....

(1)

(b) (i) Indium reacts with dilute sulphuric acid to form a solution of indium(III) sulphate, $In_2(SO_4)_3$, and hydrogen gas. Write a balanced equation for the reaction including state symbols.

(2)

(ii) Describe how dry crystals of indium(III) sulphate could be obtained from its solution.

Leave blank

.....

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.....

(4)

(c) State the numbers of protons, neutrons and electrons in the indium(III) ion, $^{115}_{49}In^{3+}$.

Protons .....

Neutrons .....

Electrons .....

(3)

Q5

(Total 12 marks)

6. Butan-1-ol can be partially oxidised to butanal.

Leave blank

(a) (i) Give the structural formula of butan-1-ol.

(1)

(ii) Name the TWO chemicals which are used to bring about the partial oxidation of butan-1-ol.

.....

.....

(2)

(iii) Draw a fully labelled diagram of the apparatus which could be used to obtain the product of this partial oxidation.

(3)

(iv) State how the colour of the reaction mixture changes during the reaction.

From .....

To .....

(2)

(b) (i) Describe what you would see if butan-1-ol and butanal were each separately warmed with Benedict's solution.

Leave blank

Butan-1-ol .....

Butanal .....

(2)

(ii) Explain why a sample of butanal which has been stored for some time may react with sodium carbonate solution.

.....

.....

.....

(2)

Q6

(Total 12 marks)

Leave blank

7. An indigestion tablet contains 680 mg of calcium carbonate. The tablet relieves indigestion by reacting with excess stomach acid, which is effectively hydrochloric acid.

(a) (i) Complete the equation for the reaction between hydrochloric acid and calcium carbonate. Include state symbols in your answer.

$CaCO_3(s)$ + ... $\longrightarrow$ ..... + $CO_2(g)$ + ...

(2)

(ii) Calculate the number of moles of calcium carbonate in one tablet.
Use the Periodic Table as a source of data.

(2)

(iii) What volume of carbon dioxide (at room temperature and pressure) would form from one tablet.
[Molar volume is 24 dm^3mol^{-1} at room temperature and pressure.]

(2)

(iv) Suggest ONE side effect of using these tablets to relieve indigestion.

.....

(1)

(b) The presence of calcium ions in the tablets can be confirmed by carrying out a flame test.

Leave blank

(i) Describe how you would carry out such a flame test.

.....

.....

.....

.....

.....

.....

.....

(3)

(ii) What flame colour would you expect to see?

.....

(1)

(iii) State why magnesium cannot be detected by a flame test.

.....

.....

(1)

Q7

(Total 12 marks)

8. Iron reacts with copper(II) sulphate solution to form iron(II) sulphate solution and copper.

Leave blank

The standard enthalpy change for the reaction between iron and copper(II) sulphate is -153.9 kJ mol^{-1}.

In an experiment to investigate this enthalpy change a student decided to use 25 cm^3 of 0.20 mol dm^{-3} copper(II) sulphate solution and 0.01 mol of iron (an excess).

(a) (i) Write an ionic equation for this reaction. Include state symbols but omit any spectator ions.

(2)

(ii) Show how the standard enthalpy change for this reaction could be calculated from the standard enthalpy changes of formation of copper(II) ions and iron(II) ions. You should include a Hess cycle in your answer.

(3)

(b) (i) What container could be used for the experiment?

.....

(1)

(ii) Calculate the mass of 0.01 mol of iron.
Use the Periodic Table as a source of data.

(1)

(iii) Calculate the number of moles of copper(II) sulphate used.

(1)

(iv) Calculate the energy change that would be expected for the number of moles of copper(II) sulphate calculated in (iii).

Leave blank

(1)

(v) State whether energy is given out or taken in. Justify your answer.

.....

.....

(1)

(vi) Calculate the expected temperature change in the reaction using the relationship:

Energy change = 4.18 × volume of solution × temperature change.

Remember to include a unit in your answer which should be given to two significant figures.

(2)

(vii) Suggest ONE reason why the actual temperature change is likely to differ from your value.

.....

(1)

Q8

(Total 13 marks)

TOTAL FOR SECTION B: 49 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)

Centre No.					
Candidate No.					

Paper Reference (complete below)						
				/		

Surname	Initial(s)
Signature	

Paper Reference(s)

6251/01

Edexcel GCE

Chemistry (Nuffield)

Advanced Level/Advanced Subsidiary

Unit Test 1

Wednesday 29 May 2002 – Morning

Time: 1 hour 15 minutes

Examiner's use only

Team Leader's use only

Materials required for examination
Nil

Items included with question papers
Nil

Question Number	Leave Blank
Section A	
5	
6	
7	
8	
9	
Total	

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname and initials, the paper reference and your signature. The paper reference is shown above.
Answer ALL 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.

Advice to Candidates

You are advised to show all the 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

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Edexcel
Success through qualifications

Answer ALL the questions in the spaces provided.

Leave blank

SECTION A

1. (a) Write a balanced equation, including state symbols, for the reaction between steam and heated magnesium.

(2)

(b) Has the magnesium been oxidised or reduced? Explain your answer.

.....

.....

(1)

2. (a) Methanol reacts with acidified potassium dichromate(VI) to form two possible products.

(i) Give the **displayed** formula of the **organic** product formed under mild conditions.

(1)

(ii) Give the **structural** formula of the acidic **organic** product formed under more vigorous conditions.

(1)

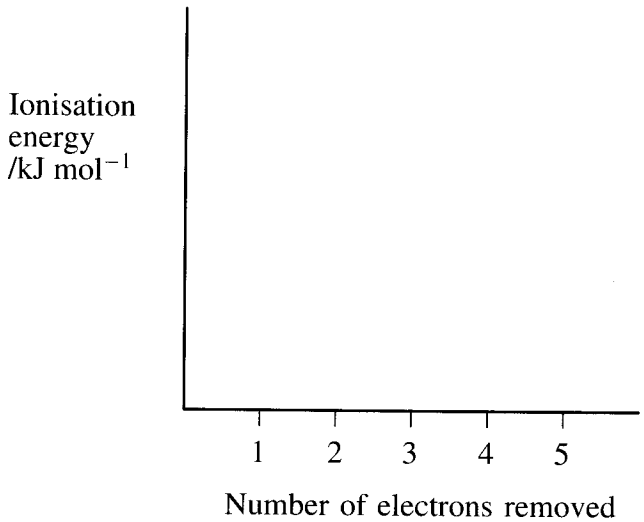
(b) State the name of the **organic** product of the reaction between methanol and sodium.

.....

(1)

3. Sketch a graph to show the first five ionisation energies of aluminium using the axes below.

Leave blank



(2)

4. Explain why iron can be formed by reacting iron(III) oxide with aluminium, but cannot be formed by reacting iron(III) oxide with copper.

.....

.....

.....

.....

(2)

SA

TOTAL FOR SECTION A: 10 MARKS

SECTION B

Leave blank

5. This question is about a titration between hydrochloric acid and sodium carbonate solution, which is alkaline.

(a) Write the formula of sodium carbonate.

.....

(1)

(b) The first step is to make up a solution of sodium carbonate.
Calculate the number of moles of solid sodium carbonate needed to make 250 cm^3 of a solution of concentration 0.0500 mol dm^{-3}.

(1)

(c) Calculate the mass of sodium carbonate needed to make up the solution in (b).
[Molar mass of sodium carbonate 106 g mol^{-1}.]

(1)

(d) Give the name of the type of flask you would use to make up exactly 250 cm^3 of the solution.

.....

(1)

(e) (i) Name an indicator for the titration.

.....

(1)

(ii) What colour is this indicator

in sodium carbonate solution; .....

in hydrochloric acid solution? .....

(2)

Q5

(Total 7 marks)

6. This question is about the element hydrogen and its isotopes.

Leave blank

Hydrogen has three isotopes.

$$^{1}_{1}H \quad ^{2}_{1}H \quad ^{3}_{1}H$$

(a) State in terms of sub-atomic particles, ONE difference and ONE similarity between these isotopes.

Difference .....

.....

Similarity .....

.....

(2)

(b) In 1781 Cavendish made hydrogen using the reaction of zinc with dilute hydrochloric acid, a method still used in school laboratories today.

$$Zn(s) + 2HCl(aq) \longrightarrow ZnCl_2(aq) + H_2(g)$$

What volume of hydrogen (at room temperature and pressure) can be obtained from 25 cm^3 of 1.0 mol dm^{-3} hydrochloric acid?
[Molar volume is 24 dm^3 mol^{-1} at room temperature and pressure.]

(3)

QUESTION 6 CONTINUES OVERLEAF

Leave blank

(c) (i) The spectra of sunlight and light emitted from a filament lamp are the same. Describe the main difference between the hydrogen emission spectrum and these spectra.

.....

.....

.....

.....

(2)

(ii) Explain the difference you have described in (i) in terms of electron energies.

.....

.....

(1)

(d) Which is larger, a hydrogen atom or a hydrogen ion? Explain your answer.

.....

.....

(2)

Q6

(Total 10 marks)

Leave blank

7. Butan-1-ol can be dehydrated to form gaseous but-1-ene.

(a) (i) Write a balanced equation for this dehydration reaction.

(2)

(ii) Draw a fully labelled diagram of the apparatus and chemicals that you would use to dehydrate butan-1-ol and collect the gas produced.

(4)

(b) State TWO **organic** products of the dehydration of butan-2-ol.

.....

.....

.....

(2)

Q7

(Total 8 marks)

Leave blank

8. Two aqueous solutions and two liquids are tested for electrical conductivity (measured in siemens, S) giving the following results:

Sodium chloride solution	200 S
Ethanoic acid solution	17 S
Pure water	7 S
Hexane	0 S

(a) (i) Give the formulae for the ions formed by sodium chloride in aqueous solution.

.....

(1)

(ii) Give the electronic structure for the sodium ion using the s,p,d notation.

.....

(1)

(iii) Draw a 'dot and cross' diagram for the chloride ion showing outer shell electrons only.

(1)

(b) (i) Explain why the solution of ethanoic acid is a much poorer conductor than the sodium chloride solution.

.....

.....

(1)

(ii) Use your answer to (i) to classify the strength of ethanoic acid as an acid.

.....

(1)

(c) Give the formulae for the three species present in pure water.

.....

(3)

(d) (i) State the type of bonding present in hexane. Use the conductivity data to justify your answer.

Leave blank

Type of bonding .....

Justification .....

.....

(2)

(ii) Give the structural formula for hexane.

(1)

Q8

(Total 11 marks)

Leave blank

9. An experiment is carried out to find the enthalpy change for the reaction of a solution of tartaric acid, $C_4H_6O_6$, with sodium hydrogencarbonate to form sodium tartrate, $C_4H_4O_6Na_2$, carbon dioxide and water.

$$C_4H_6O_6(aq) + 2NaHCO_3(s) \longrightarrow C_4H_4O_6Na_2(aq) + 2H_2O(l) + 2CO_2(g)$$

(a) 25 cm^3 of 0.10 mol dm^{-3} tartaric acid solution is reacted with 0.10 mol of sodium hydrogencarbonate (an excess).

(i) Calculate the molar mass of sodium hydrogencarbonate.

(1)

(ii) Calculate the mass of 0.1 mol of sodium hydrogencarbonate.

(1)

(iii) What precautions would you take when adding sodium hydrogencarbonate to the tartaric acid solution. Justify your answer.

.....

.....

.....

(2)

(iv) The temperature of the mixture is found to increase by 6.0 °C.

Calculate the energy change using the relationship:

energy change = 4.18 × volume of solution × temperature change

(2)

(v) Calculate the number of moles of tartaric acid used in the reaction.

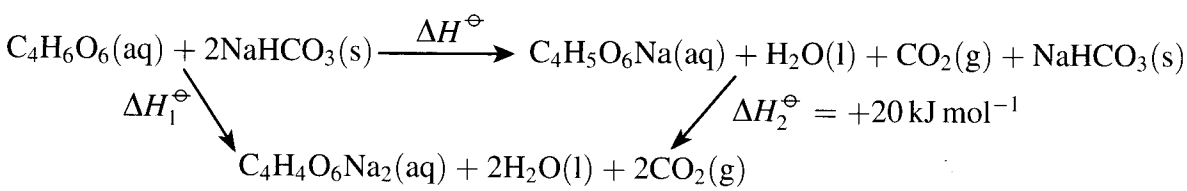
(1)

(vi) Use your answers to (iv) and (v) to calculate the standard enthalpy change of the reaction.
Remember to include a sign and units in your answer, which should be given to 2 significant figures.

Leave blank

(2)

(b) Calculate the standard enthalpy change of the reaction between tartaric acid, $C_4H_6O_6$, and sodium hydrogencarbonate to form sodium hydrogentartrate, $C_4H_5O_6Na$, carbon dioxide and water. This enthalpy change cannot be determined directly, but it can be found using the following Hess cycle.



(i) Write an expression for $\Delta H^{\ominus}$ in terms of $\Delta H_1^{\ominus}$ and $\Delta H_2^{\ominus}$.

(1)

(ii) Calculate $\Delta H^{\ominus}$ using your value for $\Delta H_1^{\ominus}$ from (a)(vi) and your expression in (i).

(2)

(c) Baking powder is a mixture of sodium hydrogentartrate and sodium hydrogencarbonate.
Suggest how baking powder acts as a raising agent in cooking.

.....

.....

(2)

Q9

(Total 14 marks)

TOTAL FOR SECTION B: 50 MARKS

END

THE PERIODIC TABLE

Group

Period

Key

Atomic Number
Symbol
Name
Molar mass in g mol^{-1}

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 Unnil-quadium (261)	105 Unp Unnil-pentium (262)	106 Unh Unnil-hexium (263)												

▶ 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)

Centre No.						Paper Reference (complete below)							Surname	Initial(s)
Candidate No.										/			Signature	

Paper Reference(s)

6251/01

Edexcel GCE

Chemistry (Nuffield)

Advanced Level/Advanced Subsidiary

Unit Test 1

Friday 17 January 2003 – Morning

Time: 1 hour 15 minutes

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
Section A	
4	
5	
6	
7	
Total	

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 and initials, the paper reference and your signature. The paper reference is shown above.
Answer ALL 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

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Answer ALL questions in the spaces provided.

Leave blank

SECTION A

1. (a) Balance the equation for the action of heat on copper(II) nitrate.

$Cu(NO_3)_2.6H_2O(s) \rightarrow \quad CuO(s) + \quad NO_2(g) + \quad O_2(g) + \quad H_2O(g)$

(2)

(b) Describe TWO observations you would expect to make during the experiment.

Observation 1 .....

.....

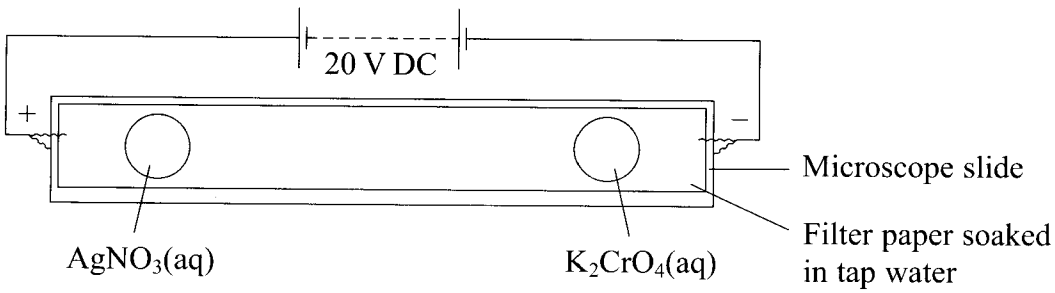
Observation 2 .....

.....

(2)

Leave blank

2. In an experiment to show the migration of ions, silver(I) nitrate solution, $AgNO_3(aq)$, and potassium chromate(VI) solution, $K_2CrO_4(aq)$, were used. The experiment was set up as shown in the diagram below. After a short while, a red precipitate formed in the centre of the filter paper.



(a) Write the formulae, including charges, of the following ions:

(i) Nitrate ions .....

(ii) Chromate(VI) ions .....

(2)

(b) Which ions would meet in the centre of the filter paper?

.....

(1)

(c) Write a balanced ionic equation, including state symbols, for the formation of the red precipitate.

(2)

Leave blank

3. An excess of zinc powder was added to 20.0 cm^3 of a solution of copper(II) sulphate of concentration 0.500 mol dm^{-3}. The temperature increased by 26.3 °C.

(a) How many moles of copper(II) sulphate were used in this experiment?

(1)

(b) Calculate the enthalpy change, ΔH, in kJ mol^{-1} for this reaction given that:

energy change	=	specific heat capacity	×	mass of solution	×	temperature change
/J		/J g^{-1} K^{-1}		/g		/K

Assume that the mass of solution is 20.0 g and the specific heat capacity of the solution is 4.18 J g^{-1} K^{-1}.

(2)

SA

TOTAL FOR SECTION A: 12 MARKS

NOW TURN OVER FOR SECTION B

SECTION B

Leave blank

4. Two important nitrogen compounds are ammonium nitrate and nitrogen(I) oxide.

These substances can be prepared as shown by the following reactions.

Reaction A $NH_3(aq) + HNO_3(aq) \longrightarrow NH_4NO_3(aq)$

Reaction B $NH_4NO_3(s) \xrightarrow{heat} N_2O(g) + 2H_2O(g)$

(a) Name the types of reaction illustrated by equations A and B.

A .....

B .....

(2)

(b) Reaction A was carried out by titration.

$10.0\ cm^3$ of $1.00\ mol\ dm^{-3}$ ammonia solution was reacted with nitric acid of concentration $0.500\ mol\ dm^{-3}$.

(i) What piece of apparatus would you use to measure out the $10.0\ cm^3$ of ammonia solution?

.....

(1)

(ii) What piece of apparatus would you use to add the nitric acid?

.....

(1)

(iii) Suggest a suitable indicator you could use to find the endpoint of this titration and give the colour change you would expect.

Indicator .....

Colour change

from ..... to .....

(2)

(iv) What volume of nitric acid would be required to react exactly with the $10.0\ cm^3$ of the ammonia solution?

(1)

(v) This experiment was repeated without the indicator. Describe how you would obtain dry crystals of ammonium nitrate from the resulting solution.

Leave blank

.....

.....

.....

.....

.....

.....

(3)

(c) In reaction B, 4.0 g of solid ammonium nitrate reacted.

(i) What is the mass of 1 mole of ammonium nitrate, NH_4NO_3?

Use the Periodic Table as a source of data.

(1)

(ii) How many moles of nitrogen(I) oxide, N_2O, were formed when 4.0 g of ammonium nitrate reacted?

(1)

(iii) What volume (at room temperature and pressure) will this amount of nitrogen(I) oxide occupy?
[Molar volume is 24 $dm^3 mol^{-1}$ at room temperature and pressure.]

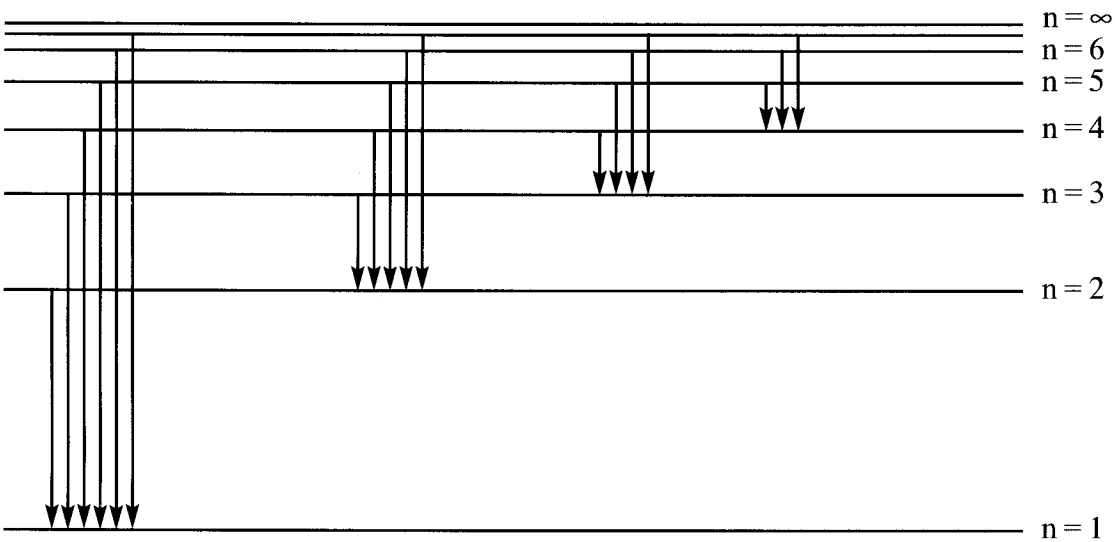
(1)

Q4

(Total 13 marks)

5. The diagram shows some of the transitions made by electrons, which result in the line emission spectrum for the hydrogen atom.

Leave blank



(a) Explain why the emission spectrum of hydrogen consists of discrete lines rather than a continuous spectrum.

.....

.....

.....

.....

(1)

(b) Which transition, shown in the diagram, corresponds to the smallest energy change?

From n = ... to n = ...

(1)

(c) (i) Draw an arrow on the diagram to represent the ionisation of a hydrogen atom from its ground state.

(2)

(ii) Write an equation to represent this ionisation, including state symbols.

(2)

Q5

(Total 6 marks)

6. A sample of titanium (atomic number 22) is made up of five isotopes. The sample has the following percentage composition:

Leave blank

Mass number	% composition
46	8.0
47	7.3
48	74.0
49	5.5
50	5.2

(a) (i) What is the average relative atomic mass of titanium? Give your answer to **three** significant figures.

(2)

(ii) What instrument would have been used to find this percentage composition?

.....

(1)

(b) (i) Give the electronic configuration of a titanium atom, using s p d notation.

.....

(2)

(ii) Name the part of the Periodic Table where titanium appears.

.....

(1)

(c) Titanium occurs naturally as rutile, TiO_2. One possible method of obtaining pure titanium is to heat rutile with carbon.

Leave blank

$$TiO_2(s) + 2C(s) \rightarrow Ti(s) + 2CO(g)$$

(i) What type of reaction is this?

.....

(1)

(ii) Calculate ΔH for this reaction given that

$$\Delta H_f^{\ominus}[TiO_2(s)] = -940 \text{ kJ mol}^{-1}$$

$$\Delta H_f^{\ominus}[CO(g)] = -110 \text{ kJ mol}^{-1}$$

Include a sign and units in your answer.

(3)

(iii) Name the law you have used in your calculation.

.....

(1)

(iv) When titanium is manufactured by this method, explain what pollution problem arises.

.....

.....

.....

(2)

Q6

(Total 13 marks)

Leave blank

7. This question is about the secondary alcohol, **X**, which has the molecular formula $C_4H_{10}O$.

(a) Draw the **displayed** formula of this secondary alcohol, **X**. Give its systematic name.

Name .....

(3)

(b) (i) Draw the **structural** formula of **Y**, a primary alcohol, which is an isomer of **X**.

(1)

(ii) If **X** and **Y** are heated with sodium dichromate and sulphuric acid, products with different functional groups are formed. Give the names of the products which could be formed.

Oxidation product of **X** .....

Oxidation products of **Y** .....

.....

(3)

(c) (i) Draw a fully labelled diagram of the laboratory apparatus to show how the alcohol **Y** could be fully oxidised.

Leave blank

(3)

(ii) How would you separate the organic product of this reaction from the resulting mixture?

.....

(1)

(d) (i) The secondary alcohol, **X**, can be dehydrated. Draw the structural formulae and give the names of TWO possible alkenes which could be formed.

(3)

(ii) If either of the alkenes is shaken with acidified potassium manganate(VII), what colour change would you **see**?

Leave blank

From..... to .....

(1)

(iii) What other reagent could you use to show that the products of the dehydration of **X** are alkenes?

.....

(1)

Q7

(Total 16 marks)

TOTAL FOR SECTION B: 48 MARKS

TOTAL FOR PAPER: 60 MARKS

END

THE PERIODIC TABLE

Period	1	2	Group										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)

Centre No.					
Candidate No.					

Paper Reference						
6	2	5	1	/	0	1

Surname	Initial(s)
Signature	

Paper Reference(s)

6251/01

Edexcel GCE

Chemistry (Nuffield)

Advanced Level/Advanced Subsidiary

Unit Test 1

Wednesday 4 June 2003 – Morning

Time: 1 hour 15 minutes

Examiner's use only

Team Leader's use only

Materials required for examination
Nil

Items included with question papers
Nil

Question Number	Leave Blank
Section A	
3	
4	
5	
6	
Total	

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initials and your signature.
Answer ALL 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.

Advice to Candidates

You are advised to show all the 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.

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Turn over

Edexcel
Success through qualifications

Answer ALL questions in the spaces provided.

Leave blank

SECTION A

Use the Periodic Table as a source of data.

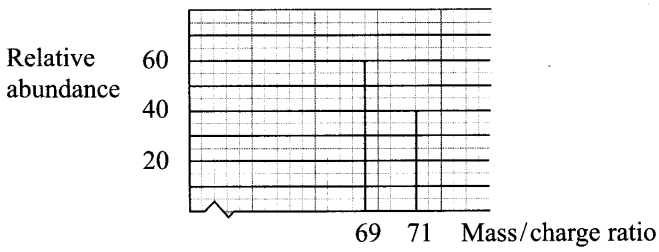
1. (a) An atom of gallium has mass number 69.

Complete the table to show the number of sub-atomic particles in this gallium atom.

Electrons	Neutrons	Protons

(2)

(b) The mass spectrum of a sample of gallium is shown below.



What is the average relative atomic mass of gallium in this sample? Give your answer to **three** significant figures.

(2)

(c) What type of bonding would you expect to find in gallium?

.....

(1)

2. (a) (i) Calculate the number of moles of sulphur atoms in 4.00 g of sulphur.

Leave blank

(1)

(ii) When sulphur burns in air, it forms sulphur dioxide gas, SO_2.

What volume of sulphur dioxide, measured at room temperature and pressure, would be produced when 4.00 g of sulphur is burnt in air?
[Molar volume is 24 $dm^3 mol^{-1}$ at room temperature and pressure.]

(2)

(b) Sulphur dioxide reacts with sodium hydroxide solution to form a solution of sodium sulphite, Na_2SO_3.

The equation for the reaction is

$$SO_2(g) + 2NaOH(aq) \rightarrow Na_2SO_3(aq) + H_2O(l)$$

Rewrite this equation as an ionic equation, omitting the spectator ions.

.....

(2)

(c) Sodium sulphite can be used as a preservative for foods such as sausage meat. Suggest ONE property which a food preservative should have, other than preventing the growth of bacteria.

.....

.....

.....

(1)

SA

TOTAL FOR SECTION A: 11 MARKS

SECTION B

Leave blank

3. (a) (i) A flame test was carried out on a sample of potassium chloride.

What flame colour would be seen?

.....

(1)

(ii) When light from the flame was viewed through a spectroscope, a line emission spectrum was seen. Explain how lines in the emission spectrum arise.

.....

.....

.....

.....

(2)

(b) (i) Complete the electron configuration of a potassium **ion, K^+**, using s p d notation.

$1s^2 2s^2$ .....

(1)

(ii) Potassium ions and chloride ions contain the same number of electrons.

Which of the two ions has the bigger radius? Explain your answer.

.....

.....

.....

(1)

(c) (i) Write an equation to represent the first ionisation of a potassium atom. Include state symbols in the equation.

.....

(2)

(ii) Explain why the first ionisation energy of potassium is smaller than the first ionisation energy of sodium.

.....

.....

.....

.....

(2)

(Total 9 marks)

Q3

Leave blank

4. (a) Cyclohexanol and hexan-1-ol are both alcohols containing 6 carbon atoms per molecule.

(i) Draw the **displayed** formula of each alcohol.

cyclohexanol hexan-1-ol

(2)

(ii) Explain why cyclohexanol and hexan-1-ol are **not** isomers.

.....

.....

(1)

(iii) State whether each of the two alcohols is a primary, secondary or tertiary alcohol.

Cyclohexanol .....

Hexan-1-ol .....

(2)

(iv) Hexan-1-ol was heated gently with a mixture of potassium dichromate and sulphuric acid. The product of the reaction was distilled off as it formed.

Leave blank

Give the structural formula of the product and name it.

Name .....

(2)

(v) The reaction in (iv) was repeated using cyclohexanol. The products which were distilled off from each of the two alcohols contain different functional groups.

State a test to distinguish between these functional groups and give the result in each case.

Test .....

.....

Result with the product from hexan-1-ol .....

.....

Result with the product from cyclohexanol .....

.....

(3)

(b) Cyclohexanol can be converted to cyclohexene.

Leave blank

(i) What type of reaction is this?

.....

(1)

(ii) Draw a fully labelled diagram of the laboratory apparatus, including the chemicals, which you would use to convert cyclohexanol into cyclohexene and collect the liquid cyclohexene which forms.

(4)

(iii) Describe how you would obtain a dry sample of cyclohexene from the liquid collected.

.....

.....

.....

(2)

Q4

(Total 17 marks)

Leave blank

5. (a) (i) Strontium hydroxide, $Sr(OH)_2$, is one of the products formed when strontium reacts with water.

Write a balanced equation for the reaction of strontium with water.

(2)

(ii) Explain why strontium is described as being **oxidised** in this reaction.

.....

.....

(1)

(b) An experiment was carried out to measure the solubility of strontium hydroxide. Solid strontium hydroxide was added to water until a layer of solid remained on the base of the container. The mixture was then left overnight. 25.0 cm^3 portions of strontium hydroxide solution were then measured by pipette and titrated with a 0.100 mol dm^{-3} solution of nitric acid. 16.9 cm^3 of the nitric acid was needed to react with the strontium hydroxide in the solution.

The equation for the reaction is

$$Sr(OH)_2(aq) + 2HNO_3(aq) \rightarrow Sr(NO_3)_2(aq) + 2H_2O(l)$$

(i) Why was the mixture left overnight before carrying out the titration?

.....

(1)

(ii) Calculate the number of moles of nitric acid used in the titration.

(1)

(iii) Calculate the number of moles of strontium hydroxide in 1 dm^3 of the solution.

(2)

(iv) Calculate the solubility of strontium hydroxide in g dm^{-3}.
Use the Periodic Table as a source of data.

Leave blank

(2)

(c) (i) Crystals of hydrated strontium nitrate have the formula $Sr(NO_3)_2.4H_2O$.

How would you make a dry sample of hydrated strontium nitrate crystals from a solution of pure strontium nitrate?

.....

.....

.....

.....

.....

.....

(3)

(ii) Hydrated strontium nitrate crystals decompose when heated.
Complete and balance the equation for the reaction.

$2Sr(NO_3)_2.4H_2O(s) \rightarrow$ .....$H_2O(l)$ + ... $SrO(s)$ + ... $NO_2(g)$ + ...

(2)

(iii) A 0.5 mol dm^{-3} solution of strontium nitrate was mixed with a 0.5 mol dm^{-3} solution of potassium sulphate, K_2SO_4.

Write an equation for the reaction which occurs. Add state symbols to the equation, using the data below.

	Solubility *mol/1000 g water*
KNO_3	3.75
$SrSO_4$	7.11×10^{-4}

Q5

(2)

(Total 16 marks)

6. (a) The equation below shows the reaction which occurs when ammonia is dissolved in water.

Leave blank

$$NH_3(g) + H_2O(1) \rightleftharpoons NH_4^+(aq) + OH^-(aq)$$

(i) Explain why water is classified as an acid in this reaction.

.....

.....

(1)

(ii) The ammonia is acting as a weak base in this reaction.

What is the difference between a weak base and a strong base?

.....

.....

.....

(1)

(b) Ammonia reacts with oxygen to form the gases nitrogen(II) oxide and steam.

Leave blank

(i) Complete the Hess cycle below so that $\Delta H_{reaction}$ can be calculated using standard enthalpy changes of formation. Include state symbols.

$$4NH_3(g) + 5O_2(g) \xrightarrow{\Delta H_{reaction}} 4NO(g) + 6H_2O(g)$$

.....

(2)

(ii) Calculate $\Delta H_{reaction}$ for this reaction using the following data.

$\Delta H_f [NH_3(g)] = -46.1 \text{ kJ mol}^{-1}$

$\Delta H_f [NO(g)] = +90.2 \text{ kJ mol}^{-1}$

$\Delta H_f [H_2O(g)] = -241.8 \text{ kJ mol}^{-1}$

Include a sign and units in your answer and give your answer to **three** significant figures.

(3) **Q6**

(Total 7 marks)

TOTAL FOR SECTION B: 49 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
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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
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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
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Centre No.						Paper Reference							Surname	Initial(s)
Candidate No.						6	2	5	1	/	0	1	Signature	

Paper Reference(s)

6251/01

Edexcel GCE

Chemistry (Nuffield)

Advanced Level/Advanced Subsidiary

Unit Test 1

Friday 16 January 2004 – Morning

Time: 1 hour 15 minutes

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
SA	
5	
6	
7	
8	
Total	

Materials required for examination
Nil

Items included with question papers
Nil

Instructions to Candidates

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Answer **ALL** questions in the spaces provided in this question paper.
Calculators may be used.
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Turn over

Edexcel
Success through qualifications

Answer ALL questions in the spaces provided.

Leave blank

SECTION A

1. (a) When sodium nitrate is heated a gas is given off, which re-lights a glowing splint. Sodium nitrite is formed.

Complete the balanced equation for this reaction, including state symbols.

.....$NaNO_3$(s) → .....$NaNO_2$(s) + ...

(2)

(b) What type of reaction is this?

.....

(1)

2. How many nitrogen molecules, N_2, are present in 12 dm^3 of nitrogen gas at room temperature and pressure?

[Molar volume is 24 $dm^3\,mol^{-1}$ at room temperature and pressure;
Avogadro constant is 6×10^{23} mol^{-1}]

(2)

Leave blank

3. (a) Draw a 'dot-and-cross' diagram for a magnesium **ion**.

Show ALL the electrons present and give the charge on this ion.

(2)

(b) Why do salts containing magnesium ions give no colour in a flame test?

.....

.....

(1)

4. (a) When ammonia dissolves in water it behaves as a weak base.

Explain what is meant by the term **weak** base.

.....

.....

(1)

(b) Suggest a simple test to show that ammonia dissolved in water is a weak base. Give the result of this test.

Test .....

.....

Result .....

.....

(2)

SA

TOTAL FOR SECTION A: 11 MARKS

SECTION B

Leave blank

5. Copper(II) sulphate solution can be prepared from solid copper(II) carbonate by reaction with hot dilute sulphuric acid.

(a) Write the balanced equation for this reaction, including state symbols.

(2)

(b) This experiment was carried out using 25 cm^3 of 1.0 mol dm^{-3} sulphuric acid.

(i) How would you measure out 25 cm^3 of 1.0 mol dm^{-3} sulphuric acid?

.....

(1)

(ii) Calculate the number of moles of sulphuric acid used.

(1)

(c) (i) It is usual to react the sulphuric acid with a slight excess of copper(II) carbonate. Calculate the mass of copper(II) carbonate needed if a 10 % excess is required. [Molar mass of copper(II) carbonate = 123.5 g mol^{-1}]

(2)

(ii) The sulphuric acid is heated to boiling and the copper(II) carbonate is added in small portions.

Suggest why the copper(II) carbonate is added in small portions.

.....

.....

(1)

(iii) What would be the next step needed to obtain pure copper(II) sulphate solution?

.....

.....

(1)

(d) 3.98 g of copper(II) sulphate-5-water, $CuSO_4.5H_2O$, was obtained from this solution.

Leave blank

(i) Calculate the molar mass of copper(II) sulphate-5-water.
Use the Periodic Table as a source of data.

(1)

(ii) Calculate the percentage yield of the reaction.

(2)

(e) Suggest why copper compounds are hazardous.

.....

(1)

Q5

(Total 12 marks)

Leave blank

6. An alcohol, **X**, has the molecular formula $C_4H_{10}O$.

(a) **X** reacts with sodium, forming bubbles of a colourless gas.

Write a balanced equation for the reaction.

(2)

(b) When **X** is heated under reflux with a mixture of sodium dichromate(VI) solution and concentrated sulphuric acid, a green solution forms.

(i) Give the formula of the **ion** responsible for the green colour of the solution.

.....

(1)

(ii) Draw a labelled diagram of the apparatus used to reflux the mixture.

(3)

(iii) A colourless organic liquid, **Y**, is distilled from the green solution.

Leave blank

This liquid will **not** neutralise sodium carbonate solution, and it will **not** react with Benedict's solution.

Draw the **displayed** formula of **Y** and state its name.

Displayed formula

Name.....

(2)

(iv) Deduce the **structural** formula of **X**.

.....

(1)

(c) Dehydration of **X** produces a mixture of products.

(i) Name a reagent which could be used to dehydrate **X**.

.....

(1)

(ii) Draw displayed formulae of TWO of the possible dehydration products.

(2)

(d) An **isomer** of **X**

Leave blank

- does **not** react with a mixture of sodium dichromate(VI) solution and concentrated sulphuric acid
- reacts with sodium
- can be dehydrated.

Draw the **displayed** formula and state the name of this **isomer** of **X**.

Displayed formula

Name .....

(2)

Q6

(Total 14 marks)

Leave blank

7. The element gallium has two isotopes.

$^{69}_{31}Ga$ $^{71}_{31}Ga$

(a) (i) State ONE similarity and ONE difference between these two isotopes in terms of the numbers of their fundamental particles.

Similarity .....

Difference .....

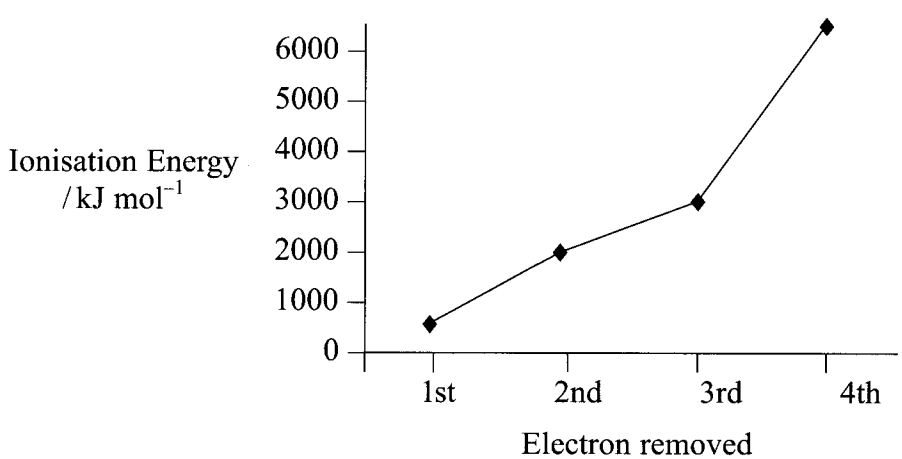
(2)

(ii) The molar mass of a sample of gallium is 69.8 g mol^{-1}.

Calculate the percentage abundance of the isotope $^{69}_{31}Ga$ in the sample.

(2)

(b) The first four ionisation energies of gallium are plotted below.



(i) Write the chemical equation, with state symbols, which corresponds to the first ionisation energy of gallium.

(2)

(ii) Why is there a general rise in the ionisation energy as successive electrons are removed?

Leave blank

.....

.....

(1)

(iii) Explain why there is a comparatively large increase in value between the third and fourth ionisation energies.

.....

.....

.....

.....

(2)

(c) (i) Suggest the formula of gallium chloride.
(You may find it helpful to refer to the Periodic Table.)

.....

(1)

(ii) Gallium chloride dissolves in water to form a solution containing ions.

Suggest an experiment to show that the solution contains ions. State the result you would expect.

Experiment .....

.....

.....

Result .....

(2)

Q7

(Total 12 marks)

8. This question is about a self-heating can of coffee.

Leave blank

The bottom of the can has a compartment containing copper(II) nitrate solution. When a button on the bottom of the can is pressed, magnesium powder is released into the compartment where it reacts with the copper(II) nitrate solution.

(a) (i) Write an ionic equation for the reaction between magnesium powder and copper(II) ions. Include state symbols, but omit any spectator ions.

(2)

(ii) Show how the standard enthalpy change for this reaction could be calculated from the standard enthalpies of formation of copper(II) ions and magnesium ions. You should include a Hess cycle in your answer.

(3)

(b) The can contains 150 g of a solution of coffee in water.

The temperature of the solution needs to increase by 60 °C to produce a hot drink.

(i) Calculate the energy change needed to produce a temperature increase of 60 °C in the coffee, using the relationship

Energy change = 4.2 × mass of solution × temperature change.

Remember to include a unit in your answer.

(2)

(ii) The standard enthalpy change for this reaction is –530 kJ mol^{-1}.

Calculate the number of moles of reactants needed to produce the energy change in (i).

Leave blank

(1)

(iii) A solution of copper(II) nitrate of concentration 8.0 mol dm^{-3} is used.

Use your answer to (ii) to calculate the volume, in cm^3, of copper(II) nitrate solution needed.

Your answer should be given to two significant figures.

(1)

(c) Suggest TWO reasons why the temperature of the coffee may **not** increase by as much as 60 °C.

.....

.....

.....

.....

(2)

Q8

(Total 11 marks)

TOTAL FOR SECTION B: 49 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)

Centre No.					
Candidate No.					

Paper Reference						
6	2	5	1	/	0	1

Surname	Initial(s)
Signature	

Paper Reference(s)

6251/01

Examiner's use only

Team Leader's use only

Edexcel GCE

Chemistry (Nuffield)

Advanced Subsidiary

Unit Test 1

Thursday 10 June 2004 – Morning

Time: 1 hour 15 minutes

Materials required for examination
Nil

Items included with question papers
Nil

Question Number	Leave Blank
SA	
6	
7	
8	
9	
Total	

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initials and your signature.
Answer **ALL** 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 16 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 account of your use of grammar, punctuation and spelling.

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Edexcel
Success through qualifications

Answer ALL questions in the spaces provided.

Leave blank

SECTION A

1. Iron(III) oxide and aluminium react together in a reaction known as the Thermit reaction.

$$Fe_2O_3(s) + 2Al(s) \rightarrow Al_2O_3(s) + 2Fe(s)$$

(a) The reaction is exothermic. Explain what is meant by **exothermic**.

.....

.....

(1)

(b) During the reaction, is the iron(III) oxide oxidised or reduced? Explain your answer.

.....

.....

.....

(1)

2. (a) An isotope of the element bohrium, $^{267}_{107}Bh$, was recently discovered. How many **neutrons** are there in a nucleus of this isotope?

.....

(1)

(b) What instrument is commonly used to determine the atomic mass of isotopes?

.....

(1)

Leave blank

3. Butan-1-ol, a primary alcohol, can be oxidised to form the aldehyde, butanal.

(a) Give the name or formula of an oxidising agent used in this reaction and of the other reagent required.

Oxidising Agent

.....

Other Reagent

.....

(2)

(b) A possible by-product of this reaction is butanoic acid, $CH_3CH_2CH_2CO_2H$, which is classified as a weak acid.

Explain what is meant by a **weak acid**.

Acid .....

.....

Weak .....

.....

(2)

4. Write the electron configuration of a magnesium **atom**, using the s, p, d notation.

.....

(1)

5. Balance this equation showing how magnesium nitrate decomposes when heated.

$$Mg(NO_3)_2(s) \rightarrow MgO(s) + NO_2(g) + O_2(g)$$

(1)

TOTAL FOR SECTION A: 10 MARKS

SA

SECTION B

Leave blank

6. (a) Propan-1-ol can be dehydrated to produce propene gas.

(i) Draw the **displayed** formula of propan-1-ol.

(1)

(ii) One method used to dehydrate propan-1-ol uses a solid catalyst.

Draw a fully labelled diagram of the apparatus used to prepare and collect propene gas. Name the solid catalyst.

(4)

(b) Propan-1-ol reacts with sodium to produce an ionic compound and hydrogen gas.

Leave blank

(i) Name the ionic compound formed.

.....

(1)

(ii) When carrying out this reaction, a student collected 48 cm^3 of hydrogen gas at room temperature and pressure. Calculate the number of moles of hydrogen molecules collected.
[Molar volume is 24 000 $cm^3\,mol^{-1}$ at room temperature and pressure]

(1)

(c) Propan-1-ol can be partially oxidised to produce the aldehyde, propanal.
Some alcohols can be oxidised to produce ketones.

(i) Write the **structural** formula and give the name of the alcohol that can be oxidised to produce the ketone, propanone.

Formula .....

Name .....

(2)

(ii) Describe what you would expect to **see** if propanal and propanone were separately warmed with Benedict's solution.

Propanal

.....

.....

Propanone

.....

.....

(2)

Q6

(Total 11 marks)

Leave blank

7. The foot and mouth virus affects farm animals such as cattle and sheep. One of the recommended disinfectants used to try to prevent foot and mouth disease from spreading is sodium carbonate solution.

(a) The sodium carbonate solution is used to disinfect footwear because it is alkaline and the virus cannot survive if exposed to a pH greater than 9.

Suggest ONE reason why the disinfectant may not destroy all of the virus present on footwear.

.....

.....

.....

(1)

(b) One method that could be used to determine the concentration of a solution of sodium carbonate is to titrate it with hydrochloric acid of known concentration.

A 25.0 cm^3 sample of sodium carbonate solution was titrated using 1.00 mol dm^{-3} hydrochloric acid to determine its concentration. 42.0 cm^3 of acid was needed to neutralise the sodium carbonate solution. The indicator used to find the end-point was methyl orange.

(i) Write a balanced equation for the reaction between a solution of sodium carbonate and hydrochloric acid, including appropriate state symbols.

(2)

(ii) What piece of apparatus should you use to add the hydrochloric acid?

.....

(1)

(iii) State the colour of the indicator:

in sodium carbonate solution .....

at the end-point of the titration. .....

(2)

(c) (i) Calculate the number of moles of hydrochloric acid added to the sodium carbonate solution.

Leave blank

(1)

(ii) Use your answer from (c)(i) and your equation from (b)(i) to work out the number of moles of sodium carbonate in the 25.0 cm^3 sample.

(1)

(iii) Use your answer from (c)(ii) to work out the concentration, in mol dm^{-3}, of the sodium carbonate solution.

(1)

Q7

(Total 9 marks)

Leave blank

8. In the manufacture of beer, brewers often add small amounts of salts of Group 2 elements to the water used. These salts influence the chemical reactions during the brewing process. Two such salts are calcium sulphate and magnesium sulphate.

(a) A flame test can be used to confirm that a sample of a salt contains calcium ions.

(i) Describe how you would carry out a flame test.

.....

.....

.....

.....

.....

.....

.....

(3)

(ii) A positive test results in a brick-red flame colour. Describe the changes that occur in calcium ions to produce a colour.

.....

.....

.....

.....

(2)

(iii) Impurities in the salt may lead to other colours being observed in the flame. What metal ion is likely to be present if a yellow flame is seen?

.....

(1)

(b) Magnesium sulphate can be used in its anhydrous form, $MgSO_4(s)$, or in its hydrated form, $MgSO_4.7H_2O(s)$.

Leave blank

An experiment was carried out to find the enthalpy change when hydrated magnesium sulphate dissolved completely in water.

$$MgSO_4.7H_2O(s) \xrightarrow{\text{excess water}} MgSO_4(aq) + 7H_2O(l)$$

12.3 g of hydrated magnesium sulphate was added to 100 g of water in a simple calorimeter and the temperature was found to fall by 1.1 °C.

(i) Calculate the energy change, in joules, that occurred in the experiment, using the relationship

Energy change (J) = 4.18 × mass of water × temperature change

(2)

(ii) Calculate the number of moles of hydrated magnesium sulphate used in the experiment. Use the Periodic Table as a source of data.

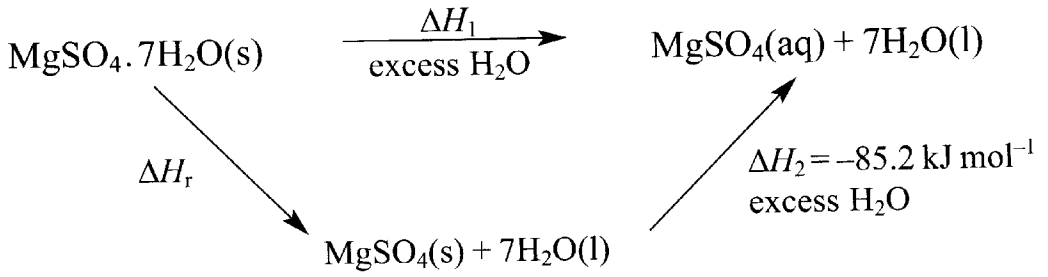
(2)

(iii) Use your answers to (i) and (ii) to calculate the enthalpy change for the reaction. Include a sign and units in your final answer, which should be given to 2 significant figures.

(2)

Leave blank

(c) The enthalpy change as hydrated magnesium sulphate is converted to anhydrous magnesium sulphate is very difficult to measure. The Hess Cycle below can be used to find this enthalpy change, ΔH_r.



(i) Use the cycle to write an expression for ΔH_r using ΔH_1 and ΔH_2.

(1)

(ii) Use your expression in (c)(i) and your answer from (b)(iii) to calculate ΔH_r.
Include a sign and units in your final answer, which should be given to 2 significant figures.

(2)

(d) Brewers are very careful to add small, controlled amounts of calcium sulphate and magnesium sulphate to the water used in brewing.

Suggest ONE possible effect if too much of either salt is added.

.....

.....

(1)

(Total 16 marks)

Q8

9. Sodium is a reactive, silver-grey element from Group 1 of the Periodic Table.

Leave blank

(a) (i) What name is given to the type of bonding in this element? Draw a diagram to illustrate this type of bonding.

Name .....

(2)

(ii) Sodium reacts readily with other elements such as chlorine.

$$\underset{\text{sodium}}{2Na(s)} + \underset{\text{chlorine}}{Cl_2(g)} \longrightarrow \underset{\text{sodium chloride}}{2NaCl(s)}$$

Draw a 'dot-and-cross' diagram, showing outer electrons only, of the ionic compound sodium chloride. Indicate charges clearly on your diagram.

(2)

(iii) Would you expect the radius of a sodium ion to be larger than, smaller than or the same as the radius of a sodium atom? Give TWO reasons to justify your answer.

.....

.....

.....

.....

(3)

(b) The table shows the first four ionisation energies for another element.

Leave blank

Ionisation Energy / kJ mol^{-1}			
1st	2nd	3rd	4th
738	1451	7733	10 541

To which Group of the Periodic Table does the element belong? Use the data to give a reason for your answer.

Group .....

Reason .....

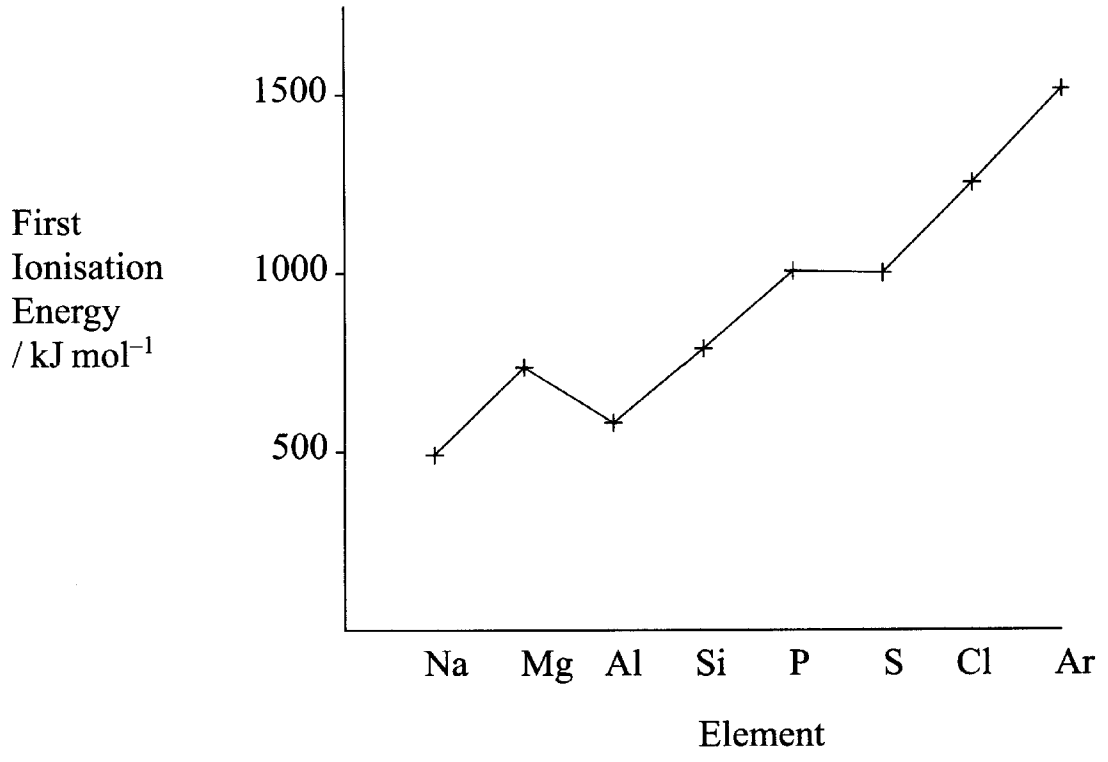
.....

.....

.....

(2)

(c) The graph below shows the first ionisation energies of the elements in Period 3. One noticeable feature of this graph is the dip from magnesium to aluminium. Use your knowledge of quantum levels and sub-levels to suggest an explanation for this dip.



.....

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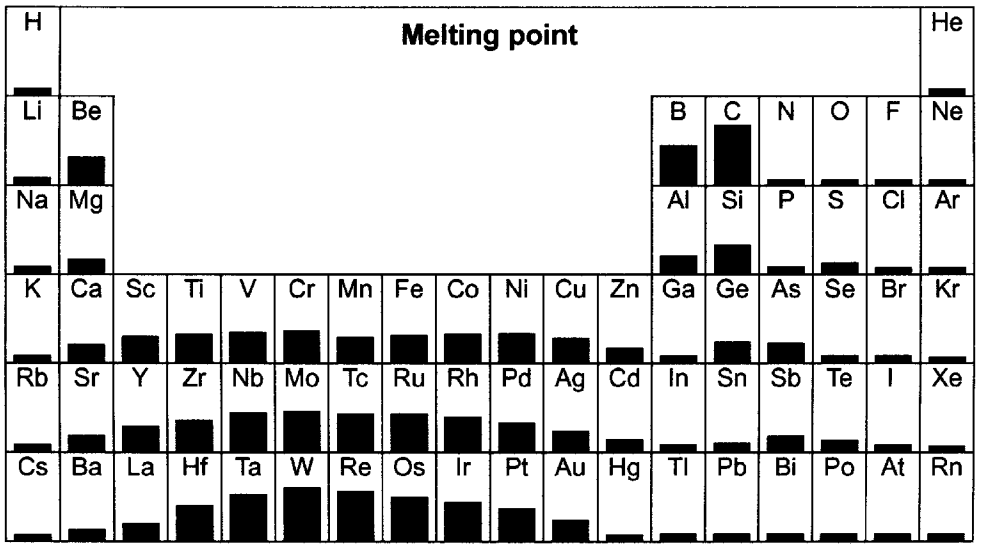
.....

(2)

(d) The Periodic Table shown here is from a website designed to help students understand the idea of periodicity. The heights of the shaded bars represent the melting points of the elements.

Leave blank

Periodic Table



Source: www.schoolscience.co.uk/ptgraphs.html

(i) Another table on this website shows the boiling points of the elements. Suggest ONE similarity and ONE difference between the two tables.

Similarity

.....

.....

.....

Difference

.....

.....

.....

(2)

(ii) Name ONE other physical property, **not** mentioned in this question, that exhibits periodicity.

.....

(1)

Q9

(Total 14 marks)

TOTAL FOR SECTION B: 50 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
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Key

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Molar mass in g mol^{-1}

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▶▶ 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)