Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

3584316295

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.

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

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.

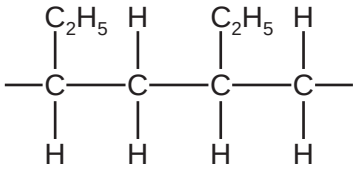
reagent .....

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]

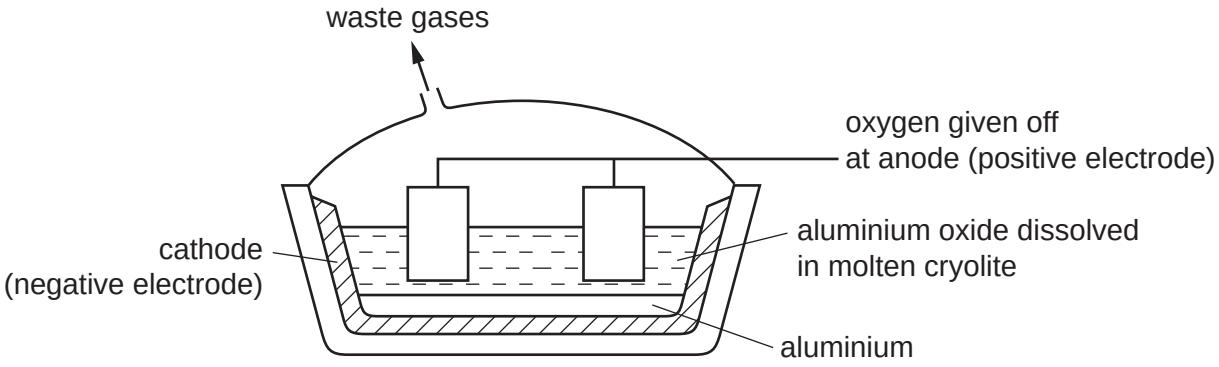
(iii) Give the structure of an isomer of the alkene in **(e)(ii)**.

[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.

.....

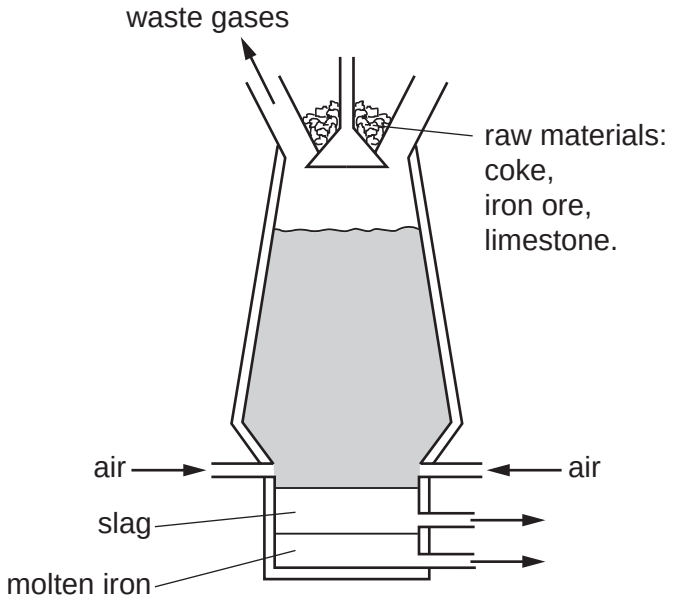
..... [2]

(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.

$$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$$

(a) State the conditions required for this reaction.

.....

..... [2]

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

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

..... mol [2]

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

..... g [2]

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

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DATA SHEET
The Periodic Table of the Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 **H** Hydrogen 1										4 **He** Helium 2
7 **Li** Lithium 3	9 **Be** Beryllium 4											11 **B** Boron 5	12 **C** Carbon 6	14 **N** Nitrogen 7	16 **O** Oxygen 8	19 **F** Fluorine 9	20 **Ne** Neon 10
23 **Na** Sodium 11	24 **Mg** Magnesium 12											27 **Al** Aluminium 13	28 **Si** Silicon 14	31 **P** Phosphorus 15	32 **S** Sulfur 16	35.5 **Cl** Chlorine 17	40 **Ar** Argon 18
39 **K** Potassium 19	40 **Ca** Calcium 20	45 **Sc** Scandium 21	48 **Ti** Titanium 22	51 **V** Vanadium 23	52 **Cr** Chromium 24	55 **Mn** Manganese 25	56 **Fe** Iron 26	59 **Co** Cobalt 27	59 **Ni** Nickel 28	64 **Cu** Copper 29	65 **Zn** Zinc 30	70 **Ga** Gallium 31	73 **Ge** Germanium 32	75 **As** Arsenic 33	79 **Se** Selenium 34	80 **Br** Bromine 35	84 **Kr** Krypton 36
85 **Rb** Rubidium 37	88 **Sr** Strontium 38	89 **Y** Yttrium 39	91 **Zr** Zirconium 40	93 **Nb** Niobium 41	96 **Mo** Molybdenum 42	**Tc** Technetium 43	101 **Ru** Ruthenium 44	103 **Rh** Rhodium 45	106 **Pd** Palladium 46	108 **Ag** Silver 47	112 **Cd** Cadmium 48	115 **In** Indium 49	119 **Sn** Tin 50	122 **Sb** Antimony 51	128 **Te** Tellurium 52	127 **I** Iodine 53	131 **Xe** Xenon 54
133 **Cs** Caesium 55	137 **Ba** Barium 56	139 **La** Lanthanum 57 *	178 **Hf** Hafnium 72	181 **Ta** Tantalum 73	184 **W** Tungsten 74	186 **Re** Rhenium 75	190 **Os** Osmium 76	192 **Ir** Iridium 77	195 **Pt** Platinum 78	197 **Au** Gold 79	201 **Hg** Mercury 80	204 **Tl** Thallium 81	207 **Pb** Lead 82	209 **Bi** Bismuth 83	**Po** Polonium 84	**At** Astatine 85	**Rn** Radon 86
Fr Francium 87	226 **Ra** Radium 88	227 **Ac** Actinium 89 †															

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

140 **Ce** Cerium 58	141 **Pr** Praseodymium 59	144 **Nd** Neodymium 60	**Pm** Promethium 61	150 **Sm** Samarium 62	152 **Eu** Europium 63	157 **Gd** Gadolinium 64	159 **Tb** Terbium 65	162 **Dy** Dysprosium 66	165 **Ho** Holmium 67	167 **Er** Erbium 68	169 **Tm** Thulium 69	173 **Yb** Ytterbium 70	175 **Lu** Lutetium 71
232 **Th** Thorium 90	**Pa** Protactinium 91	238 **U** Uranium 92	**Np** Neptunium 93	**Pu** Plutonium 94	**Am** Americium 95	**Cm** Curium 96	**Bk** Berkelium 97	**Cf** Californium 98	**Es** Einsteinium 99	**Fm** Fermium 100	**Md** Mendelevium 101	**No** Nobelium 102	**Lr** Lawrencium 103

Key

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

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