



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
International General Certificate of Secondary Education

CANDIDATE  
NAME

CENTRE  
NUMBER

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CANDIDATE  
NUMBER

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**CHEMISTRY**

**0620/33**

Paper 3 (Extended)

**May/June 2012**

**1 hour 15 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 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.**

Answer **all** questions.

A copy of the Periodic Table is printed on page 12.

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**

1	
2	
3	
4	
5	
6	
7	
8	
<b>Total</b>	

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This document consists of **11** printed pages and **1** blank page.



- 1 The table below includes information about some of the elements in Period 2.

element	carbon	nitrogen	fluorine	neon
symbol	C	N	F	Ne
structure	macromolecular	simple molecules N <sub>2</sub>	simple molecules F <sub>2</sub>	single atoms Ne
boiling point/°C	4200	-196	-188	-246

- (a) Why does neon exist as single atoms but fluorine exists as molecules?

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

- (b) What determines the order of the elements in a period?

..... [1]

- (c) When liquid nitrogen boils the following change occurs.



The boiling point of nitrogen is very low even though the bond between the atoms in a nitrogen molecule is very strong. Suggest an explanation.

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

- (d) Draw a diagram showing the arrangement of the outer shell (valency) electrons in a molecule of nitrogen.

[2]

[Total: 7]

2 Diamond and graphite are different forms of the same element, carbon. Explain the following in terms of their structure.

(a) Graphite is a soft material which is used as a lubricant.

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

(b) Diamond is a very hard material which is used for drilling and cutting.

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

(c) Graphite is a good conductor of electricity and diamond is a poor conductor.

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

[Total: 6]

3 The uses of a substance are determined by its properties.

(a) Plastics are poor conductors of electricity. They are used as insulation for electric cables. Which other **two** properties of plastics make them suitable for this purpose?

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

(b) Chromium is a hard, shiny metal. Suggest **two** reasons why chromium is used to electroplate steel.

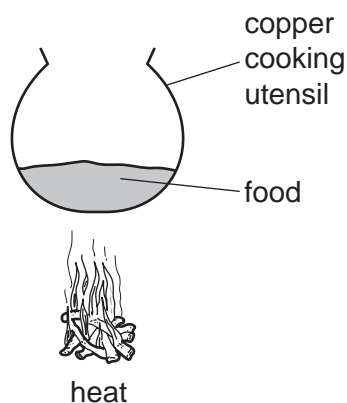
.....  
..... [2]

(c) Why is aluminium used extensively in the manufacture of aeroplanes?



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

(d) Why is copper a suitable material from which to make cooking utensils?



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

(e) Describe the bonding in a typical metal.

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

[Total: 10]

4 The ore of aluminium is bauxite which is impure aluminium oxide. Alumina, pure aluminium oxide, is obtained from bauxite. Aluminium is formed at the cathode when a molten mixture of alumina and cryolite,  $\text{Na}_3\text{AlF}_6$ , is electrolysed.

(a) (i) Name **two** products formed at the anode in this electrolysis.

..... [2]

(ii) All the aluminium formed comes from the alumina not the cryolite. Suggest **two** reasons why the electrolyte must contain cryolite.

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

(iii) The major impurity in bauxite is iron(III) oxide. Iron(III) oxide is basic, aluminium oxide is amphoteric. Explain how aqueous sodium hydroxide can be used to separate them.

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

**(b)** The purification of bauxite uses large amounts of sodium hydroxide.

**(i)** Describe the chemistry of how sodium hydroxide is made from concentrated aqueous sodium chloride. The description must include at least one ionic equation.

.....  
 .....  
 .....  
 .....  
 ..... [5]

**(ii)** Making sodium hydroxide from sodium chloride produces two other chemicals. Name these two chemicals and state one use of each chemical.

chemical .....

use .....

chemical .....

use ..... [2]

[Total: 13]

**5** Islay is an island off the west coast of Scotland. The main industry on the island is making ethanol from barley.

Barley contains the complex carbohydrate, starch. Enzymes catalyse the hydrolysis of starch to a solution of glucose.

**(a) (i)** Draw the structure of the starch.

Glucose can be represented by HO——OH

[2]

(ii) Enzymes can catalyse the hydrolysis of starch. Name another catalyst for this reaction.

..... [1]

(iii) Both starch and glucose are carbohydrates. Name the elements found in all carbohydrates.

.....  
..... [1]

(b) Yeast cells are added to the aqueous glucose. Fermentation produces a solution containing up to 10% of ethanol.

(i) Complete the word equation for the fermentation of glucose.

glucose → ..... + ..... [1]

(ii) Explain why it is necessary to add yeast and suggest why the amount of yeast in the mixture increases.

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

(iii) Fermentation is carried out at 35 °C. For many reactions a higher temperature would give a faster reaction. Why is a higher temperature not used in this process?

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

(c) The organic waste, the residue of the barley and yeast, is disposed of through a pipeline into the sea. In the future this waste will be converted into biogas by the anaerobic respiration of bacteria. Biogas, which is mainly methane, will supply most of the island's energy.

(i) Anaerobic means in the absence of oxygen. Suggest an explanation why oxygen must be absent.

..... [1]

(ii) The obvious advantage of converting the waste into methane is economic. Suggest **two** other advantages.

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

[Total: 12]

- 6 A length of magnesium ribbon was added to 50 cm<sup>3</sup> of sulfuric acid, concentration 1.0 mol/dm<sup>3</sup>. The time taken for the magnesium to react was measured. The experiment was repeated with the same volume of different acids. In all these experiments, the acid was in excess and the same length of magnesium ribbon was used.

(a)

experiment	acid	concentration in mol/dm <sup>3</sup>	time/s
A	sulfuric acid	1.0	20
B	propanoic acid	0.5	230
C	hydrochloric acid	1.0	40
D	hydrochloric acid	0.5	80

- (i) Write these experiments in order of reaction speed. Give the experiment with the fastest speed first.

..... [1]

- (ii) Give reasons for the order you have given in (i).

.....  
 .....  
 .....  
 .....  
 .....  
 .....  
 ..... [5]

- (b) Suggest **two** changes to experiment C which would increase the speed of the reaction and explain why the speed would increase. The volume of the acid, the concentration of the acid and the mass of magnesium used were kept the same.

change 1 .....

explanation .....

.....

change 2 .....

explanation .....

..... [5]

[Total: 11]

7 The alkenes are unsaturated hydrocarbons. They form a homologous series, the members of which have similar chemical properties:

- easily oxidised
- addition reactions
- polymerisation
- combustion.

(a) All the alkenes have the same empirical formula.

(i) State their empirical formula.

..... [1]

(ii) Why is the empirical formula the same for all alkenes?

..... [1]

(b) Alkenes can be oxidised to carboxylic acids by boiling with aqueous potassium manganate(VII).

(i) Pent-2-ene,  $\text{CH}_3\text{-CH}_2\text{-CH=CH-CH}_3$ , oxidises to  $\text{CH}_3\text{-CH}_2\text{-COOH}$  and  $\text{CH}_3\text{COOH}$ . Name these two acids.

$\text{CH}_3\text{-CH}_2\text{-COOH}$  .....

$\text{CH}_3\text{COOH}$  ..... [2]

(ii) Most alkenes oxidise to two carboxylic acids. Deduce the formula of an alkene which forms only one carboxylic acid.

[1]

(c) Complete the following equations for the addition reactions of propene.

(i)  $\text{CH}_3\text{-CH=CH}_2 + \text{Br}_2 \rightarrow$  ..... [1]

(ii)  $\text{CH}_3\text{-CH=CH}_2 + \text{H}_2\text{O} \rightarrow$  ..... [1]

(d) Draw the structural formula of poly(propene)

[2]



- (e) 0.01 moles of an alkene needed 2.4 g of oxygen for complete combustion. 2.2 g of carbon dioxide were formed. Determine the following mole ratio.

moles of alkene : moles of O<sub>2</sub> : moles of CO<sub>2</sub>

From this ratio determine the formula of the alkene.

..... [3]

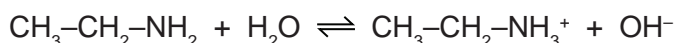
Write an equation for the complete combustion of this alkene.

..... [1]

[Total: 13]

- 8 Ethylamine, CH<sub>3</sub>-CH<sub>2</sub>-NH<sub>2</sub>, is a base which has similar properties to ammonia.

- (a) In aqueous ethylamine, there is the following equilibrium.



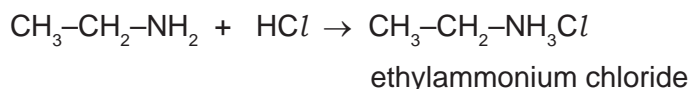
Explain why water is behaving as an acid in this reaction.

..... [1]

- (b) Given aqueous solutions of ethylamine and sodium hydroxide, describe how you could show that ethylamine is a weak base like ammonia and not a strong base like sodium hydroxide.

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

- (c) Ethylamine, like ammonia, reacts with acids to form salts.



Suggest how you could displace ethylamine from the salt, ethylammonium chloride.

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

(d) Explain the chemistry of the following reaction:

When aqueous ethylamine is added to aqueous iron(III) chloride, a brown precipitate is formed.

.....

..... [2]

[Total: 8]



**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	3	4	5	6	7	8	9	10	18	36	54	86										
<b>Li</b> Lithium	<b>Be</b> Beryllium	<b>B</b> Boron	<b>C</b> Carbon	<b>N</b> Nitrogen	<b>O</b> Oxygen	<b>F</b> Fluorine	<b>Ne</b> Neon	<b>Ar</b> Argon	<b>Kr</b> Krypton	<b>Xe</b> Xenon	<b>Rn</b> Radon											
23	12	13	14	15	16	17	18	36	54	86	118											
<b>Na</b> Sodium	<b>Mg</b> Magnesium	<b>Al</b> Aluminium	<b>Si</b> Silicon	<b>P</b> Phosphorus	<b>S</b> Sulfur	<b>Cl</b> Chlorine	<b>Ar</b> Argon	<b>Kr</b> Krypton	<b>Xe</b> Xenon	<b>Rn</b> Radon												
39	20	19	21	22	23	24	36	54	86	118	150											
<b>K</b> Potassium	<b>Ca</b> Calcium	<b>Ti</b> Titanium	<b>V</b> Vanadium	<b>Cr</b> Chromium	<b>Mn</b> Manganese	<b>Fe</b> Iron	<b>Co</b> Cobalt	<b>Ni</b> Nickel	<b>Cu</b> Copper	<b>Zn</b> Zinc	<b>Ga</b> Gallium	<b>Ge</b> Germanium										
85	38	40	41	42	43	44	45	46	47	48	50	52										
<b>Rb</b> Rubidium	<b>Sr</b> Strontium	<b>Y</b> Yttrium	<b>Zr</b> Zirconium	<b>Nb</b> Niobium	<b>Tc</b> Technetium	<b>Ru</b> Ruthenium	<b>Rh</b> Rhodium	<b>Pd</b> Palladium	<b>Ag</b> Silver	<b>Cd</b> Cadmium	<b>In</b> Indium	<b>Sn</b> Tin										
133	56	57	73	74	75	76	77	78	79	80	81	82										
<b>Cs</b> Caesium	<b>Ba</b> Barium	<b>La</b> Lanthanum	<b>Ta</b> Tantalum	<b>W</b> Tungsten	<b>Re</b> Rhenium	<b>Os</b> Osmium	<b>Ir</b> Iridium	<b>Pt</b> Platinum	<b>Au</b> Gold	<b>Hg</b> Mercury	<b>Tl</b> Thallium	<b>Pb</b> Lead										
87	88	89	72	74	75	76	77	78	79	80	81	82										
<b>Fr</b> Francium	<b>Ra</b> Radium	<b>Ac</b> Actinium																				
87	88	89																				
											152	157	162	165	167	169	173	175				
											63	64	66	67	68	69	70	71				
											60	61	62	63	64	65	66	67				
											59	60	61	62	63	64	65	66				
											91	92	93	94	95	96	97	98				
											73	74	75	76	77	78	79	80				
											181	182	186	190	192	195	197	201				
											93	94	95	96	97	98	99	100				
											23	24	25	26	27	28	29	30				
											51	52	55	56	59	59	64	65				
											23	24	25	26	27	28	29	30				
											93	94	95	96	97	98	99	100				
											140	141	144	150	152	157	159	162	165			
											58	59	60	61	62	63	64	65	66			
											90	91	92	94	95	96	97	98				
											137	139	181	182	186	190	192	195	197			
											55	56	57	72	74	75	76	77	78			
											137	139	181	182	186	190	192	195	197			
											226	227										
											88	89										
											88	89										
											88	89										
											88	89										

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

a	<b>X</b>
Key	b

a = relative atomic mass

x = atomic symbol

b = proton (atomic) number

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

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