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O LevelCambridge International Examinations
Cambridge Ordinary LevelCANDIDATE
NAME

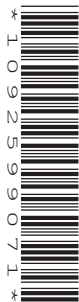
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CENTRE
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**CHEMISTRY**

Paper 2 Theory

5070/22**May/June 2014****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 an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, 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 BAnswer any **three** questions.

Write your answers in the spaces provided in the Question Paper.

Electronic calculators may be used.

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

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.

This document consists of **18** printed pages and **2** blank pages.

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 gases to answer the questions below.



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

Which gas is

(a) used in making steel,

.....[1]

(b) made by the bacterial decay of vegetable matter,

.....[1]

(c) responsible for ozone depletion in the upper atmosphere,

.....[1]

(d) used to manufacture margarine?

.....[1]

[Total: 4]

A2 Farmers use chemicals to improve crop yield.

Ammonium phosphate, $(\text{NH}_4)_3\text{PO}_4$, is used as a fertiliser and calcium hydroxide, $\text{Ca}(\text{OH})_2$, is used to reduce the acidity of soils.

The relative formula mass of ammonium phosphate is 149.

(a) Calculate the percentage by mass of nitrogen in ammonium phosphate.

percentage = % [1]

(b) A farmer adds ammonium phosphate to a field.

He then adds calcium hydroxide to the field because the soil is very acidic.

(i) Calcium hydroxide neutralises the acid in the soil.

Give the ionic equation for this reaction.

.....[1]

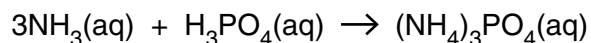
(ii) The calcium hydroxide reduces the effectiveness of the ammonium phosphate fertiliser because it reduces the nitrogen content.

Explain why adding calcium hydroxide reduces the nitrogen content.

.....

[2]

- (c) A sample of ammonium phosphate can be produced by the reaction of aqueous ammonia and phosphoric acid.



25.0 cm³ of 1.25 mol/dm³ phosphoric acid is neutralised by 45.3 cm³ of aqueous ammonia.

- (i) Calculate the concentration, in mol/dm³, of the ammonia used.

concentration of ammonia = mol/dm³ [3]

- (ii) Show, by calculation, that 4.66 g of ammonium phosphate would be produced. Assume that the yield is 100%.
[*M_r*: (NH₄)₃PO₄, 149]

[1]

- (iii) In practice, the actual mass of ammonium phosphate produced is 2.93 g.

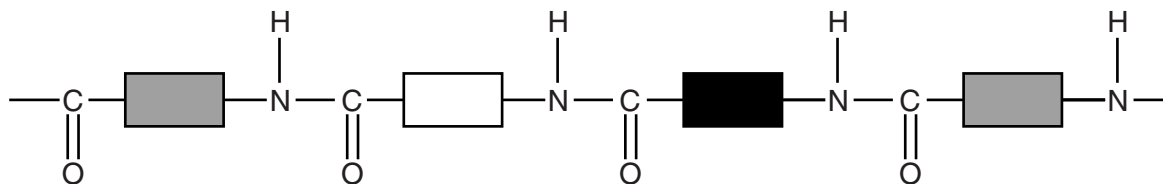
Calculate the percentage yield of ammonium phosphate.

percentage yield = % [1]

[Total: 9]

A3 Proteins, carbohydrates and fats are natural macromolecules.

The partial structure of a protein is shown below.



(a) Name the linkage that joins the monomer units in a protein.

..... [1]

(b) Name a synthetic polymer that has the same linkage as a protein.

..... [1]

(c) Proteins are hydrolysed to give a mixture of colourless amino acids.

Describe, with the aid of a labelled diagram, how paper chromatography can be used to identify the amino acids present in a mixture of amino acids.

.....

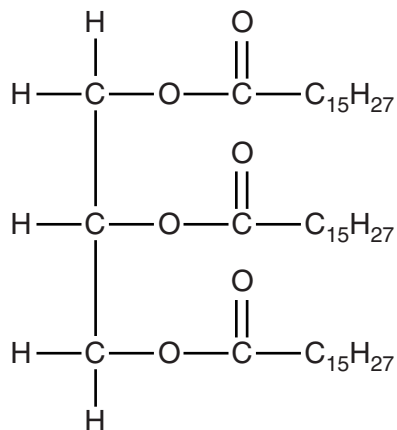
 [4]

(d) Carbohydrates can be hydrolysed.

Name the class of compound formed when carbohydrates are hydrolysed.

..... [1]

(e) The diagram shows the structure of a simple fat.



(i) This fat is polyunsaturated.

What is the meaning of the term *polyunsaturated*?

.....

 [2]

(ii) Describe a chemical test to show that the fat is unsaturated.

name of reagent

result of test [2]

(iii) Name a synthetic macromolecule that contains the same linkage as fats.

..... [1]

[Total: 12]

A4 Only liquids that contain moving ions can be electrolysed. These liquids are called electrolytes.

- (a) Complete the following table which shows the products formed when some liquids are electrolysed using inert graphite electrodes.

electrolyte	ions present in electrolyte	product formed at the positive electrode	product formed at the negative electrode
aqueous copper(II) sulfate	Cu^{2+} , H^+ , OH^- and SO_4^{2-}
concentrated aqueous sodium chloride	H^+ , Na^+ , Cl^- and OH^-	chlorine	hydrogen
molten lead(II) bromide	Pb^{2+} and Br^-

[3]

- (b) When concentrated aqueous sodium chloride is electrolysed, chlorine is formed at the positive electrode (anode) and hydrogen at the negative electrode (cathode).

- (i) Construct the ionic equation to show the formation of chlorine at the positive electrode.

.....[1]

- (ii) Explain why hydrogen is formed at the negative electrode rather than sodium.

.....
[1]

- (c) Name a metal manufactured by the electrolysis of a molten ionic compound.

.....[1]

[Total: 6]

A5 Haematite, limestone and coke are heated together in a blast furnace in the manufacture of iron.

(a) State why each of the following compounds are needed in a blast furnace.

haematite

.....

limestone

.....

coke

.....[3]

(b) Iron has a high melting point because it has strong metallic bonding.

Describe, using a labelled diagram, metallic bonding.

.....

.....[2]

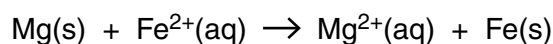
(c) When iron is made into the alloy steel, the properties of iron are changed.

High carbon steels are stronger than iron but are brittle.

State a property of low carbon steels.

.....[1]

(d) When magnesium powder is added to aqueous iron(II) sulfate, the following reaction occurs.



(i) Explain, using electron transfer, why iron(II) ions are reduced in this reaction.

.....

.....[1]

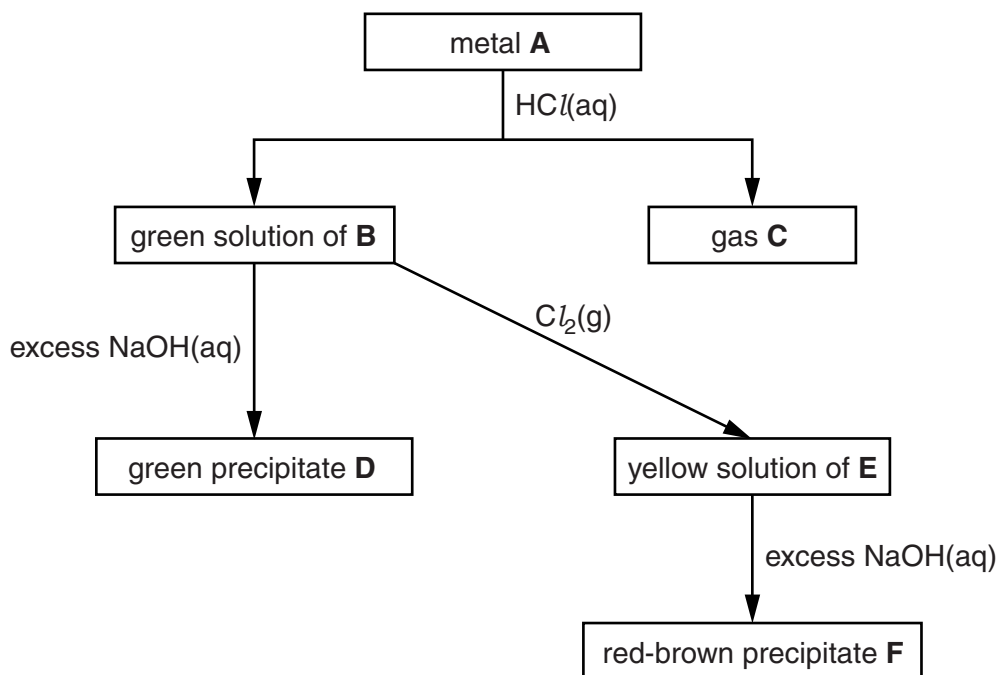
(ii) What would you observe in this reaction?

.....

.....[1]

[Total: 8]

A6 The flow chart shows the reactions of metal **A** and some of its compounds.



Identify, by name, each of the substances.

A

B

C

D

E

F

[Total: 6]

Section B

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

The total mark for this section is 30.

B7 Alkanes are a homologous series of hydrocarbons.

(a) There are two alkanes with the molecular formula C_4H_{10} .

Draw the structures, showing all the atoms and all the bonds, of these two alkanes.

[2]

(b) One of the alkanes with the molecular formula C_4H_{10} is butane.

Butane is used as a fuel.

(i) Construct the equation for the **complete** combustion of butane.

.....[1]

(ii) Describe one problem associated with the **incomplete** combustion of butane.

.....

.....[1]

(c) Butane reacts with chlorine in the presence of ultraviolet radiation.

Write an equation for this reaction.

.....[1]

(d) Nonane, C_9H_{20} , is heated strongly in the presence of a catalyst. Two products are made: an alkane, **G**, and an alkene, **H**.

(i) Name this type of reaction.

.....[1]

(ii) Alkane **G** contains 84% carbon by mass.

Calculate the molecular formula for **G**.

molecular formula [3]

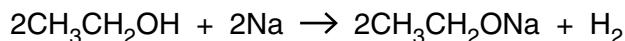
(iii) Suggest a molecular formula for **H**.

.....[1]

[Total: 10]

B8 Butan-1-ol, $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$, and ethanol, $\text{CH}_3\text{CH}_2\text{OH}$, are both alcohols.

Alcohols, such as ethanol, react with sodium to form hydrogen.



(a) Construct the equation to show the reaction of butan-1-ol with potassium.

.....[1]

(b) Describe the chemical test for hydrogen.

.....[1]

(c) A sample containing 0.233 g of an unknown Group I element is added to excess ethanol. The volume of hydrogen gas formed at room temperature and pressure is 400 cm^3 .

Calculate the relative atomic mass, A_r , of the Group I element and suggest the identity of the element.

relative atomic mass =

identity of the element =[4]

(d) Ethanol reacts with ethanoic acid to make an organic compound.

Draw the structure, showing all the atoms and all the bonds, of this organic compound.

[1]

(e) Describe the manufacture of ethanol starting from glucose. Include an equation and the conditions needed.

.....

.....

.....

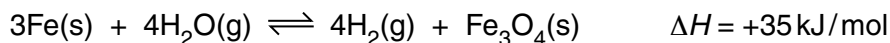
.....

.....

.....[3]

[Total: 10]

B9 When iron is heated with steam in a sealed container, an equilibrium mixture is obtained.



(a) The forward reaction is endothermic. What is the meaning of the term *endothermic*?

.....
[1]

(b) Describe and explain what happens to the rate of the forward reaction when the temperature is increased. The pressure remains constant.

.....

[2]

(c) Describe and explain what happens, if anything, to the position of equilibrium when the pressure is increased. The temperature remains constant.

.....

[2]

(d) Calculate the mass of Fe_3O_4 formed when 2.80 g of iron completely reacts with excess steam.

mass of Fe_3O_4 = g [3]

(e) At room temperature iron will rust in moist air.

Describe and explain how galvanising iron prevents rusting.

.....

.....

.....

.....[2]

[Total: 10]

B10 Astatine, At, is an element in Group VII of the Periodic Table.

The table shows some information about two isotopes of astatine.

symbol	number of protons	number of electrons	number of neutrons
${}^{210}_{85}\text{At}$
${}^{211}_{85}\text{At}$

(a) (i) Complete the table. [2]

(ii) What is meant by the term *isotopes*?

.....

 [1]

(b) Astatine forms a diatomic molecule with the same type of bonding as in a chlorine molecule.

Draw the 'dot-and-cross' diagram for an astatine molecule.

Only draw the outer shell electrons.

[1]

(c) Astatine reacts with magnesium to form magnesium astatide, MgAt_2 , which contains Mg^{2+} and At^- ions.

(i) Describe how a magnesium ion and an astatide ion are formed from a magnesium atom and an astatine atom.

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

(ii) Predict **two** physical properties of magnesium astatide.

1.

2.[2]

(d) (i) Bromine reacts with aqueous magnesium astatide. Construct the ionic equation for this reaction.

.....[1]

(ii) Explain why astatine does not react with aqueous magnesium iodide.

.....
.....[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 H Hydrogen											2 He Helium																				
3 Li Lithium	4 Be Beryllium	5 B Boron	6 C Carbon	7 N Nitrogen	8 O Oxygen	9 F Fluorine	10 Ne Neon					11 B Boron																			
11 Na Sodium	12 Mg Magnesium	13 Al Aluminium	14 Si Silicon	15 P Phosphorus	16 S Sulfur	17 Cl Chlorine	18 Ar Argon					19 F Fluorine																			
19 K Potassium	20 Ca Calcium	21 Sc Scandium	22 Ti Titanium	23 V Vanadium	24 Cr Chromium	25 Mn Manganese	26 Fe Iron	27 Co Cobalt	28 Ni Nickel	29 Cu Copper	30 Zn Zinc	31 Ga Gallium	32 Ge Germanium	33 As Arsenic	34 Se Selenium	35 Br Bromine	36 Kr Krypton														
37 Rb Rubidium	38 Sr Strontium	39 Y Yttrium	40 Zr Zirconium	41 Nb Niobium	42 Mo Molybdenum	43 Tc Technetium	44 Ru Ruthenium	45 Rh Rhodium	46 Pd Palladium	47 Ag Silver	48 Cd Cadmium	49 In Indium	50 Sn Tin	51 Sb Antimony	52 Te Tellurium	53 I Iodine	54 Xe Xenon														
55 Cs Caesium	56 Ba Barium	57 La Lanthanum	72 Hf Hafnium	73 Ta Tantalum	74 W Tungsten	75 Re Rhenium	76 Os Osmium	77 Ir Iridium	78 Pt Platinum	79 Au Gold	80 Hg Mercury	81 Tl Thallium	82 Pb Lead	83 Bi Bismuth	84 Po Polonium	85 At Astatine	86 Rn Radon														
87 Fr Francium	88 Ra Radium	89 Ac Actinium											131 Xe Xenon																		
223 Fr Francium	226 Ra Radium	227 Ac Actinium											131 Xe Xenon																		
89 La Lanthanum	90 Th Thorium	91 Pa Protactinium	92 U Uranium	93 Np Neptunium	94 Pu Plutonium	95 Am Americium	96 Cm Curium	97 Bk Berkelium	98 Cf Californium	99 Es Einsteinium	100 Fm Fermium	101 Md Mendelevium	102 No Nobelium	103 Lr Lawrencium	104 Rf Rutherfordium	105 Db Dubnium	106 Sg Seaborgium	107 Bh Bohrium	108 Hs Hassium	109 Mt Meitnerium	110 Ds Darmstadtium	111 Rg Roentgenium	112 Cn Copernicium	113 Nh Nihonium	114 Fl Flerovium	115 Mc Moscovium	116 Lv Livermorium	117 Ts Tennessine	118 Og Oganesson		
119 Fr Francium	120 Ra Radium	121 Ac Actinium	122 Th Thorium	123 Pa Protactinium	124 U Uranium	125 Np Neptunium	126 Pu Plutonium	127 Am Americium	128 Cm Curium	129 Bk Berkelium	130 Cf Californium	131 Es Einsteinium	132 Fm Fermium	133 Md Mendelevium	134 No Nobelium	135 Lr Lawrencium	136 Rf Rutherfordium	137 Db Dubnium	138 Sg Seaborgium	139 Bh Bohrium	140 Hs Hassium	141 Mt Meitnerium	142 Ds Darmstadtium	143 Rg Roentgenium	144 Cn Copernicium	145 Nh Nihonium	146 Fl Flerovium	147 Mc Moscovium	148 Lv Livermorium	149 Ts Tennessine	150 Og Oganesson
151 Fr Francium	152 Ra Radium	153 Ac Actinium	154 Th Thorium	155 Pa Protactinium	156 U Uranium	157 Np Neptunium	158 Pu Plutonium	159 Am Americium	160 Cm Curium	161 Bk Berkelium	162 Cf Californium	163 Es Einsteinium	164 Fm Fermium	165 Md Mendelevium	166 No Nobelium	167 Lr Lawrencium	168 Rf Rutherfordium	169 Db Dubnium	170 Sg Seaborgium	171 Bh Bohrium	172 Hs Hassium	173 Mt Meitnerium	174 Ds Darmstadtium	175 Rg Roentgenium	176 Cn Copernicium	177 Nh Nihonium	178 Fl Flerovium	179 Mc Moscovium	180 Lv Livermorium	181 Ts Tennessine	182 Og Oganesson
183 Fr Francium	184 Ra Radium	185 Ac Actinium	186 Th Thorium	187 Pa Protactinium	188 U Uranium	189 Np Neptunium	190 Pu Plutonium	191 Am Americium	192 Cm Curium	193 Bk Berkelium	194 Cf Californium	195 Es Einsteinium	196 Fm Fermium	197 Md Mendelevium	198 No Nobelium	199 Lr Lawrencium	200 Rf Rutherfordium	201 Db Dubnium	202 Sg Seaborgium	203 Bh Bohrium	204 Hs Hassium	205 Mt Meitnerium	206 Ds Darmstadtium	207 Rg Roentgenium	208 Cn Copernicium	209 Nh Nihonium	210 Fl Flerovium	211 Mc Moscovium	212 Lv Livermorium	213 Ts Tennessine	214 Og Oganesson
215 Fr Francium	216 Ra Radium	217 Ac Actinium	218 Th Thorium	219 Pa Protactinium	220 U Uranium	221 Np Neptunium	222 Pu Plutonium	223 Am Americium	224 Cm Curium	225 Bk Berkelium	226 Cf Californium	227 Es Einsteinium	228 Fm Fermium	229 Md Mendelevium	230 No Nobelium	231 Lr Lawrencium	232 Rf Rutherfordium	233 Db Dubnium	234 Sg Seaborgium	235 Bh Bohrium	236 Hs Hassium	237 Mt Meitnerium	238 Ds Darmstadtium	239 Rg Roentgenium	240 Cn Copernicium	241 Nh Nihonium	242 Fl Flerovium	243 Mc Moscovium	244 Lv Livermorium	245 Ts Tennessine	246 Og Oganesson
247 Fr Francium	248 Ra Radium	249 Ac Actinium	250 Th Thorium	251 Pa Protactinium	252 U Uranium	253 Np Neptunium	254 Pu Plutonium	255 Am Americium	256 Cm Curium	257 Bk Berkelium	258 Cf Californium	259 Es Einsteinium	260 Fm Fermium	261 Md Mendelevium	262 No Nobelium	263 Lr Lawrencium	264 Rf Rutherfordium	265 Db Dubnium	266 Sg Seaborgium	267 Bh Bohrium	268 Hs Hassium	269 Mt Meitnerium	270 Ds Darmstadtium	271 Rg Roentgenium	272 Cn Copernicium	273 Nh Nihonium	274 Fl Flerovium	275 Mc Moscovium	276 Lv Livermorium	277 Ts Tennessine	278 Og Oganesson
279 Fr Francium	280 Ra Radium	281 Ac Actinium	282 Th Thorium	283 Pa Protactinium	284 U Uranium	285 Np Neptunium	286 Pu Plutonium	287 Am Americium	288 Cm Curium	289 Bk Berkelium	290 Cf Californium	291 Es Einsteinium	292 Fm Fermium	293 Md Mendelevium	294 No Nobelium	295 Lr Lawrencium	296 Rf Rutherfordium	297 Db Dubnium	298 Sg Seaborgium	299 Bh Bohrium	300 Hs Hassium	301 Mt Meitnerium	302 Ds Darmstadtium	303 Rg Roentgenium	304 Cn Copernicium	305 Nh Nihonium	306 Fl Flerovium	307 Mc Moscovium	308 Lv Livermorium	309 Ts Tennessine	310 Og Oganesson

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

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

The volume of one mole of any gas is 24dm³ at room temperature and pressure (r.t.p.).