



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

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CANDIDATE
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CHEMISTRY

0620/32

Paper 3 (Extended)

May/June 2013

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.

Electronic calculators may be used.

A copy of the Periodic Table is printed on page 16.

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.

This document consists of **14** printed pages and **2** blank pages.



1 Air is a mixture of gases. The main constituents are the elements oxygen and nitrogen.

(a) (i) Name another element in air.

..... [1]

(ii) Give the formula of a compound in unpolluted air.

..... [1]

(b) Common pollutants present in air are the oxides of nitrogen and sulfur dioxide.

(i) How are the oxides of nitrogen formed?

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

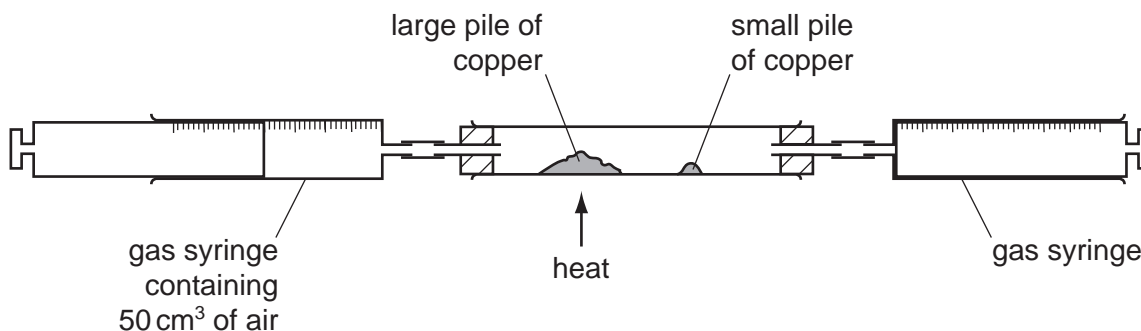
(ii) How is sulfur dioxide formed?

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

(iii) These oxides are largely responsible for acid rain.
State **two** harmful effects of acid rain.

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

(c) The percentage of oxygen in air can be determined by the following experiment.



The gas syringe contains 50 cm³ of air. The large pile of copper is heated and the air is passed from one gas syringe to the other over the hot copper. The large pile of copper turns black. The gas is allowed to cool and its volume measured.

The small pile of copper is heated and the remaining gas passed over the hot copper. The copper does not turn black. The final volume of gas left in the apparatus is less than 50 cm³.

(i) Explain why the copper in the large pile turns black.

.....
 [2]

(ii) Why must the gas be allowed to cool before its volume is measured?

..... [1]

(iii) Explain why the copper in the small pile did not turn black.

..... [1]

(iv) What is the approximate volume of the gas left in the apparatus?

..... [1]

[Total: 13]

- 2 (a) The table below gives the number of protons, neutrons and electrons in atoms or ions. Complete the table. The first line is given as an example. You will need to use the Periodic Table.

particle	number of protons	number of electrons	number of neutrons	symbol or formula
A	4	4	5	${}^9_4\text{Be}$
B	19	18	20
C	30	30	35
D	8	10	8
E	31	31	39

[6]

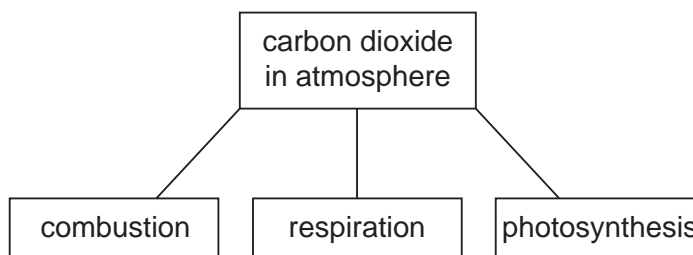
- (b) Using the data in the table, explain how you can determine whether a particle is an atom, a negative ion or a positive ion.

.....

 [3]

[Total: 9]

- 3 The diagram shows some of the processes which determine the percentage of carbon dioxide in the atmosphere.



- (a) Explain how the following two processes alter the percentage of carbon dioxide in the atmosphere.

- (i) combustion

.....

 [3]

(ii) respiration

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

(b) Photosynthesis reduces the percentage of carbon dioxide in the atmosphere.

(i) Complete the word equation for photosynthesis.

carbon dioxide + water → + [2]

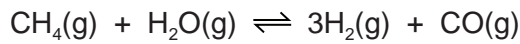
(ii) State **two** essential conditions for the above reaction to occur.

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

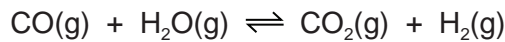
[Total: 10]

4 At present the most important method of manufacturing hydrogen is steam reforming of methane.

(a) In the first stage of the process, methane reacts with steam at 800 °C.



In the second stage of the process, carbon monoxide reacts with steam at 200 °C.



(i) Explain why the position of equilibrium in the first reaction is affected by pressure but the position of equilibrium in the second reaction is not.

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

(ii) Suggest why a high temperature is needed in the first reaction to get a high yield of products but in the second reaction a high yield is obtained at a low temperature.

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

(b) Two other ways of producing hydrogen are cracking and electrolysis.

- (i) Hydrogen can be a product of the cracking of long chain alkanes. Complete the equation for the cracking of C_8H_{18} .



- (ii) There are three products of the electrolysis of concentrated aqueous sodium chloride. Hydrogen is one of them. Write an equation for the electrode reaction which forms hydrogen.

..... [2]

- (iii) Name the other **two** products of the electrolysis of concentrated aqueous sodium chloride and give a use of each one.

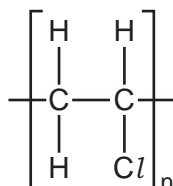
product use

product use [4]

[Total: 11]

5 Many monomer molecules react together to form one molecule of a polymer. This reaction is called polymerisation.

- (a) The structural formula of the polymer, poly(chloroethene), is given below. This polymer is also known as PVC.



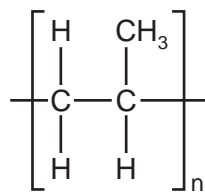
- (i) A major use of PVC is insulation of electric cables. PVC is a poor conductor of electricity. Suggest another property which makes it suitable for this use.

..... [1]

- (ii) One way of disposing of waste PVC is by burning it. This method has the disadvantage that poisonous gases are formed. Suggest **two** poisonous gases which could be formed by the combustion of PVC.

..... [2]

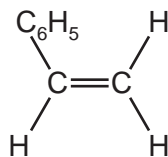
- (b) (i) Deduce the structural formula of the monomer from that of the polymer.



structural formula of monomer

[1]

- (ii) Deduce the structural formula of the polymer, poly(phenylethene), from the formula of its monomer, phenylethene.



structural formula of polymer

[2]

(c) The carbohydrate, glucose, polymerises to form the more complex carbohydrate starch.

If glucose is represented by



then the structural formula of starch is as drawn below.



How does the polymerisation of glucose differ from that of an alkene such as phenylethene?

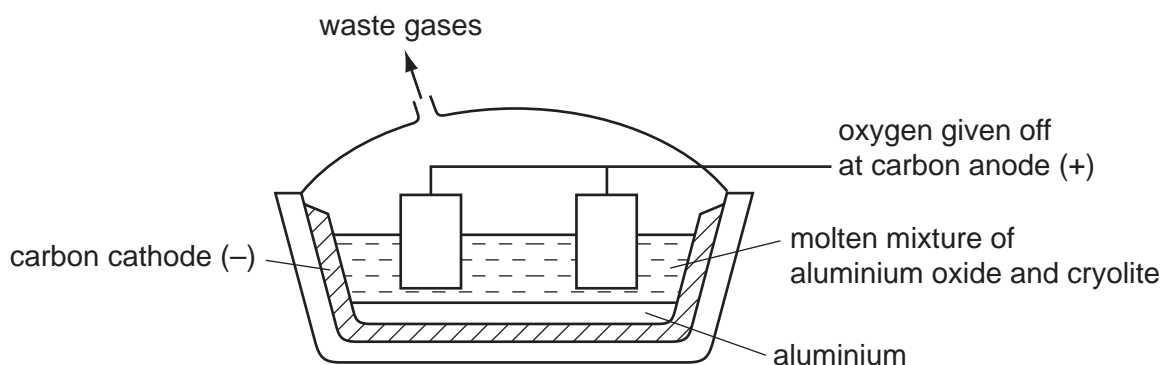
.....

 [2]

[Total: 8]

6 Aluminium is an important metal with a wide range of uses.

(a) Aluminium is obtained by the electrolysis of aluminium oxide dissolved in molten cryolite.



(i) Solid aluminium oxide is a poor conductor of electricity. It conducts either when molten or when dissolved in molten cryolite. Explain why.

.....

 [2]

(ii) Why is a solution of aluminium oxide in molten cryolite used rather than molten aluminium oxide?

..... [1]

(iii) Explain why the carbon anodes need to be replaced periodically.

..... [1]

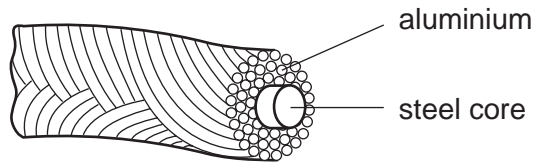
(iv) One reason why graphite is used for the electrodes is that it is a good conductor of electricity. Give another reason.

..... [1]

(b) Aluminium is used to make food containers because it resists corrosion. Explain why it is not attacked by the acids in food.

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

(c) Aluminium is used for overhead power (electricity) cables which usually have a steel core.



(i) Give **two** properties of aluminium which make it suitable for this use.

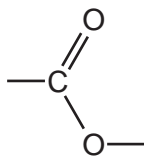
.....
..... [2]

(ii) Explain why the cables have a steel core.

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

[Total: 10]

7 The ester linkage showing all the bonds is drawn as



or more simply it can be written as -COO- .

(a) (i) Give the structural formula of the ester ethyl ethanoate.

For
Examiner's
Use

[1]

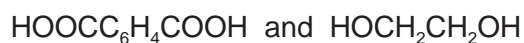
(ii) Deduce the name of the ester formed from methanoic acid and butanol.

..... [1]

(b) (i) Which group of naturally occurring compounds contains the ester linkage?

..... [1]

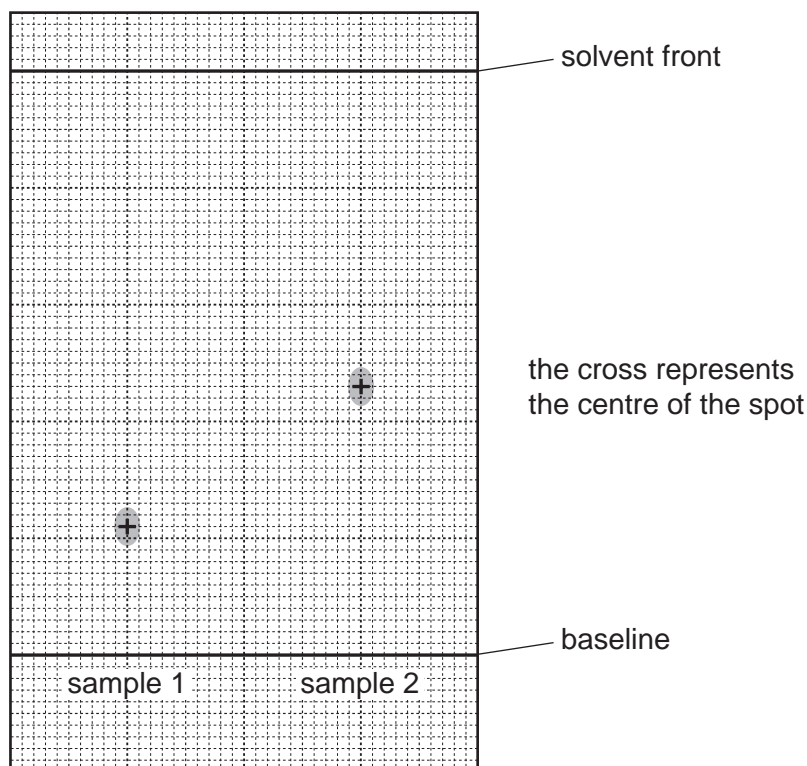
(ii) Draw the structural formula of the polyester formed from the following monomers.



You are advised to use the simpler form of the ester linkage.

[3]

(c) Esters can be used as solvents in chromatography. The following shows a chromatogram of plant acids.



An ester was used as the solvent and the chromatogram was sprayed with bromothymol blue.

(i) Suggest why it was necessary to spray the chromatogram.

.....
 [2]

(ii) Explain what is meant by the R_f value of a sample.

.....
 [1]

- (iii) Calculate the R_f values of the two samples and use the data in the table to identify the plant acids.

For
Examiner's
Use

plant acid	R_f value
tartaric acid	0.22
citric acid	0.30
oxalic acid	0.36
malic acid	0.46
succinic acid	0.60

sample 1 $R_f = \dots\dots\dots$ It is $\dots\dots\dots$ acid.

sample 2 $R_f = \dots\dots\dots$ It is $\dots\dots\dots$ acid. [2]

[Total: 11]

- 8 (a) Define the following

- (i) the mole

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

- (ii) the Avogadro constant

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

- (b) Which **two** of the following contain the same number of molecules?
Show how you arrived at your answer.

2.0 g of methane, CH_4

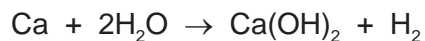
8.0 g of oxygen, O_2

2.0 g of ozone, O_3

8.0 g of sulfur dioxide, SO_2

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

(c) 4.8 g of calcium is added to 3.6 g of water. The following reaction occurs.



For
Examiner's
Use

(i) the number of moles of Ca =

the number of moles of H₂O = [1]

(ii) Which reagent is in excess? Explain your choice.

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

(iii) Calculate the mass of the reagent named in (ii) which remained at the end of the experiment.

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

[Total: 8]

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DATA SHEET
The Periodic Table of the Elements

		Group																																																																																														
I	II	III	IV	V	VI	VII	0																																																																																									
7 Li Lithium 3	9 Be Beryllium 4	1 H Hydrogen 1	11 B Boron 5	12 C Carbon 6	13 Al Aluminium 13	14 N Nitrogen 7	15 O Oxygen 8	16 F Fluorine 9	17 Ne Neon 10	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	27 Co Cobalt 27	28 Ni Nickel 28	29 Cu Copper 29	30 Zn Zinc 30	31 Ga Gallium 31	32 Ge Germanium 32	33 As Arsenic 33	34 Se Selenium 34	35 Br Bromine 35	36 Kr Krypton 36	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	45 Rh Rhodium 45	46 Pd Palladium 46	47 Ag Silver 47	48 Cd Cadmium 48	49 In Indium 49	50 Sn Tin 50	51 Sb Antimony 51	52 Te Tellurium 52	53 I Iodine 53	54 Xe Xenon 54	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	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	90 Th Thorium 90	91 Pa Protactinium 91	92 U Uranium 92	93 Np Neptunium 93	94 Pu Plutonium 94	95 Am Americium 95	96 Cm Curium 96	97 Bk Berkelium 97	98 Cf Californium 98	99 Es Einsteinium 99	100 Fm Fermium 100	101 Md Mendelevium 101	102 No Nobelium 102	103 Lr Lawrencium 103	104 Rf Rutherfordium 104	105 Db Dubnium 105	106 Sg Seaborgium 106	107 Bh Bohrium 107	108 Hs Hassium 108	109 Mt Meitnerium 109	110 Ds Darmstadtium 110	111 Rg Roentgenium 111	112 Cn Copernicium 112	113 Nh Nihonium 113	114 Fl Flerovium 114	115 Mc Moscovium 115	116 Lv Livermorium 116	117 Ts Tennessine 117	118 Og Oganesson 118
133 Cs Caesium 55	137 Ba Barium 56	226 Ra Radium 88	227 Ac Actinium 89	140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	145 Pm Promethium 61	150 Sm Samarium 62	151 Eu Europium 63	152 Gd Gadolinium 64	157 Tb Terbium 65	162 Dy Dysprosium 66	163 Ho Holmium 67	164 Er Erbium 68	165 Tm Thulium 69	167 Yb Ytterbium 70	173 Lu Lutetium 71	232 Th Thorium 90	238 U Uranium 92	238 Np Neptunium 93	238 Pu Plutonium 94	238 Am Americium 95	238 Cm Curium 96	238 Bk Berkelium 97	238 Cf Californium 98	238 Es Einsteinium 99	238 Fm Fermium 100	238 Md Mendelevium 101	238 No Nobelium 102	238 Lr Lawrencium 103																																																																		

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

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 dm³ at room temperature and pressure (r.t.p.).

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