



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

0620/32

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	
Total	

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 ₂	simple molecules F ₂	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.

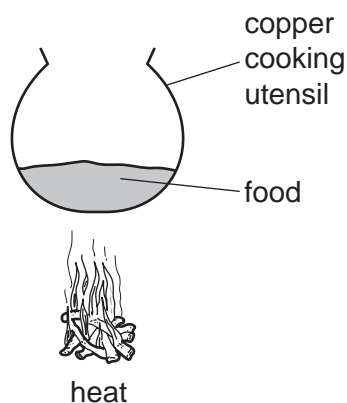
.....
..... [2]

(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, Na_3AlF_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 cm³ of sulfuric acid, concentration 1.0 mol/dm³. 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 ³	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 CH_3COOH . Name these two acids.

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

CH_3COOH [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 O₂ : moles of CO₂

From this ratio determine the formula of the alkene.

..... [3]

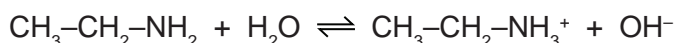
Write an equation for the complete combustion of this alkene.

..... [1]

[Total: 13]

- 8 Ethylamine, CH₃-CH₂-NH₂, 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.

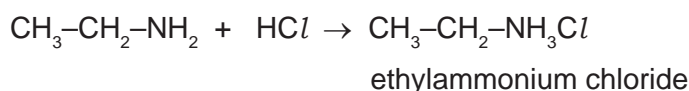
..... [1]

- (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 H Hydrogen 1							2 He Helium 2
7 Li Lithium 3	9 Be Beryllium 4			5 B Boron 5	6 C Carbon 6	7 N Nitrogen 7	8 O Oxygen 8	9 F Fluorine 9	10 Ne Neon 10
11 Na Sodium 11	12 Mg Magnesium 12			13 Al Aluminium 13	14 Si Silicon 14	15 P Phosphorus 15	16 S Sulfur 16	17 Cl Chlorine 17	18 Ar Argon 18
19 K Potassium 19	20 Ca Calcium 20			21 Sc Scandium 21	22 Ti Titanium 22	23 V Vanadium 23	24 Cr Chromium 24	25 Mn Manganese 25	26 Fe Iron 26
37 Rb Rubidium 37	38 Sr Strontium 38			39 Y Yttrium 39	40 Zr Zirconium 40	41 Nb Niobium 41	42 Mo Molybdenum 42	43 Tc Technetium 43	44 Ru Ruthenium 44
55 Cs Caesium 55	56 Ba Barium 56			57 La Lanthanum 57	72 Hf Hafnium 72	73 Ta Tantalum 73	74 W Tungsten 74	75 Re Rhenium 75	76 Os Osmium 76
87 Fr Francium 87	88 Ra Radium 88			89 Ac Actinium 89					
					29 Cu Copper 29	30 Zn Zinc 30	31 Ga Gallium 31	32 Ge Germanium 32	33 As Arsenic 33
				45 Sc Scandium 45	46 Ti Titanium 46	47 V Vanadium 47	48 Cr Chromium 48	49 Mn Manganese 49	50 Fe Iron 50
				59 Ni Nickel 59	60 Cu Copper 60	61 Zn Zinc 61	62 Ga Gallium 62	63 Ge Germanium 63	64 As Arsenic 64
				77 Ir Iridium 77	78 Pt Platinum 78	79 Au Gold 79	80 Hg Mercury 80	81 Tl Thallium 81	82 Pb Lead 82
				83 Bi Bismuth 83	84 Po Polonium 84	85 At Astatine 85	86 Rn Radon 86		
				87 Fr Francium 87	88 Ra Radium 88	89 Ac Actinium 89			
				91 Sc Scandium 91	92 Ti Titanium 92	93 V Vanadium 93	94 Cr Chromium 94	95 Mn Manganese 95	96 Fe Iron 96
				97 Ni Nickel 97	98 Cu Copper 98	99 Zn Zinc 99	100 Ga Gallium 100	101 Ge Germanium 101	102 As Arsenic 102
				103 Y Yttrium 103	104 Zr Zirconium 104	105 Nb Niobium 105	106 Mo Molybdenum 106	107 Tc Technetium 107	108 Ru Ruthenium 108
				109 Sr Strontium 109	110 Rb Rubidium 110	111 K Potassium 111	112 Ca Calcium 112	113 Sc Scandium 113	114 Ti Titanium 114
				115 La Lanthanum 115	116 Ce Cerium 116	117 Pr Praseodymium 117	118 Nd Neodymium 118	119 Pm Promethium 119	120 Sm Samarium 120
				121 Ba Barium 121	122 La Lanthanum 122	123 Ce Cerium 123	124 Pr Praseodymium 124	125 Nd Neodymium 125	126 Pm Promethium 126
				127 Yb Ytterbium 127	128 Lu Lutetium 128	129 Hf Hafnium 129	130 Ta Tantalum 130	131 W Tungsten 131	132 Re Rhenium 132
				133 Fr Francium 133	134 Ra Radium 134	135 Ac Actinium 135			
				137 Sc Scandium 137	138 Ti Titanium 138	139 V Vanadium 139	140 Cr Chromium 140	141 Mn Manganese 141	142 Fe Iron 142
				143 Ni Nickel 143	144 Cu Copper 144	145 Zn Zinc 145	146 Ga Gallium 146	147 Ge Germanium 147	148 As Arsenic 148
				149 Y Yttrium 149	150 Zr Zirconium 150	151 Nb Niobium 151	152 Mo Molybdenum 152	153 Tc Technetium 153	154 Ru Ruthenium 154
				155 Sr Strontium 155	156 Rb Rubidium 156	157 K Potassium 157	158 Ca Calcium 158	159 Sc Scandium 159	160 Ti Titanium 160
				161 La Lanthanum 161	162 Ce Cerium 162	163 Pr Praseodymium 163	164 Nd Neodymium 164	165 Pm Promethium 165	166 Sm Samarium 166
				167 Ba Barium 167	168 La Lanthanum 168	169 Ce Cerium 169	170 Pr Praseodymium 170	171 Nd Neodymium 171	172 Pm Promethium 172
				173 Yb Ytterbium 173	174 Lu Lutetium 174	175 Hf Hafnium 175	176 Ta Tantalum 176	177 W Tungsten 177	178 Re Rhenium 178
				179 Fr Francium 179	180 Ra Radium 180	181 Ac Actinium 181			
				183 Sc Scandium 183	184 Ti Titanium 184	185 V Vanadium 185	186 Cr Chromium 186	187 Mn Manganese 187	188 Fe Iron 188
				189 Ni Nickel 189	190 Cu Copper 190	191 Zn Zinc 191	192 Ga Gallium 192	193 Ge Germanium 193	194 As Arsenic 194
				195 Y Yttrium 195	196 Zr Zirconium 196	197 Nb Niobium 197	198 Mo Molybdenum 198	199 Tc Technetium 199	200 Ru Ruthenium 200
				201 Ba Barium 201	202 La Lanthanum 202	203 Ce Cerium 203	204 Pr Praseodymium 204	205 Nd Neodymium 205	206 Pm Promethium 206
				207 Yb Ytterbium 207	208 Lu Lutetium 208	209 Hf Hafnium 209	210 Ta Tantalum 210	211 W Tungsten 211	212 Re Rhenium 212
				213 Fr Francium 213	214 Ra Radium 214	215 Ac Actinium 215			
				217 Sc Scandium 217	218 Ti Titanium 218	219 V Vanadium 219	220 Cr Chromium 220	221 Mn Manganese 221	222 Fe Iron 222
				223 Ni Nickel 223	224 Cu Copper 224	225 Zn Zinc 225	226 Ga Gallium 226	227 Ge Germanium 227	228 As Arsenic 228
				229 Y Yttrium 229	230 Zr Zirconium 230	231 Nb Niobium 231	232 Mo Molybdenum 232	233 Tc Technetium 233	234 Ru Ruthenium 234
				235 Ba Barium 235	236 La Lanthanum 236	237 Ce Cerium 237	238 Pr Praseodymium 238	239 Nd Neodymium 239	240 Pm Promethium 240
				241 Yb Ytterbium 241	242 Lu Lutetium 242	243 Hf Hafnium 243	244 Ta Tantalum 244	245 W Tungsten 245	246 Re Rhenium 246
				247 Fr Francium 247	248 Ra Radium 248	249 Ac Actinium 249			
				251 Sc Scandium 251	252 Ti Titanium 252	253 V Vanadium 253	254 Cr Chromium 254	255 Mn Manganese 255	256 Fe Iron 256
				257 Ni Nickel 257	258 Cu Copper 258	259 Zn Zinc 259	260 Ga Gallium 260	261 Ge Germanium 261	262 As Arsenic 262
				263 Y Yttrium 263	264 Zr Zirconium 264	265 Nb Niobium 265	266 Mo Molybdenum 266	267 Tc Technetium 267	268 Ru Ruthenium 268
				269 Ba Barium 269	270 La Lanthanum 270	271 Ce Cerium 271	272 Pr Praseodymium 272	273 Nd Neodymium 273	274 Pm Promethium 274
				275 Yb Ytterbium 275	276 Lu Lutetium 276	277 Hf Hafnium 277	278 Ta Tantalum 278	279 W Tungsten 279	280 Re Rhenium 280
				281 Fr Francium 281	282 Ra Radium 282	283 Ac Actinium 283			
				287 Sc Scandium 287	288 Ti Titanium 288	289 V Vanadium 289	290 Cr Chromium 290	291 Mn Manganese 291	292 Fe Iron 292
				293 Ni Nickel 293	294 Cu Copper 294	295 Zn Zinc 295	296 Ga Gallium 296	297 Ge Germanium 297	298 As Arsenic 298
				299 Y Yttrium 299	300 Zr Zirconium 300	301 Nb Niobium 301	302 Mo Molybdenum 302	303 Tc Technetium 303	304 Ru Ruthenium 304
				305 Ba Barium 305	306 La Lanthanum 306	307 Ce Cerium 307	308 Pr Praseodymium 308	309 Nd Neodymium 309	310 Pm Promethium 310
				311 Yb Ytterbium 311	312 Lu Lutetium 312	313 Hf Hafnium 313	314 Ta Tantalum 314	315 W Tungsten 315	316 Re Rhenium 316
				317 Fr Francium 317	318 Ra Radium 318	319 Ac Actinium 319			
				321 Sc Scandium 321	322 Ti Titanium 322	323 V Vanadium 323	324 Cr Chromium 324	325 Mn Manganese 325	326 Fe Iron 326
				327 Ni Nickel 327	328 Cu Copper 328	329 Zn Zinc 329	330 Ga Gallium 330	331 Ge Germanium 331	332 As Arsenic 332
				333 Y Yttrium 333	334 Zr Zirconium 334	335 Nb Niobium 335	336 Mo Molybdenum 336	337 Tc Technetium 337	338 Ru Ruthenium 338
				339 Ba Barium 339	340 La Lanthanum 340	341 Ce Cerium 341	342 Pr Praseodymium 342	343 Nd Neodymium 343	344 Pm Promethium 344
				345 Yb Ytterbium 345	346 Lu Lutetium 346	347 Hf Hafnium 347	348 Ta Tantalum 348</		