

CANDIDATE
NAME

CENTRE
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CANDIDATE
NUMBER

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CHEMISTRY

0620/32

Paper 3 (Extended)

February/March 2015

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 an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

Electronic calculators may be used.

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

You may lose marks if you do not show your working or if you do not use appropriate units.

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.

The syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 1/Level 2 Certificate.

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

1 For each of the following, give the name of an element from Period 3 (sodium to argon), which matches the description.

(a) an element which is gaseous at room temperature and pressure

..... [1]

(b) an element that is added to water to kill bacteria

..... [1]

(c) an element that forms a basic oxide of the type XO

..... [1]

(d) an element used as an inert atmosphere in lamps

..... [1]

(e) an element that forms an amphoteric oxide

..... [1]

(f) an element that reacts vigorously with cold water to produce hydrogen

..... [1]

[Total: 6]

2 (a) Define the term *isotope*.

.....

..... [2]

(b) The table gives information about four particles, **A**, **B**, **C** and **D**.

Complete the table.

The first line has been done for you.

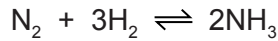
| particle | number of protons | number of electrons | number of neutrons | nucleon number | symbol or formula |
|----------|-------------------|---------------------|--------------------|----------------|-------------------|
| A | 6 | 6 | 6 | 12 | C |
| B | 11 | 10 | 12 | | |
| C | 8 | | 8 | | O ²⁻ |
| D | | 10 | | 28 | Al ³⁺ |

[7]

[Total: 9]

- 3 Ammonia is manufactured by the Haber process. Nitrogen and hydrogen are passed over a catalyst at a temperature of 450 °C and a pressure of 200 atmospheres.

The equation for the reaction is as follows.



The forward reaction is exothermic.

- (a) State **one** use of ammonia.

..... [1]

- (b) What is the meaning of the symbol \rightleftharpoons ?

..... [1]

- (c) What are the sources of nitrogen and hydrogen used in the Haber process?

nitrogen

hydrogen [2]

- (d) Name the catalyst in the Haber process.

..... [1]

- (e) (i) If a temperature higher than 450 °C was used in the Haber process, what would happen to the **rate** of the reaction? Give a reason for your answer.

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

- (ii) If a temperature higher than 450 °C was used in the Haber process, what would happen to the **yield** of ammonia? Give a reason for your answer.

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

- (f) (i) If a pressure higher than 200 atmospheres was used in the Haber process, what would happen to the **yield** of ammonia? Give a reason for your answer.

.....

 [2]

- (ii) Explain why the rate of reaction would be faster if the pressure was greater than 200 atmospheres.

.....
 [1]

- (iii) Suggest **one** reason why a pressure higher than 200 atmospheres is not used in the Haber process.

.....
 [1]

- (g) Draw a dot-and-cross diagram to show the arrangement of the outer (valency) electrons in one molecule of ammonia.

[2]

- (h) Ammonia acts as a base when it reacts with sulfuric acid.

- (i) What is a base?

..... [1]

- (ii) Write a balanced equation for the reaction between ammonia and sulfuric acid.

..... [2]

[Total: 18]

4 (a) A compound **X** contains 82.76% of carbon by mass and 17.24% of hydrogen by mass.

(i) Calculate the empirical formula of compound **X**.

[2]

(ii) Compound **X** has a relative molecular mass of 58.

Deduce the molecular formula of compound **X**.

[2]

(b) Alkenes are unsaturated hydrocarbons.

(i) State the general formula of alkenes.

..... [1]

(ii) State the empirical formula of alkenes.

..... [1]

(c) What is meant by the term *unsaturated hydrocarbon*?

unsaturated

.....

hydrocarbon

.....

[2]

(d) Describe a test that would distinguish between saturated and unsaturated hydrocarbons.

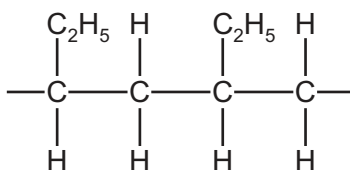
reagent

observation (saturated hydrocarbon)

observation (unsaturated hydrocarbon)

[3]

(e) Addition polymers can be made from alkenes. The diagram shows part of an addition polymer.



(i) Draw a circle on the diagram to show one repeat unit in this polymer. [1]

(ii) Give the structure and the name of the monomer used to make this polymer.

structure

name

[2]

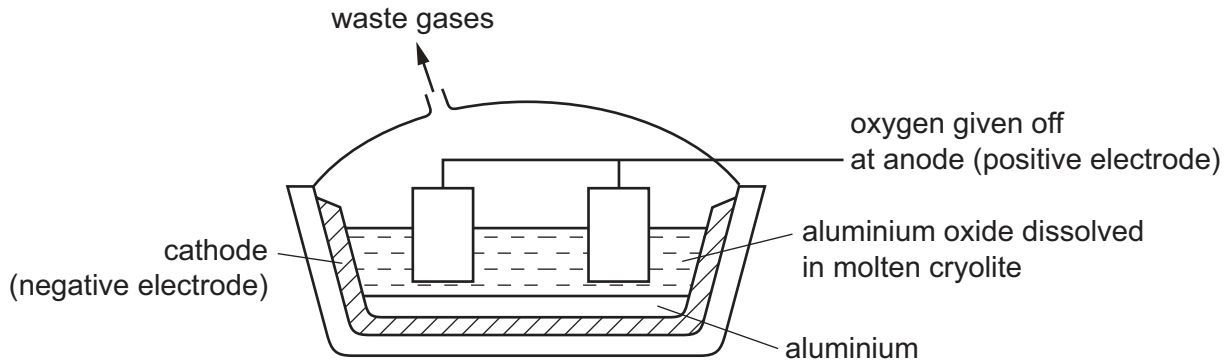
(iii) Give the structure of an isomer of the alkene in (e)(ii).

[1]

[Total: 15]

- 5 Aluminium and iron are extracted from their ores by different methods.

Aluminium is extracted from its purified oxide ore by electrolysis.



- (a) What is the name of the ore of aluminium which consists mainly of aluminium oxide?

..... [1]

- (b) The electrodes are both made of the same substance.

Name this substance.

..... [1]

- (c) Aluminium oxide is dissolved in molten cryolite before it is electrolysed.

Give **two** reasons why aluminium oxide dissolved in molten cryolite is electrolysed rather than molten aluminium oxide alone.

.....
 [2]

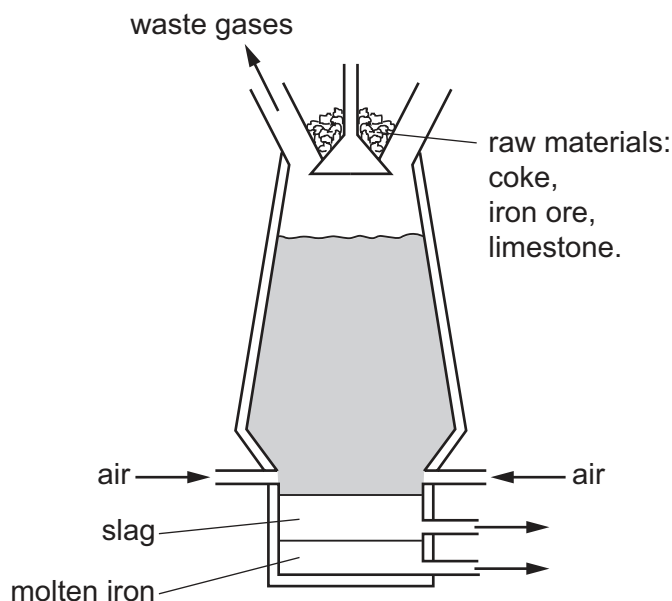
- (d) Write the **ionic** equations for the reactions at the electrodes in this electrolysis.

anode (positive electrode)

cathode (negative electrode)

[2]

(e) Iron is extracted from its oxide ore by reduction using carbon in a blast furnace.



(i) Place the elements aluminium, carbon and iron in order of reactivity with the **least** reactive element first.

..... [1]

(ii) Use your answer to (e)(i) to explain why iron is extracted by reduction using carbon but aluminium is not.

.....
 [1]

(f) What is the name of the ore of iron which consists mainly of iron(III) oxide?

..... [1]

(g) Write balanced equations for the reactions occurring in the blast furnace which involve

(i) the complete combustion of coke (carbon),

..... [1]

(ii) the production of carbon monoxide from carbon dioxide,

..... [1]

(iii) the reduction of iron(III) oxide,

..... [1]

(iv) the formation of slag.

..... [1]

[Total: 13]

- 6 A student is told to produce the maximum amount of copper from a mixture of copper and copper(II) carbonate.

The student adds the mixture to an excess of dilute sulfuric acid in a beaker and stirs the mixture with a glass rod. The copper(II) carbonate reacts with the sulfuric acid, forming a solution of copper(II) sulfate but the copper does not react with the sulfuric acid.

The student then

- removes the unreacted copper from the mixture,
- converts the solution of copper(II) sulfate into copper by a series of reactions.

- (a) Describe **two** things that the student would observe when the mixture is added to the dilute sulfuric acid.

.....
 [2]

- (b) Describe how the student can produce pure dry copper from the mixture of copper and copper(II) sulfate solution.

.....

 [3]

- (c) The student then adds sodium hydroxide solution to the copper(II) sulfate solution to produce copper(II) hydroxide.

- (i) Describe what the student would observe.

..... [1]

- (ii) Write an **ionic** equation for this reaction.

..... [1]

- (d) After separating the copper(II) hydroxide from the mixture, the copper(II) hydroxide is heated strongly. The copper(II) hydroxide decomposes into copper(II) oxide and steam.

- (i) Write an equation for the decomposition of copper(II) hydroxide. Include state symbols.

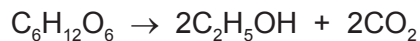
..... [2]

- (ii) Name a non-metallic element that can be used to convert copper(II) oxide into copper.

..... [1]

[Total: 10]

- 7 Ethanol is manufactured from glucose, $C_6H_{12}O_6$, by fermentation according to the following equation.



- (a) State the conditions required for this reaction.

.....
 [2]

- (b) In an experiment, 30.0g of glucose was fermented.

- (i) Calculate the number of moles of glucose in 30.0g.

..... mol [2]

- (ii) Calculate the maximum mass of ethanol that could be obtained from 30.0g of glucose.

..... g [2]

- (iii) Calculate the volume of carbon dioxide at room temperature and pressure that can be obtained from 30.0g of glucose.

..... dm^3 [1]

- (c) Ethanol can also be manufactured from ethene.

- (i) Name the raw material which is the source of ethene.

..... [1]

- (ii) Write a balanced equation for the manufacture of ethanol from ethene.

..... [1]

[Total: 9]

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 | | | | | |
| | | | | 91 Ti Titanium 91 | 92 Zr Zirconium 92 | 93 Nb Niobium 93 | 94 Mo Molybdenum 94 | 95 Tc Technetium 95 | 96 Ru Ruthenium 96 |
| | | | | 97 Co Cobalt 97 | 98 Ni Nickel 98 | 99 Cu Copper 99 | 100 Zn Zinc 100 | 101 Ga Gallium 101 | 102 Ge Germanium 102 |
| | | | | 103 As Arsenic 103 | 104 Se Selenium 104 | 105 Br Bromine 105 | 106 Kr Krypton 106 | 107 Sb Antimony 107 | 108 Te Tellurium 108 |
| | | | | 109 In Indium 109 | 110 Sn Tin 110 | 111 Pb Lead 111 | 112 Hg Mercury 112 | 113 Tl Thallium 113 | 114 Po Polonium 114 |
| | | | | 115 Bi Bismuth 115 | 116 Po Polonium 116 | 117 At Astatine 117 | 118 Rn Radon 118 | | |
| | | | | 119 Fr Francium 119 | 120 Ra Radium 120 | | | | |
| | | | | 121 La Lanthanum 121 | 122 Ce Cerium 122 | 123 Pr Praseodymium 123 | 124 Nd Neodymium 124 | 125 Pm Promethium 125 | 126 Sm Samarium 126 |
| | | | | 127 Eu Europium 127 | 128 Gd Gadolinium 128 | 129 Tb Terbium 129 | 130 Dy Dysprosium 130 | 131 Ho Holmium 131 | 132 Er Erbium 132 |
| | | | | 133 Tm Thulium 133 | 134 Yb Ytterbium 134 | 135 Lu Lutetium 135 | | | |
| | | | | 136 Hf Hafnium 136 | 137 Ta Tantalum 137 | 138 W Tungsten 138 | 139 Re Rhenium 139 | 140 Os Osmium 140 | 141 Pt Platinum 141 |
| | | | | 142 Au Gold 142 | 143 Hg Mercury 143 | 144 Tl Thallium 144 | 145 Pb Lead 145 | 146 Bi Bismuth 146 | 147 Po Polonium 147 |
| | | | | 148 At Astatine 148 | 149 Rn Radon 149 | | | | |
| | | | | 150 Fr Francium 150 | 151 Ra Radium 151 | | | | |
| | | | | 152 La Lanthanum 152 | 153 Ce Cerium 153 | 154 Pr Praseodymium 154 | 155 Nd Neodymium 155 | 156 Pm Promethium 156 | 157 Sm Samarium 157 |
| | | | | 158 Eu Europium 158 | 159 Gd Gadolinium 159 | 160 Tb Terbium 160 | 161 Dy Dysprosium 161 | 162 Ho Holmium 162 | 163 Er Erbium 163 |
| | | | | 164 Tm Thulium 164 | 165 Yb Ytterbium 165 | 166 Lu Lutetium 166 | | | |
| | | | | 167 Hf Hafnium 167 | 168 Ta Tantalum 168 | 169 W Tungsten 169 | 170 Re Rhenium 170 | 171 Os Osmium 171 | 172 Pt Platinum 172 |
| | | | | 173 Au Gold 173 | 174 Hg Mercury 174 | 175 Tl Thallium 175 | 176 Pb Lead 176 | 177 Bi Bismuth 177 | 178 Po Polonium 178 |
| | | | | 179 At Astatine 179 | 180 Rn Radon 180 | | | | |
| | | | | 181 Fr Francium 181 | 182 Ra Radium 182 | | | | |
| | | | | 183 La Lanthanum 183 | 184 Ce Cerium 184 | 185 Pr Praseodymium 185 | 186 Nd Neodymium 186 | 187 Pm Promethium 187 | 188 Sm Samarium 188 |
| | | | | 189 Eu Europium 189 | 190 Gd Gadolinium 190 | 191 Tb Terbium 191 | 192 Dy Dysprosium 192 | 193 Ho Holmium 193 | 194 Er Erbium 194 |
| | | | | 195 Tm Thulium 195 | 196 Yb Ytterbium 196 | 197 Lu Lutetium 197 | | | |
| | | | | 198 Hf Hafnium 198 | 199 Ta Tantalum 199 | 200 W Tungsten 200 | 201 Re Rhenium 201 | 202 Os Osmium 202 | 203 Pt Platinum 203 |
| | | | | 204 Au Gold 204 | 205 Hg Mercury 205 | 206 Tl Thallium 206 | 207 Pb Lead 207 | 208 Bi Bismuth 208 | 209 Po Polonium 209 |
| | | | | 210 At Astatine 210 | 211 Rn Radon 211 | | | | |
| | | | | 212 Fr Francium 212 | 213 Ra Radium 213 | | | | |
| | | | | 214 La Lanthanum 214 | 215 Ce Cerium 215 | 216 Pr Praseodymium 216 | 217 Nd Neodymium 217 | 218 Pm Promethium 218 | 219 Sm Samarium 219 |
| | | | | 220 Eu Europium 220 | 221 Gd Gadolinium 221 | 222 Tb Terbium 222 | 223 Dy Dysprosium 223 | 224 Ho Holmium 224 | 225 Er Erbium 225 |
| | | | | 226 Tm Thulium 226 | 227 Yb Ytterbium 227 | 228 Lu Lutetium 228 | | | |
| | | | | 229 Hf Hafnium 229 | 230 Ta Tantalum 230 | 231 W Tungsten 231 | 232 Re Rhenium 232 | 233 Os Osmium 233 | 234 Pt Platinum 234 |
| | | | | 235 Au Gold 235 | 236 Hg Mercury 236 | 237 Tl Thallium 237 | 238 Pb Lead 238 | 239 Bi Bismuth 239 | 240 Po Polonium 240 |
| | | | | 241 At Astatine 241 | 242 Rn Radon 242 | | | | |
| | | | | 243 Fr Francium 243 | 244 Ra Radium 244 | | | | |
| | | | | 245 La Lanthanum 245 | 246 Ce Cerium 246 | 247 Pr Praseodymium 247 | 248 Nd Neodymium 248 | 249 Pm Promethium 249 | 250 Sm Samarium 250 |
| | | | | 251 Eu Europium 251 | 252 Gd Gadolinium 252 | 253 Tb Terbium 253 | 254 Dy Dysprosium 254 | 255 Ho Holmium 255 | 256 Er Erbium 256 |
| | | | | 257 Tm Thulium 257 | 258 Yb Ytterbium 258 | 259 Lu Lutetium 259 | | | |
| | | | | 260 Hf Hafnium 260 | 261 Ta Tantalum 261 | 262 W Tungsten 262 | 263 Re Rhenium 263 | 264 Os Osmium 264 | 265 Pt Platinum 265 |
| | | | | 266 Au Gold 266 | 267 Hg Mercury 267 | 268 Tl Thallium 268 | 269 Pb Lead 269 | 270 Bi Bismuth 270 | 271 Po Polonium 271 |
| | | | | 272 At Astatine 272 | 273 Rn Radon 273 | | | | |
| | | | | 274 Fr Francium 274 | 275 Ra Radium 275 | | | | |
| | | | | 276 La Lanthanum 276 | 277 Ce Cerium 277 | 278 Pr Praseodymium 278 | 279 Nd Neodymium 279 | 280 Pm Promethium 280 | 281 Sm Samarium 281 |
| | | | | 282 Eu Europium 282 | 283 Gd Gadolinium 283 | 284 Tb Terbium 284 | 285 Dy Dysprosium 285 | 286 Ho Holmium 286 | 287 Er Erbium 287 |
| | | | | 288 Tm Thulium 288 | 289 Yb Ytterbium 289 | 290 Lu Lutetium 290 | | | |
| | | | | 291 Hf Hafnium 291 | 292 Ta Tantalum 292 | 293 W Tungsten 293 | 294 Re Rhenium 294 | 295 Os Osmium 295 | 296 Pt Platinum 296 |
| | | | | 297 Au Gold 297 | 298 Hg Mercury 298 | 299 Tl Thallium 299 | 300 Pb Lead 300 | 301 Bi Bismuth 301 | 302 Po Polonium 302 |
| | | | | 303 At Astatine 303 | 304 Rn Radon 304 | | | | |
| | | | | 305 Fr Francium 305 | 306 Ra Radium 306 | | | | |
| | | | | 307 La Lanthanum 307 | 308 Ce Cerium 308 | 309 Pr Praseodymium 309 | 310 Nd Neodymium 310 | 311 Pm Promethium 311 | 312 Sm Samarium 312 |
| | | | | 313 Eu Europium 313 | 314 Gd Gadolinium 314 | 315 Tb Terbium 315 | 316 Dy Dysprosium 316 | 317 Ho Holmium 317 | 318 Er Erbium 318 |
| | | | | 319 Tm Thulium 319 | 320 Yb Ytterbium 320 | 321 Lu Lutetium 321 | | | |
| | | | | 322 Hf Hafnium 322 | 323 Ta Tantalum 323 | 324 W Tungsten 324 | 325 Re Rhenium 325 | 326 Os Osmium 326 | 327 Pt Platinum 327 |
| | | | | 328 Au Gold 328 | 329 Hg Mercury 329 | 330 Tl Thallium 330 | 331 Pb Lead 331 | 332 Bi Bismuth 332 | 333 Po Polonium 333 |
| | | | | 334 At Astatine 334 | 335 Rn Radon 335 | | | | |
| | | | | 336 Fr Francium 336 | 337 Ra Radium 337 | | | | |
| | | | | 338 La Lanthanum 338 | 339 Ce Cerium 339 | 340 Pr Praseodymium 340 | 341 Nd Neodymium 341 | 342 Pm Promethium 342 | 343 Sm Samarium 343 |
| | | | | 344 Eu Europium 344 | 345 Gd Gadolinium 345 | 346 Tb Terbium 346 | 347 Dy Dysprosium 347 | 348 Ho Holmium 348 | 349 Er Erbium 349 |
| | | | | 350 Tm Thulium 350 | 351 Yb Ytterbium 351 | 352 Lu Lutetium 352 | | | |