



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
General Certificate of Education Ordinary Level

CANDIDATE  
NAME

CENTRE  
NUMBER

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CANDIDATE  
NUMBER

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**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	
<b>Section A</b>	
<b>B7</b>	
<b>B8</b>	
<b>B9</b>	
<b>B10</b>	
<b>Total</b>	

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



## Section A

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

The total mark for this section is 45.

For  
Examiner's  
Use

**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.

For  
Examiner's  
Use

**(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,  $N_2O$ . This gas is a greenhouse gas.

For  
Examiner's  
Use

(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 Table. Scientists are trying to synthesise a new element in Group VII with a proton number of 117.

For  
Examiner's  
Use

(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,  $\text{CF}_3\text{Cl}$ , is a covalent compound.

- (i) Draw a 'dot-and-cross' diagram for a  $\text{CF}_3\text{Cl}$  molecule.  
You only need to show the outer electrons for each atom.

For  
Examiner's  
Use

[2]

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

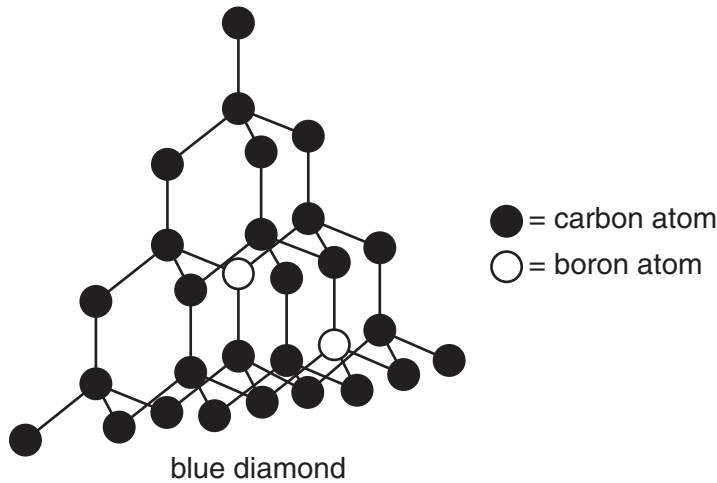
.....[1]

- (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 diamond is shown below.



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.



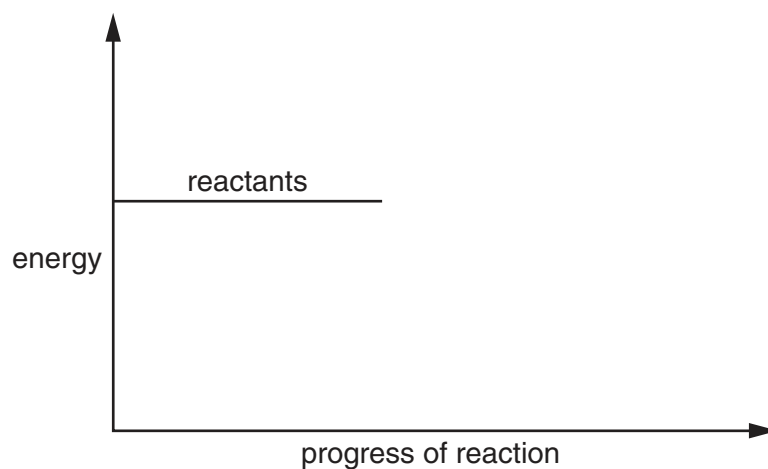
This reaction is endothermic.

- (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,  $\Delta H$ .



[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 when the pressure of the gaseous mixture is increased from 1 atmosphere to 10 atmospheres.

*For  
Examiner's  
Use*

.....  
.....  
.....  
.....[3]

[Total: 10]

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

For  
Examiner's  
Use

(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

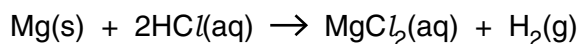
(i) name the gas,

.....[1]

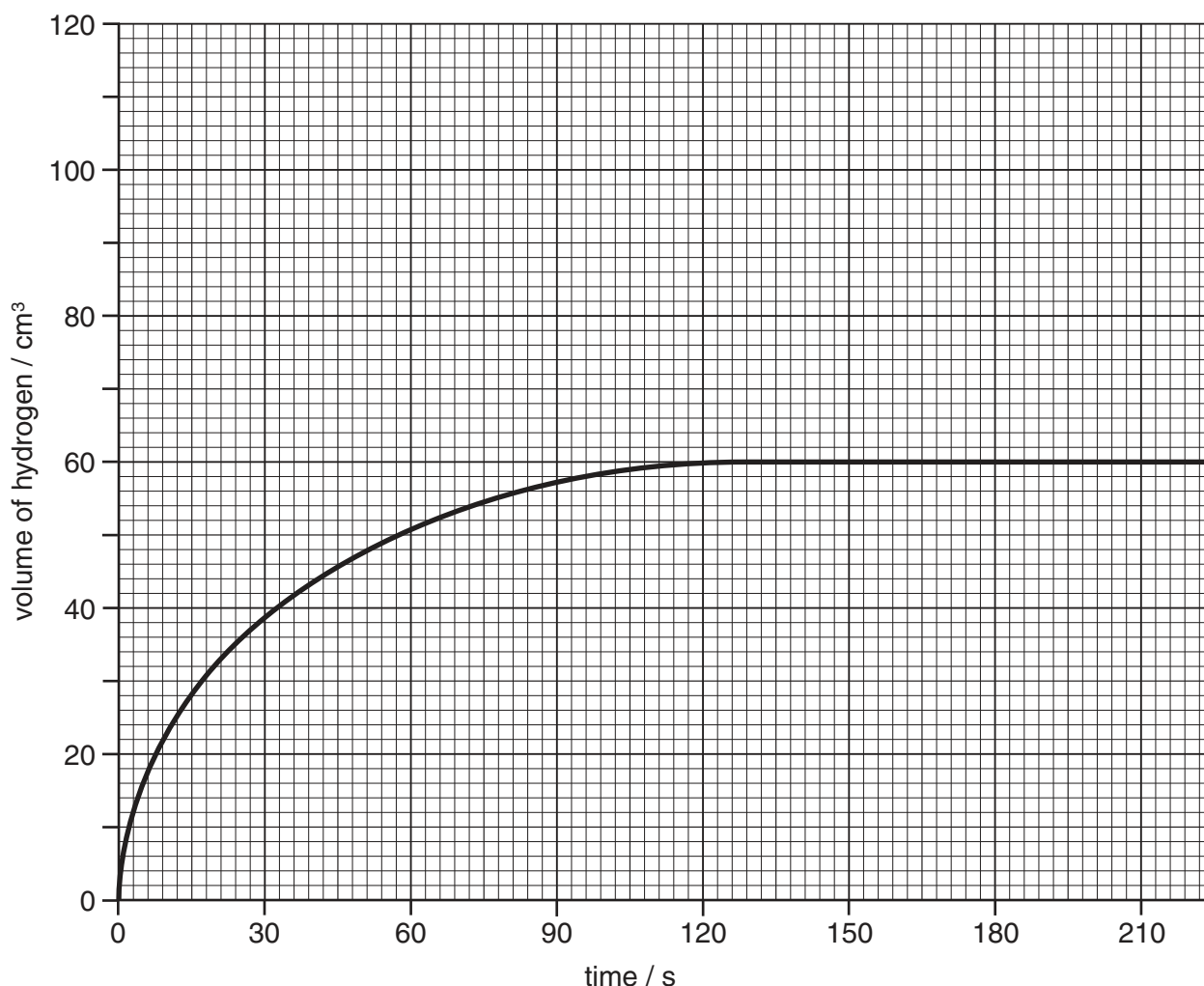
(ii) give the formula of the salt.

.....[1]

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



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<sup>3</sup>.]

For  
Examiner's  
Use

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

- (ii) The experiment was repeated using the same mass of magnesium ribbon but with 25.0 cm<sup>3</sup> of 1.00 mol/dm<sup>3</sup> 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.

*For  
Examiner's  
Use*

.....

.....

.....

.....

.....

.....

.....[3]

[Total: 10]

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

For  
Examiner's  
Use

(a) State the empirical formula for glucose.

.....[1]

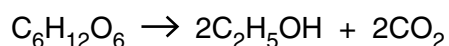
(b) (i) Write an equation to show how glucose is formed in photosynthesis.

[1]

(ii) Give the essential conditions for this process.

.....  
.....  
.....[2]

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



(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	II	III	IV	V	VI	VII	0								
		1 <b>H</b> Hydrogen 1							4 <b>He</b> Helium 2								
7 <b>Li</b> Lithium 3	9 <b>Be</b> Beryllium 4							16 <b>O</b> Oxygen 8	19 <b>F</b> Fluorine 9	20 <b>Ne</b> Neon 10							
23 <b>Na</b> Sodium 11	24 <b>Mg</b> Magnesium 12	27 <b>Al</b> Aluminium 13	28 <b>Si</b> Silicon 14	31 <b>P</b> Phosphorus 15	32 <b>S</b> Sulfur 16	35.5 <b>Cl</b> Chlorine 17			40 <b>Ar</b> Argon 18								
39 <b>K</b> Potassium 19	40 <b>Ca</b> Calcium 20	45 <b>Sc</b> Scandium 21	48 <b>Ti</b> Titanium 22	55 <b>Mn</b> Manganese 25	56 <b>Fe</b> Iron 26	59 <b>Ni</b> Nickel 28	64 <b>Cu</b> Copper 29	65 <b>Zn</b> Zinc 30	73 <b>Ge</b> Germanium 32	75 <b>As</b> Arsenic 33	77 <b>Se</b> Selenium 34	80 <b>Br</b> Bromine 35	84 <b>Kr</b> Krypton 36				
85 <b>Rb</b> Rubidium 37	88 <b>Sr</b> Strontium 38	89 <b>Y</b> Yttrium 39	91 <b>Zr</b> Zirconium 40	96 <b>Mo</b> Molybdenum 42	101 <b>Ru</b> Ruthenium 44	103 <b>Rh</b> Rhodium 45	106 <b>Pd</b> Palladium 46	108 <b>Ag</b> Silver 47	112 <b>Cd</b> Cadmium 48	115 <b>In</b> Indium 49	119 <b>Sn</b> Tin 50	122 <b>Sb</b> Antimony 51	127 <b>I</b> Iodine 53	131 <b>Xe</b> Xenon 54			
133 <b>Cs</b> Caesium 55	137 <b>Ba</b> Barium 56	139 <b>La</b> Lanthanum 57	178 <b>Hf</b> Hafnium 72	184 <b>W</b> Tungsten 74	186 <b>Re</b> Rhenium 75	192 <b>Ir</b> Iridium 77	195 <b>Pt</b> Platinum 78	197 <b>Au</b> Gold 79	201 <b>Hg</b> Mercury 80	204 <b>Tl</b> Thallium 81	207 <b>Pb</b> Lead 82	209 <b>Bi</b> Bismuth 83	210 <b>Po</b> Polonium 84	222 <b>Rn</b> Radon 86			
223 <b>Fr</b> Francium 87	226 <b>Ra</b> Radium 88	227 <b>Ac</b> Actinium 89							159 <b>Tb</b> Terbium 65	162 <b>Dy</b> Dysprosium 66	165 <b>Ho</b> Holmium 67	167 <b>Er</b> Erbium 68	169 <b>Tm</b> Thulium 69	173 <b>Yb</b> Ytterbium 70	175 <b>Lu</b> Lutetium 71		
				140 <b>Ce</b> Cerium 58	141 <b>Pr</b> Praseodymium 59	144 <b>Nd</b> Neodymium 60	147 <b>Pm</b> Promethium 61	150 <b>Sm</b> Samarium 62	152 <b>Eu</b> Europium 63	157 <b>Gd</b> Gadolinium 64	159 <b>Tb</b> Terbium 65	162 <b>Dy</b> Dysprosium 66	165 <b>Ho</b> Holmium 67	167 <b>Er</b> Erbium 68	169 <b>Tm</b> Thulium 69	173 <b>Yb</b> Ytterbium 70	175 <b>Lu</b> Lutetium 71
		232 <b>Th</b> Thorium 90	231 <b>Pa</b> Protactinium 91	238 <b>U</b> Uranium 92	237 <b>Np</b> Neptunium 93	244 <b>Pu</b> Plutonium 94	243 <b>Am</b> Americium 95	247 <b>Cm</b> Curium 96	251 <b>Bk</b> Berkelium 97	251 <b>Cf</b> Californium 98	251 <b>Bk</b> Berkelium 97	257 <b>Fm</b> Fermium 100	257 <b>Fm</b> Fermium 100	257 <b>Fm</b> Fermium 100	258 <b>Md</b> Mendelevium 101	259 <b>No</b> Nobelium 102	260 <b>Lr</b> Lawrencium 103

\* 58–71 Lanthanoid series  
† 90–103 Actinoid series

a **X**  
b

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

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