UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER | | | | | |

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2925136620

CHEMISTRY **0620/33**

Paper 3 (Extended) **May/June 2012**

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

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.

For Examiner's Use	
1	
2	
3	
4	
5	
6	
7	
8	
Total	

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

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1 The table below includes information about some of the elements in Period 2.

element	carbon	nitrogen	fluorine	neon
symbol	C	N	F	Ne
structure	macromolecular	simple molecules N_2	simple molecules F_2	single atoms Ne
boiling point / °C	4200	–196	–188	–246

(a) Why does neon exist as single atoms but fluorine exists as molecules?

.....

..... [2]

(b) What determines the order of the elements in a period?

..... [1]

(c) When liquid nitrogen boils the following change occurs.

$$N_2(l) \rightarrow N_2(g)$$

The boiling point of nitrogen is very low even though the bond between the atoms in a nitrogen molecule is very strong. Suggest an explanation.

.....

..... [2]

(d) Draw a diagram showing the arrangement of the outer shell (valency) electrons in a molecule of nitrogen.

[2]

[Total: 7]

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2 Diamond and graphite are different forms of the same element, carbon.
Explain the following in terms of their structure.

(a) Graphite is a soft material which is used as a lubricant.

.....

..... [2]

(b) Diamond is a very hard material which is used for drilling and cutting.

.....

..... [2]

(c) Graphite is a good conductor of electricity and diamond is a poor conductor.

.....

.....

..... [2]

[Total: 6]

3 The uses of a substance are determined by its properties.

(a) Plastics are poor conductors of electricity. They are used as insulation for electric cables. Which other **two** properties of plastics make them suitable for this purpose?

.....

..... [2]

(b) Chromium is a hard, shiny metal. Suggest **two** reasons why chromium is used to electroplate steel.

.....

..... [2]

(c) Why is aluminium used extensively in the manufacture of aeroplanes?

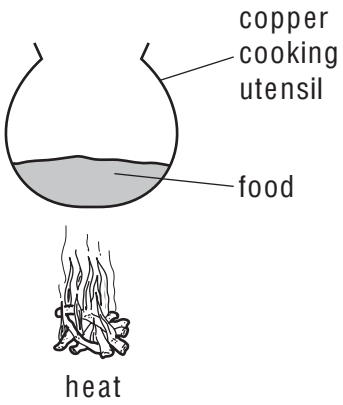


.....

..... [2]

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(d) Why is copper a suitable material from which to make cooking utensils?



.....

..... [2]

(e) Describe the bonding in a typical metal.

.....

.....

..... [2]

[Total: 10]

4 The ore of aluminium is bauxite which is impure aluminium oxide. Alumina, pure aluminium oxide, is obtained from bauxite.
Aluminium is formed at the cathode when a molten mixture of alumina and cryolite, $Na_3Al F_6$, is electrolysed.

(a) (i) Name **two** products formed at the anode in this electrolysis.

..... [2]

(ii) All the aluminium formed comes from the alumina not the cryolite.
Suggest **two** reasons why the electrolyte must contain cryolite.

.....

..... [2]

(iii) The major impurity in bauxite is iron(III) oxide. Iron(III) oxide is basic, aluminium oxide is amphoteric. Explain how aqueous sodium hydroxide can be used to separate them.

.....

.....

..... [2]

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(b) The purification of bauxite uses large amounts of sodium hydroxide.

(i) Describe the chemistry of how sodium hydroxide is made from concentrated aqueous sodium chloride. The description must include at least one ionic equation.

.....

.....

.....

.....

..... [5]

(ii) Making sodium hydroxide from sodium chloride produces two other chemicals. Name these two chemicals and state one use of each chemical.

chemical .....

use .....

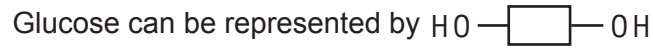
chemical .....

use ..... [2]

[Total: 13]

5 Islay is an island off the west coast of Scotland. The main industry on the island is making ethanol from barley.

Barley contains the complex carbohydrate, starch. Enzymes catalyse the hydrolysis of starch to a solution of glucose.

(a) (i) Draw the structure of the starch.
Glucose can be represented by 

[2]

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(ii) Enzymes can catalyse the hydrolysis of starch. Name another catalyst for this reaction.

..... [1]

(iii) Both starch and glucose are carbohydrates. Name the elements found in all carbohydrates.

.....

..... [1]

(b) Yeast cells are added to the aqueous glucose. Fermentation produces a solution containing up to 10 % of ethanol.

(i) Complete the word equation for the fermentation of glucose.

glucose → ..... + ...

[1]

(ii) Explain why is it necessary to add yeast and suggest why the amount of yeast in the mixture increases.

.....

.....

..... [2]

(iii) Fermentation is carried out at 35 °C. For many reactions a higher temperature would give a faster reaction. Why is a higher temperature not used in this process?

.....

..... [2]

(c) The organic waste, the residue of the barley and yeast, is disposed of through a pipeline into the sea. In the future this waste will be converted into biogas by the anaerobic respiration of bacteria. Biogas, which is mainly methane, will supply most of the island's energy.

(i) Anaerobic means in the absence of oxygen. Suggest an explanation why oxygen must be absent.

..... [1]

(ii) The obvious advantage of converting the waste into methane is economic.
Suggest **two** other advantages.

.....

..... [2]

[Total: 12]

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6 A length of magnesium ribbon was added to 50 cm^3 of sulfuric acid, concentration 1.0 mol / dm^3. The time taken for the magnesium to react was measured. The experiment was repeated with the same volume of different acids. In all these experiments, the acid was in excess and the same length of magnesium ribbon was used.

(a)

experiment	acid	concentration in mol / dm^3	time / s
A	sulfuric acid	1.0	20
B	propanoic acid	0.5	230
C	hydrochloric acid	1.0	40
D	hydrochloric acid	0.5	80

(i) Write these experiments in order of reaction speed. Give the experiment with the fastest speed first.

..... [1]

(ii) Give reasons for the order you have given in **(i)**.

.....

.....

.....

.....

.....

..... [5]

(b) Suggest **two** changes to experiment C which would increase the speed of the reaction and explain why the speed would increase. The volume of the acid, the concentration of the acid and the mass of magnesium used were kept the same.

change 1 .....

explanation .....

.....

change 2 .....

explanation .....

..... [5]

[Total: 11]

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7 The alkenes are unsaturated hydrocarbons. They form a homologous series, the members of which have similar chemical properties:

- easily oxidised
- addition reactions
- polymerisation
- combustion.

(a) All the alkenes have the same empirical formula.

(i) State their empirical formula.

..... [1]

(ii) Why is the empirical formula the same for all alkenes?

..... [1]

(b) Alkenes can be oxidised to carboxylic acids by boiling with aqueous potassium manganate(VII).

(i) Pent-2-ene, $CH_3–CH_2–CH=CH–CH_3$, oxidises to $CH_3–CH_2–COOH$ and CH_3COOH. Name these two acids.

$CH_3–CH_2–COOH$ .....

CH_3COOH ..... [2]

(ii) Most alkenes oxidise to two carboxylic acids. Deduce the formula of an alkene which forms only one carboxylic acid.

[1]

(c) Complete the following equations for the addition reactions of propene.

(i) $CH_3–CH=CH_2 + Br_2 \rightarrow$ ..... [1]

(ii) $CH_3–CH=CH_2 + H_2O \rightarrow$ ..... [1]

(d) Draw the structural formula of poly(propene)

[2]

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(e) 0.01 moles of an alkene needed 2.4 g of oxygen for complete combustion. 2.2 g of carbon dioxide were formed. Determine the following mole ratio.

moles of alkene **:** moles of O_2 **:** moles of CO_2

From this ratio determine the formula of the alkene.

..... [3]

Write an equation for the complete combustion of this alkene.

..... [1]

[Total: 13]

8 Ethylamine, $CH_3–CH_2–NH_2$, is a base which has similar properties to ammonia.

(a) In aqueous ethylamine, there is the following equilibrium.

$$CH_3–CH_2–NH_2 + H_2O \rightleftharpoons CH_3–CH_2–NH_3^+ + OH^-$$

Explain why water is behaving as an acid in this reaction.

..... [1]

(b) Given aqueous solutions of ethylamine and sodium hydroxide, describe how you could show that ethylamine is a weak base like ammonia and not a strong base like sodium hydroxide.

.....

.....

..... [3]

(c) Ethylamine, like ammonia, reacts with acids to form salts.

$$CH_3–CH_2–NH_2 + HCl \rightarrow CH_3–CH_2–NH_3Cl$$

ethylammonium chloride

Suggest how you could displace ethylamine from the salt, ethylammonium chloride.

.....

..... [2]

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(d) Explain the chemistry of the following reaction:

When aqueous ethylamine is added to aqueous iron(III) chloride, a brown precipitate is formed.

.....

..... [2]

[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
3	7 Li Lithium	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
11	23 Na Sodium	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
19	39 K Potassium	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
37	85 Rb Rubidium	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
55	133 Cs Caesium	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	86 Rn Radon
87	Fr Francium	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 = 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.).

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