UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

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.

For Examiner's Use

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?

.....

.....

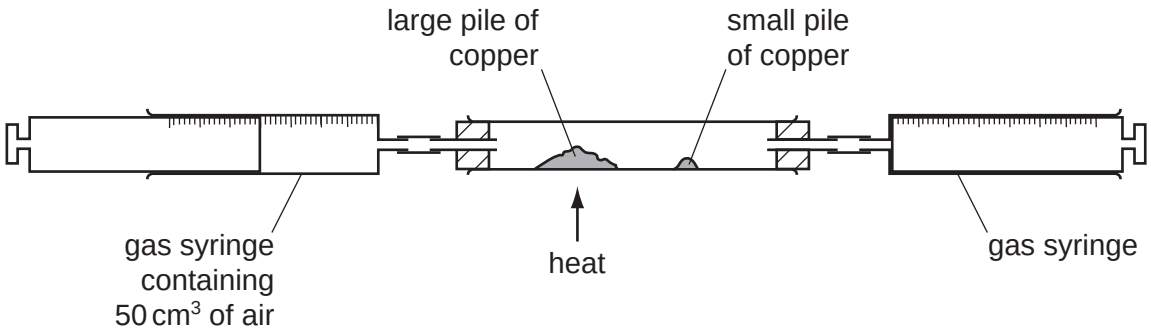
..... [2]

(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 cm^3 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 cm^3.

(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]

[Turn over

For Examiner's Use

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	$^{9}_{4}Be$
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.

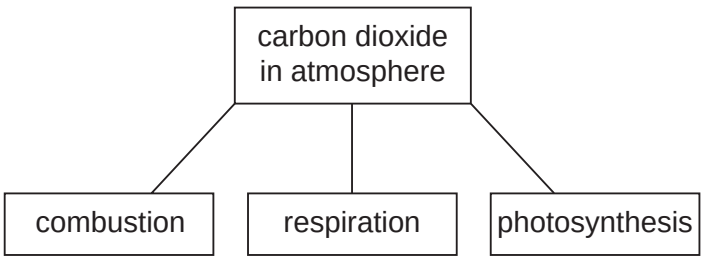
.....

.....

..... [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.

$$CH_4(g) + H_2O(g) \rightleftharpoons 3H_2(g) + CO(g)$$

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

$$CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g)$$

(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}.

$$C_8H_{18} \rightarrow 2..... + H_2$$ [1]

(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.

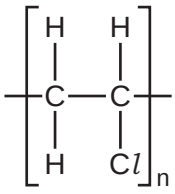
product ..... use .....

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.

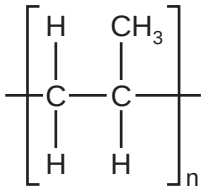
..... [1]

(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]

For Examiner's Use

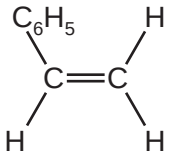
(b) (i) Deduce the structural formula of the monomer from that of the polymer.



structural formula of monomer

[1]

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

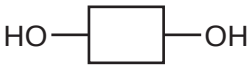


structural formula of polymer

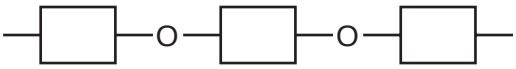
[2]

(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?

.....

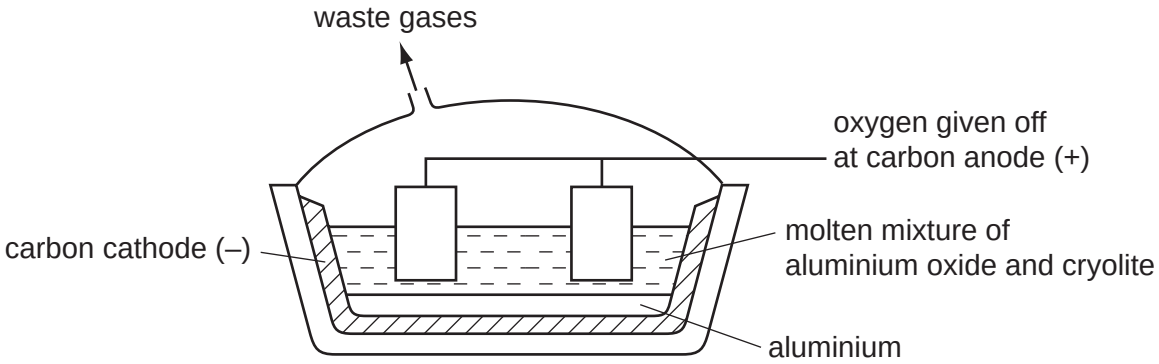
.....

..... [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]

For Examiner's Use

(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.

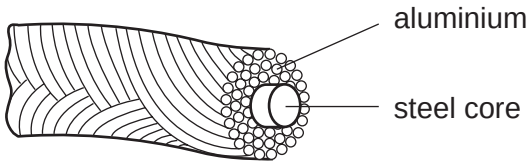
..... [1]

(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.

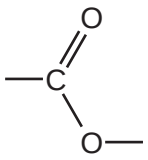
.....

..... [1]

[Total: 10]

For Examiner's Use

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.

[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.

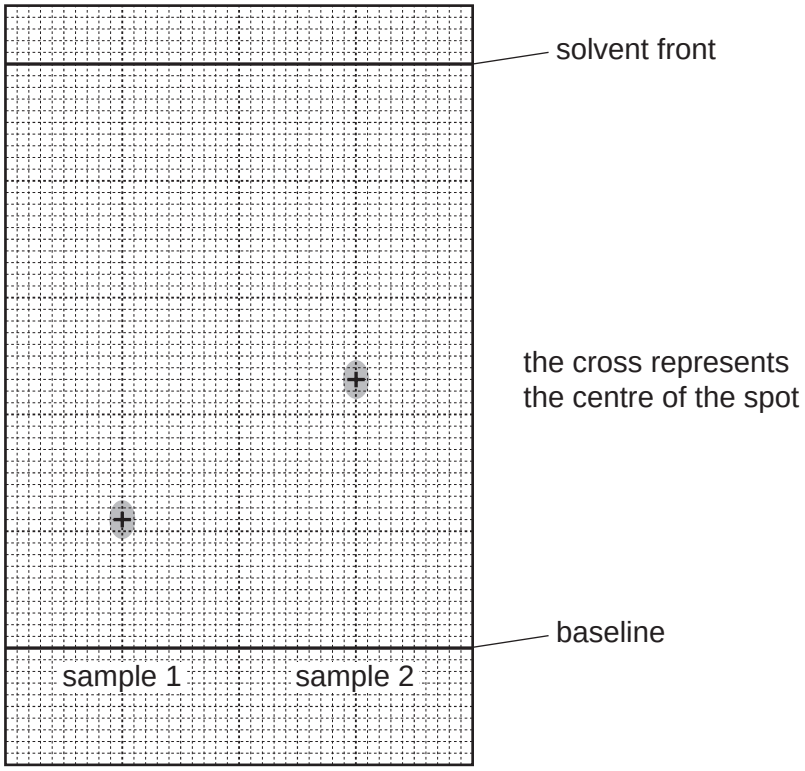
$HOOCC_6H_4COOH$ and $HOCH_2CH_2OH$

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

[3]

For Examiner's Use

(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.

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 = ... It is ..... acid.

sample 2 R_f = ... It is ..... 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]

For Examiner's Use

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

$$Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$$

(i) the number of moles of Ca = ...

the number of moles of H_2O = ... [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
							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 †															

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

*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 dm^3 at room temperature and pressure (r.t.p.).