Centre No.						Paper Reference							Surname	Initial(s)
Candidate No.						4	4	3	7	/	5	H	Signature	

Paper Reference(s)

4437/5H

Examiner's use only

Team Leader's use only

London Examinations IGCSE

Science (Double Award)

Chemistry

Paper 5H

Higher Tier

Tuesday 16 November 2010 – Afternoon

Time: 1 hour 30 minutes

Materials required for examination
Nil

Items included with question papers
Nil

Question Number	Leave Blank
1	
2	
3	
4	
5	
6	
7	
8	
9	
Total	

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname and initial(s) and your signature.
The paper reference is shown at the top of this page. Check that you have the correct question paper.
Answer ALL the questions. Write your answers in the spaces provided in this question paper.
Show all stages in any calculations and state the units. Calculators may be used.

Information for Candidates

The total mark for this paper is 90. The marks for individual questions and the parts of questions are shown in round brackets: e.g. **(2)**.
There are 9 questions in this question paper.
There are 28 pages in this question paper. Any blank pages are indicated.
A Periodic Table is given on page 2.

Advice to Candidates

Write your answers neatly and in good English.

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THE PERIODIC TABLE

Period	1	2	Group										3	4	5	6	7	0
1																		4 He Helium 2
2	7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
3	23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulphur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
4	39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	63.5 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
5	86 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	99 Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
6	133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57	179 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
7	223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89															

Key

Relative atomic mass
Symbol
Name
Atomic number

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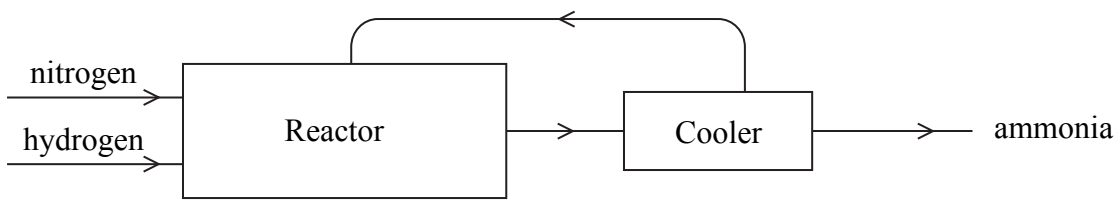
SECTION A

1. The flow diagram represents the manufacture of ammonia by the Haber process.



(a) State **three** conditions used in the reactor.

1 .....

2 .....

3 .....

(3)

(b) What change of state does the ammonia undergo in the cooler?

.....

(1)

(c) Some of the ammonia formed in the Haber process is reacted with nitric acid to form ammonium nitrate.

(i) Write a chemical equation for this reaction.

.....

(2)

(ii) Give **one** major use of ammonium nitrate.

.....

(1)

Q1

(Total 7 marks)

Leave blank

2. Copper, iron and zinc can be reactants or products in displacement reactions.
These metals have different reactivities.

The table shows the observations made when a student added a small amount of each metal to a solution of the sulphate of one of the other metals.

Experiment	Reagents	Observations
1	copper + iron(II) sulphate	no change
2	copper + zinc sulphate	no change
3	iron + copper(II) sulphate	solution turns from blue to pale green solid turns from dark grey to pink-brown
4	iron + zinc sulphate	no change
5	zinc + copper(II) sulphate	solution turns from blue to colourless solid turns from light grey to pink-brown
6	zinc + iron(II) sulphate	solution turns from pale green to colourless solid turns from light grey to dark grey

(a) In Experiment 1, why was there no reaction?

.....

.....

(1)

(b) In Experiment 3, which ion is responsible for the blue colour?

.....

(1)

(c) In Experiment 5, what is the pink-brown solid?

.....

(1)

(d) In Experiment 6, why does the solid turn from light grey to dark grey?

.....

.....

(1)

Leave blank

(e) Which of the three metals is the most reactive?

.....

(1)

(f) When preparing for these experiments, the student found a bottle labelled "iron sulphate solution". To find out whether the solution contained iron(II) sulphate or iron(III) sulphate he tested it by adding sodium hydroxide solution.

State the observation made, and identify the substance responsible for the observation, if the bottle contained iron(II) sulphate solution.

Observation .....

Substance responsible .....

(2)

(Total 7 marks)

Q2

Leave blank

3. The formulae C_2H_6 and C_3H_8 represent two organic compounds.

(a) The compounds C_2H_6 and C_3H_8 are members of the same homologous series.

(i) What is the name of this homologous series?

.....

(1)

(ii) What is the general formula of this homologous series?

.....

.....

(1)

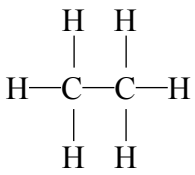
(iii) Other than having the same general formula, state **two** other characteristics of members of the same homologous series.

1 .....

2 .....

(2)

(b) The displayed formula of C_2H_6 is



Draw the displayed formula of C_3H_8.

(1)

Leave blank

(c) Compounds with the molecular formula C_4H_{10} are also members of this homologous series.

There are two isomers with this molecular formula.

(i) What is meant by the term **isomers**?

.....

.....

(2)

(ii) Name **one** of these isomers and draw its displayed formula.

Name .....

Displayed formula

(2)

(d) Methane is another member of this homologous series.

Write a word equation for the complete combustion of methane.

.....

.....

(2)

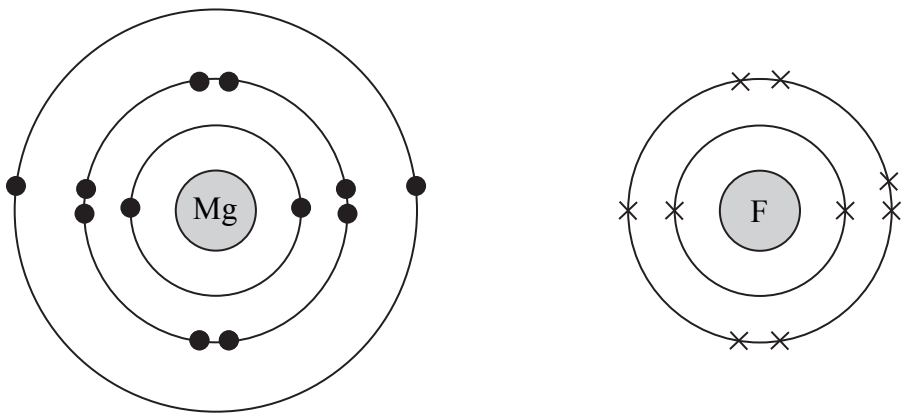
Q3

(Total 11 marks)

Leave blank

4. Magnesium and fluorine react to form the ionic compound magnesium fluoride.

(a) The diagrams show the electron arrangement in an atom of magnesium and in an atom of fluorine.



Describe what happens, in terms of electrons, when magnesium reacts with fluorine.

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.....

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.....

(3)

(b) Give the formula of each of the ions in magnesium fluoride.

.....

.....

(2)

Q4

(Total 5 marks)

TOTAL FOR SECTION A: 30 MARKS

Leave blank

SECTION B

5. Copper(I) sulphide reacts with oxygen when heated in air.

$$Cu_2S + O_2 \rightarrow 2Cu + SO_2$$

The copper produced by this reaction is impure.

(a) State **two** problems caused by releasing sulphur dioxide into the atmosphere.

.....

.....

.....

(2)

(b) Copper can be purified by electrolysis.
The impure copper is used as the positive electrode (anode).

(i) What is used as the negative electrode (cathode)?

.....

(1)

(ii) Identify the solution used as the electrolyte.

.....

(1)

(c) Give **one** use of copper and state the property of copper on which that use depends.

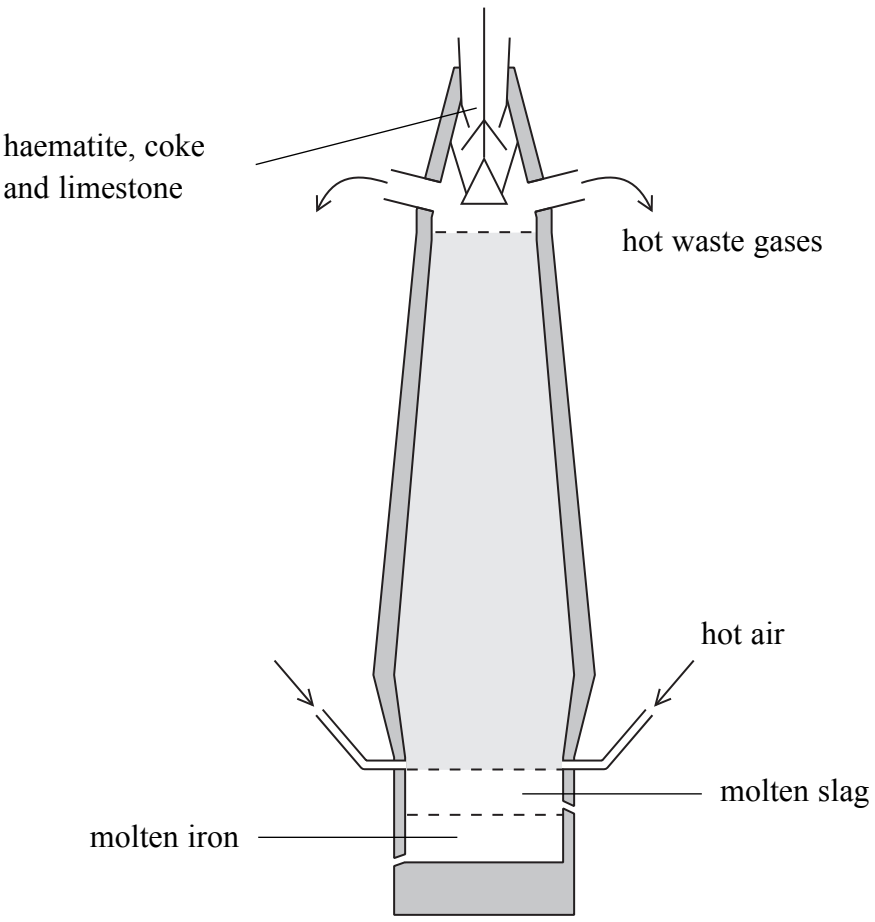
Use .....

Property .....

(2)

Leave blank

(d) Iron is obtained by reducing iron(III) oxide contained in haematite using a blast furnace.



(i) Why is hot air blown into the bottom of the blast furnace?

.....

.....

.....

(2)

(ii) The haematite contains silicon dioxide as an impurity.
The limestone is added to remove the silicon dioxide.

Explain how the limestone does this. You may use equations in your answer.

.....

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.....

.....

.....

(4)

Leave blank

(iii) One of the reactions that produces iron in the blast furnace is represented by the equation:

$$2Fe_2O_3 + 3C \rightarrow 4Fe + 3CO_2$$

Using the equation, explain why this is called a **redox** reaction.

.....

.....

.....

.....

.....

(2) Q5

(Total 14 marks)

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6. A teacher adds a small piece of sodium to a large volume of water.
He makes the following observations:

- the sodium melts
- the sodium slowly moves across the surface of the water
- there is fizzing.

(a) Rubidium is in the same group of the Periodic Table as sodium.

(i) Why do elements in the same group have similar chemical properties?

.....

.....

.....

(1)

(ii) Write a chemical equation for the reaction of rubidium with water.

.....

.....

.....

(2)

(iii) Compared to sodium, suggest **one** different observation that could be made when rubidium reacts with water.

.....

.....

(1)

(b) Complete the table about the atomic structures of sodium and rubidium.

Element	**Atomic number**	**Mass number**	**Number of neutrons**	**Number of protons**	**Number of electrons**
sodium	11		12	11	
rubidium	37	85		37	37

(3)

Leave blank

(c) A sample of rubidium contains two isotopes.

(i) What are isotopes?

.....

.....

.....

(2)

(ii) 72.2% of rubidium atoms in this sample have a mass number of 85.
All other rubidium atoms in this sample have a mass number of 87.

Calculate the relative atomic mass of rubidium.
Give your answer to one decimal place.

(3)

Leave blank

(d) Rubidium chloride and sodium chloride exist as ionic crystals.
Neither compound conducts electricity when solid but both do when molten.

(i) Describe the structure of rubidium chloride in terms of the arrangement and types of particle.

.....

.....

.....

.....

(2)

(ii) Why does rubidium chloride conduct electricity when it is molten?

.....

.....

(1)

Q6

(Total 15 marks)

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7. (a) Carbon dioxide can be prepared in the laboratory by reacting dilute hydrochloric acid with calcium carbonate.

(i) Write a chemical equation for this reaction.

.....

.....

(2)

(ii) Carbon dioxide reacts with water to form a weakly acidic solution.

$$CO_2(g) + H_2O(l) \rightleftharpoons H_2CO_3(aq)$$

What is the name of the acid formed?

.....

(1)

(b) Magnesium oxide forms when magnesium burns in air.

$$2Mg(s) + O_2(g) \rightarrow 2MgO(s)$$

Describe what is observed when magnesium burns in air.

.....

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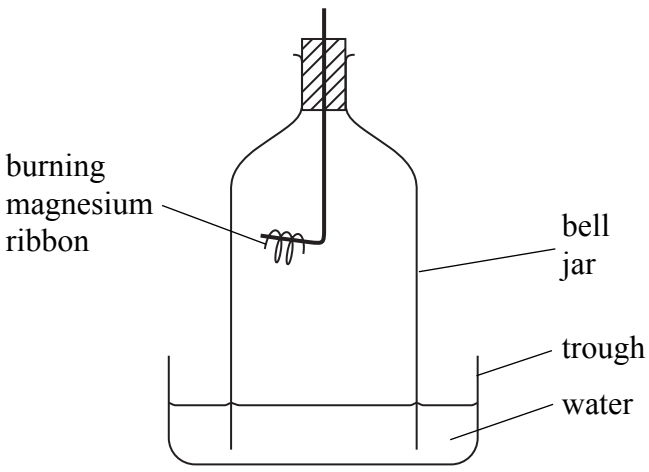
(2)

Leave blank

(c) The following apparatus can be used to determine the percentage by volume of oxygen in the air.



The approximate percentage by volume of oxygen in air is 20%.

(i) The volume of air in the bell jar at the start of the experiment is 5.0 dm^3.

Calculate the amount, in moles, of oxygen molecules in the bell jar.
(The molar volume of a gas is 24 dm^3.)

(2)

(ii) Calculate the amount, in moles, of magnesium needed to react with this amount of oxygen.

(1)

(iii) Calculate the minimum mass, in grams, of magnesium needed to react with all the oxygen in the bell jar.

(2)

(Total 10 marks)

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Q7

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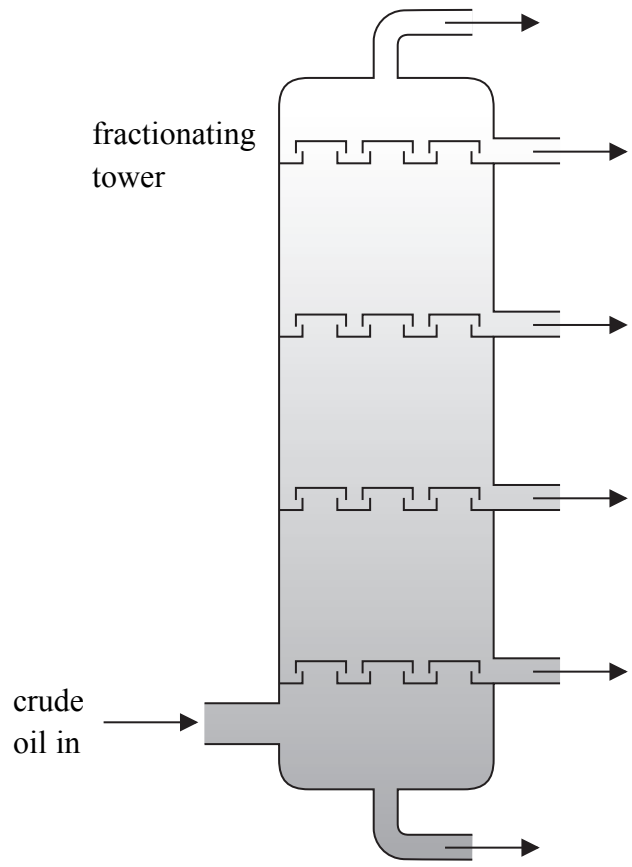
8. Crude oil is a complex mixture of hydrocarbons.
It is separated into fractions by fractional distillation.
The diagram shows a fractionating tower.



(a) Describe how crude oil is separated into fractions.

.....

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.....

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.....

(3)

Leave blank

(b) Some fractions containing long-chain hydrocarbons are cracked.

(i) During cracking, a hydrocarbon with the formula $C_{20}H_{42}$ produces only two products. One of the products is an alkene.

Complete the following equation:

$C_{20}H_{42} \rightarrow$ .....

(2)

(ii) Give **two** reasons why it is economically important to crack long-chain hydrocarbons.

.....

.....

.....

.....

(2)

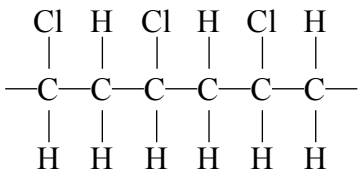
(c) Alkenes can form addition polymers.

(i) Draw the repeat unit of the addition polymer formed by propene, $CH_3CH{=}CH_2$.

(2)

Leave blank

(ii) Another addition polymer has the structure



Name and draw the displayed formula of the alkene that forms this polymer.

Name .....

Displayed formula

(2) **Q8**

(Total 11 marks)

Leave blank

9. Ammonia is a covalent compound with a simple molecular structure.
It is a gas at room temperature.

(a) Explain why ammonia has a low boiling point.

.....

.....

.....

.....

.....

.....

(3)

(b) Ammonia reacts with iodine.

$$NH_3 + 3I_2 \rightarrow NI_3 + 3HI$$

Hydrogen iodide, HI, is given off as a gas; it is very similar to hydrogen chloride.

Suggest what is seen when hydrogen iodide reacts with sodium carbonate solution.

.....

.....

(1)

Leave blank

(c) Nitrogen triiodide, NI_3, readily decomposes.

$$2NI_3 \rightarrow N_2 + 3I_2$$

(i) Draw a dot and cross diagram to show the bonding in a nitrogen molecule.

(2)

(ii) Name the type of bonding in nitrogen.

.....

(1)

(d) Ammonia reacts with phosphoric acid to form a compound that contains 28.2% nitrogen, 8.1% hydrogen, 20.8% phosphorus and 42.9% oxygen by mass.

Calculate the empirical formula of this compound.

(3) **Q9**

(Total 10 marks)

TOTAL FOR SECTION B: 60 MARKS

TOTAL FOR PAPER: 90 MARKS

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