UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

3253603518

CHEMISTRY **5070/22**

Paper 2 Theory **May/June 2011**

1 hour 30 minutes

Candidates answer on the Question Paper.

No additional materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Section A
Answer **all** questions.
Write your answers in the spaces provided in the Question Paper.

Section B
Answer any **three** questions.
Write your answers in the spaces provided in the Question Paper.

A copy of the Periodic Table is printed on page 20.
At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A	
B7	
B8	
B9	
B10	
Total	

This document consists of **17** printed pages and **3** blank pages.

UNIVERSITY of CAMBRIDGE International Examinations

Section A

Answer **all** the questions in this section in the spaces provided.

The total mark for this section is 45.

A1 Choose from the following compounds to answer the questions below.

ammonia

carbon monoxide

copper(II) carbonate

copper(II) chloride

copper(II) sulfate

sodium chloride

sodium hydroxide

sodium sulfate

sulfur dioxide

sulfuric acid

zinc carbonate

zinc nitrate

Each compound can be used once, more than once or not at all.

Which compound

(a) is a white solid with a high melting point that dissolves in water to form an alkaline solution,

.....[1]

(b) is a blue solid which, when dissolved in water, gives a white precipitate with aqueous barium nitrate,

.....[1]

(c) is a colourless gas that turns moist red litmus paper blue,

.....[1]

(d) is a white solid that decomposes on heating to form carbon dioxide?

.....[1]

[Total: 4]

A2 Alkanes are a homologous series of saturated hydrocarbons.

(a) What is the general formula of alkanes?

.....[1]

(b) Draw the structures of the two isomers of C_4H_{10}.

[2]

(c) One of the isomers of C_4H_{10}, butane, reacts with chlorine in the presence of ultra-violet light. It forms hydrogen chloride gas and a mixture of liquid compounds.

(i) Name this type of reaction.

.....[1]

(ii) Draw the structure of one of the liquid compounds.

[1]

(d) Name the process by which butane is separated from crude oil.

.....[1]

[Total: 6]

A3 Vegetable oils can be used both to make margarine and as fuels such as bio-diesel.

(a) Many vegetable oils are polyunsaturated.

(i) Explain the meaning of the term *polyunsaturated.*

.....

.....

.....[2]

(ii) Describe how you could distinguish between samples of saturated and unsaturated vegetable oils.

.....

.....

.....

.....[2]

(b) Describe how margarine can be manufactured from unsaturated vegetable oils.

.....

.....[1]

(c) Bio-diesel contains the compound $C_{15}H_{30}O_2$.
Suggest the products of the complete combustion of this compound.

.....[2]

(d) Farmers that grow vegetable oil crops often use large quantities of ammonium nitrate fertiliser, NH_4NO_3.
Calculate the percentage by mass of nitrogen in ammonium nitrate.

percentage = ... % [2]

(e) Microorganisms in the soil convert ammonium nitrate into gaseous nitrous oxide. This gas is a greenhouse gas.

(i) Describe **two** possible consequences of an increasing concentration of greenhouse gases in the atmosphere.

.....

.....

.....

.....[2]

(ii) Ammonium nitrate can be thermally decomposed in the laboratory to form nitrous oxide and one other product.
Construct the equation for this decomposition.

[1]

[Total: 12]

A4 Fluorine, chlorine, bromine and iodine are elements in Group VII of the Periodic [illegible]. Scientists are trying to synthesise a new element in Group VII with a proton number of 1[illegible].

(a) How many valency electrons will be present in one atom of this new element?

.....[1]

(b) Complete the following table about an isotope of this new element.

nucleon number	280
number of protons	
number of neutrons	

[2]

(c) Predict **two** physical properties of this new element.

1 .....

2 .....[2]

(d) Fluorine reacts with magnesium to form magnesium fluoride.

(i) Write a balanced equation for this reaction.

[1]

(ii) Give both the electronic configuration and the charge on the ions which are present in magnesium fluoride.

[2]

(e) Trifluorochloromethane, CF_3Cl, is a covalent compound.

(i) Draw a 'dot-and-cross' diagram for a CF_3Cl molecule.
You only need to show the outer electrons for each atom.

[2]

(ii) Trifluorochloromethane does not conduct electricity.
Suggest one **other** physical property of trifluorochloromethane.

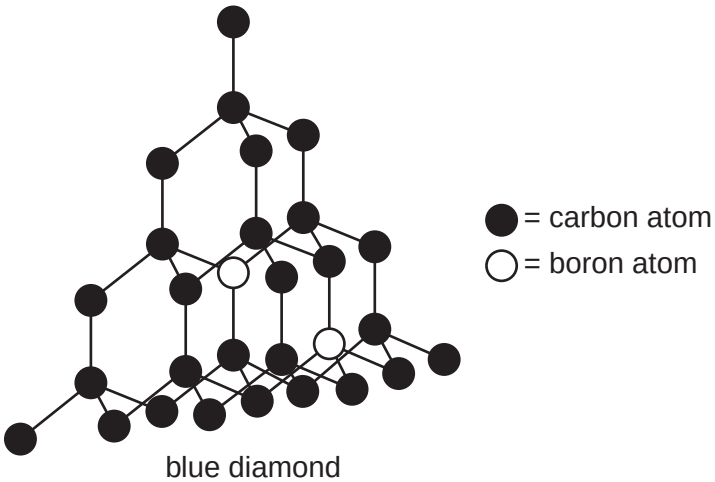
.....[1]

(iii) Suggest one environmental problem associated with the presence of trifluorochloromethane in the atmosphere.

.....[1]

[Total: 12]

A5 Blue diamonds are an impure form of carbon. Part of the structure of a blue diam[illegible] shown below.



blue diamond

Blue diamonds have a high melting point and can conduct electricity.

(a) Explain, in terms of structure and bonding, why blue diamonds have a high melting point.

.....

.....

.....

.....[2]

(b) Normal diamonds are a pure form of carbon. They do not conduct electricity.

(i) Explain, in terms of structure and bonding, why normal diamonds do **not** conduct electricity.

.....

.....[1]

(ii) Suggest why blue diamonds can conduct electricity.

.....

.....[1]

(c) Graphite is another pure form of carbon. Suggest **two** reasons why graphite is often used as an electrode in electrolysis.

1 .....

2 .....[2]

[Total: 6]

A6 Proteins are natural polyamides which can be hydrolysed to form amino acids.

(a) Name a synthetic polyamide.

.....[1]

(b) The hydrolysis of proteins forms a mixture of colourless amino acids.
Describe, with the aid of a labelled diagram, how paper chromatography can be used to identify a mixture of amino acids.

.....

.....

.....

.....

.....

.....[4]

[Total: 5]

Section B

Answer **three** questions from this section in the spaces provided.

The total mark for this section is 30.

B7 Nitric oxide, NO, is an atmospheric pollutant formed inside car engines by the reaction between nitrogen and oxygen.

$$N_2(g) + O_2(g) \rightarrow 2NO(g) \quad \Delta H = +66\,kJ\,mol^{-1}$$

This reaction is endothermic.

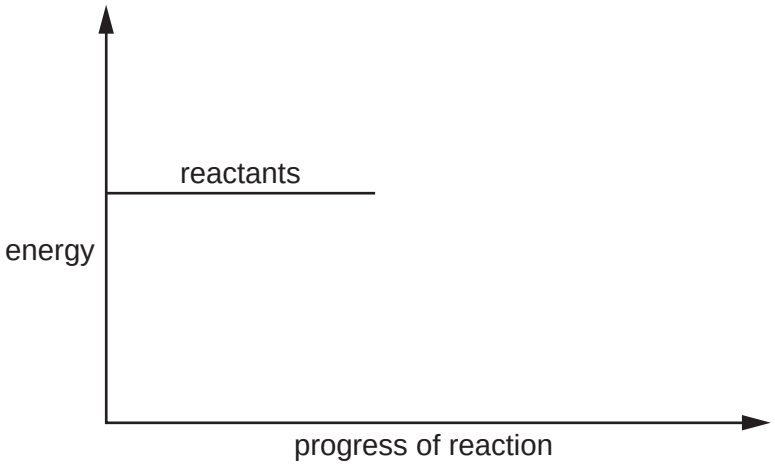
(a) Explain the meaning of the term *endothermic*.

.....

.....[1]

(b) Complete the energy profile diagram for the reaction between nitrogen and oxygen.
On your diagram label the

- product,
- activation energy, E_a,
- enthalpy change for the reaction, ΔH.



[3]

(c) Calculate the mass of nitric oxide formed when 100 g of nitrogen reacts completely with oxygen.

mass of nitric oxide = ... g [3]

(d) Explain how the speed of reaction between nitrogen and oxygen changes wh... pressure of the gaseous mixture is increased from 1 atmosphere to 10 atmosphere...

.....

.....

.....

.....[3]

[Total: 10]

B8 Propanoic acid, $C_2H_5CO_2H$, and hydrochloric acid, HCl, both act as acids when dissolved in water.

(a) State the formula of an ion found in both dilute propanoic acid and in dilute hydrochloric acid.

.....[1]

(b) Propanoic acid reacts with magnesium carbonate to form water, a colourless gas and a salt. In this reaction

(i) name the gas,

.....[1]

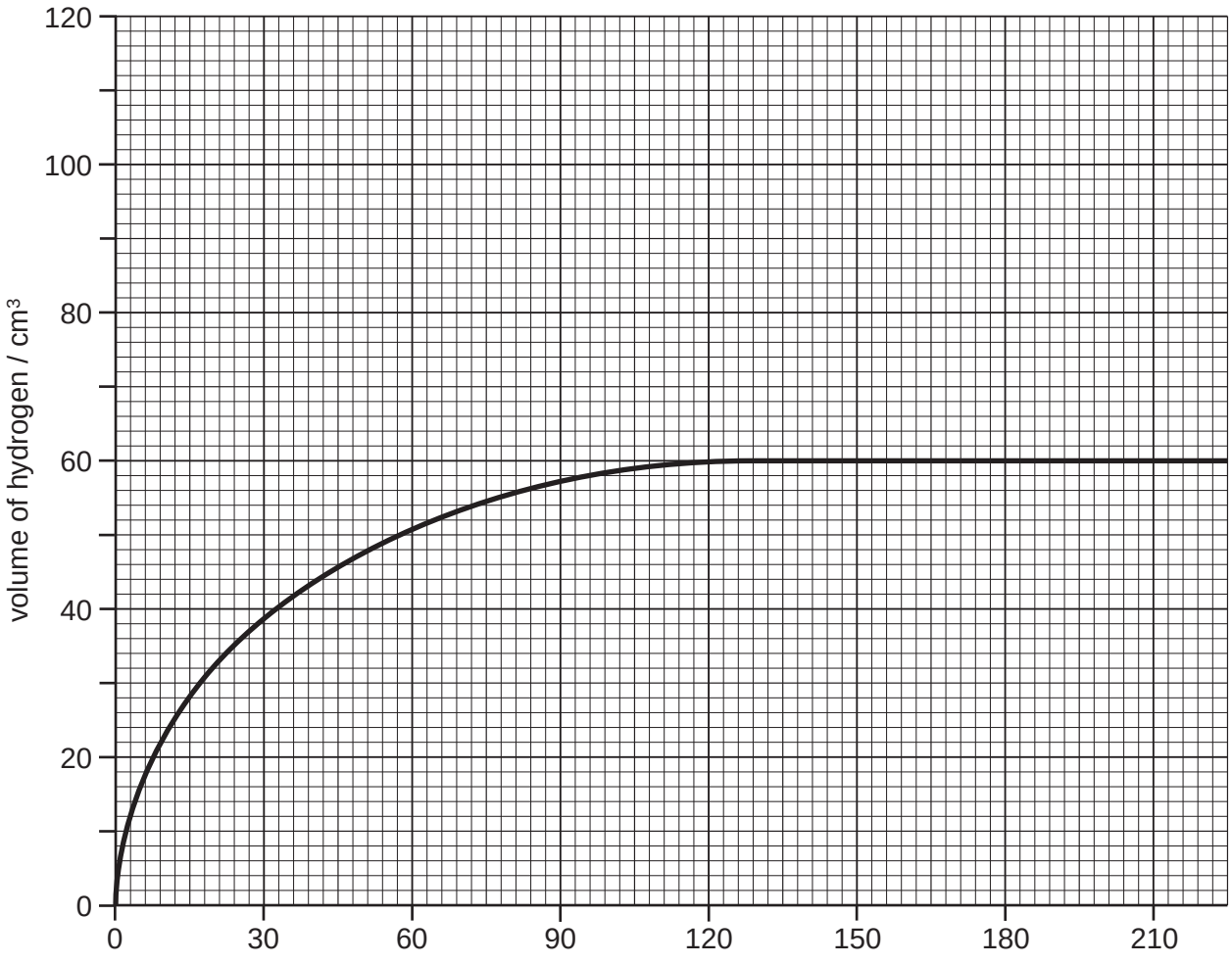
(ii) give the formula of the salt.

.....[1]

(c) In an experiment magnesium ribbon is added to 25.0 cm^3 of 1.00 mol/dm^3 hydrochloric acid, an excess.

$$Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$$

Every 30 seconds the total volume of hydrogen formed is measured at room temperature and pressure. The results are shown on the grid below.



(i) Use information from the graph to calculate the mass of magnesium ribbon used in the experiment.
[One mole of any gas at room temperature and pressure occupies a volume of 24 000 cm^3.]

mass of magnesium ribbon = ... g [3]

(ii) The experiment was repeated using the same mass of magnesium ribbon but with 25.0 cm^3 of 1.00 mol/dm^3 propanoic acid, an excess.
Draw on the grid a graph of the results for the reaction between magnesium ribbon and propanoic acid.

[2]

(d) Dilute hydrochloric acid reacts with aqueous silver nitrate to form a white precipitate.
Write an ionic equation, with state symbols, for this reaction.

[2]

[Total:10]

B9 Copper is a transition metal. It is used both in its pure form and in alloys.

(a) The physical properties of copper can be explained in terms of metallic bonding.

Describe, with the aid of a labelled diagram, the metallic bonding in copper.

.....

.....

.....

.....[3]

(b) Pure copper is used to make electrical wires because it is a good electrical conductor.

(i) Explain why copper is a good electrical conductor.

.....

.....[1]

(ii) Describe how impure copper can be purified.

.....

.....

.....

.....[2]

(c) Name an alloy that contains copper.

.....[1]

(d) Many millions of tonnes of copper are recycled every year.
Describe some of the advantages and disadvantages of recycling copper.

.....

.....

.....

.....

.....

.....[3]

[Total: 10]

B10 Glucose, $C_6H_{12}O_6$, is one of the products of photosynthesis.

(a) State the empirical formula for glucose.

.....[1]

(b) **(i)** Write an equation to show how glucose is formed in photosynthesis.

[1]

(ii) Give the essential conditions for this process.

.....

.....

.....[2]

(c) Fermentation converts glucose into ethanol, a biofuel.

$$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$$

(i) State **two** essential conditions for fermentation to take place.

1 .....

2 .....[2]

(ii) Calculate the maximum mass of ethanol that can be made from 1 tonne of glucose.
[One tonne is one million grams.]

maximum mass of ethanol = ... tonne [3]

(iii) Suggest one possible problem in making biofuels by fermentation.

.....[1]

[Total: 10]

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DATA SHEET
The Periodic Table of the Elements

Group I	Group II						Group III	Group IV	Group V	Group VI	Group VII	Group 0
					1 H Hydrogen 1							4 He Helium 2
7 Li Lithium	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
23 Na Sodium 1	24 Mg Magnesium 12						27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
39 K Potassium 9	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	64 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
85 Rb Rubidium 7	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	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
133 Cs Caesium 5	137 Ba Barium 56	139 La Lanthanum 57 *	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	209 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
223 Fr Francium 7	226 Ra Radium 88	227 Ac Actinium 89 †															

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	147 Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
232 Th Thorium 90	231 Pa Protactinium 91	238 U Uranium 92	237 Np Neptunium 93	244 Pu Plutonium 94	243 Am Americium 95	247 Cm Curium 96	247 Bk Berkelium 97	251 Cf Californium 98	252 Es Einsteinium 99	257 Fm Fermium 100	258 Md Mendelevium 101	259 No Nobelium 102	260 Lr Lawrencium 103

58–71 Lanthanoid series
90–103 Actinoid series

ey

a
X
b

a = relative atomic mass
X = atomic symbol
b = atomic (proton) number

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).