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Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME	

CENTRE NUMBER						CANDIDATE NUMBER					

* 4 1 8 2 0 2 1 4 2 0 *

CHEMISTRY **0620/33**

Paper 3 (Extended) **May/June 2014**

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 **12** printed pages.

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CAMBRIDGE International Examinations

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1 Choose a gas from the following list to answer the questions below. Each gas may be used once, more than once or not at all.

ammonia **carbon dioxide** **carbon monoxide** **fluorine**

hydrogen **krypton** **nitrogen** **propene** **sulfur dioxide**

(a) It is a product of respiration. ..... [1]

(b) It polymerises to form a poly(alkene). ..... [1]

(c) It is a noble gas. ..... [1]

(d) It is the main component of air. ..... [1]

(e) It is a very reactive non-metal. ..... [1]

(f) It is used to kill micro-organisms in fruit juice. ..... [1]

(g) It burns to form water as the only product. ..... [1]

[Total: 7]

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2 Explain each of the following in terms of the kinetic particle theory.

(a) The rate of most reactions increases at higher temperatures.

.....

.....

.....

..... [3]

(b) A liquid has a fixed volume but takes up the shape of the container. A gas takes up the shape of the container but it does not have a fixed volume.

.....

.....

.....

.....

..... [3]

[Total: 6]

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3 **(a)** Biological catalysts produced by microbes cause food to deteriorate and decay.

(i) What is the name of these biological catalysts?

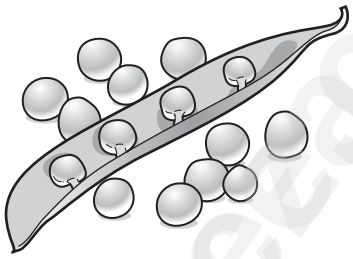
..... [1]

(ii) Freezing does not kill the microbes.
Suggest why freezing is still a very effective way of preserving food.

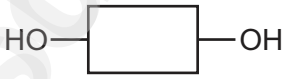
.....

..... [2]

(b) Pea seeds grow in pods on pea plants.



Freshly picked pea seeds contain a sugar. The sugar can form a polymer.
Give the structural formula of the polymer and name the other product of this polymerisation reaction.
You may represent the sugar by the formula:



structural formula of the polymer

other product ..... [3]

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(c) Describe how the pea plant makes a sugar such as glucose.

.....

.....

.....

.....

..... [3]

[Total: 9]

4 Iron from a blast furnace contains about 5% of the impurities – carbon, silicon, phosphorus and sulfur. Most of this impure iron is used to make steels, such as mild steel, and a very small percentage is used to make pure iron.

(a) Calcium oxide and oxygen are used to remove the impurities from the iron produced in the blast furnace.

(i) State how these chemicals are manufactured.

calcium oxide .....

.....

oxygen .....

.....

[3]

(ii) Describe how these two chemicals remove the four impurities. Include at least one equation in your answer.

.....

.....

.....

.....

.....

.....

..... [5]

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(b) **(i)** Describe the structure of a typical metal such as iron. You may include a diagram.

.....

.....

[2]

(ii) Explain why pure iron is malleable.

.....

..... [2]

(iii) Mild steel is an alloy of iron and carbon.
Suggest why mild steel is harder than pure iron.

.....

.....

..... [2]

[Total: 14]

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5 Ammonia is made by the Haber process.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

The forward reaction is exothermic.
The conditions in the reaction chamber are:

- a pressure of 200 atmospheres,
- a catalyst of finely divided iron,
- a temperature of 400 to 450 °C.

(a) What are the **two** advantages of using a high pressure? Give a reason for both.

advantage 1 .....

reason .....

.....

advantage 2 .....

reason .....

.....
[4]

(b) A higher temperature would give a faster reaction rate.
Why is a higher temperature **not** used?

.....

.....

..... [3]

(c) **(i)** Why is the iron catalyst used as a fine powder?

.....

..... [1]

(ii) Give **two** reasons why a catalyst is used.

.....

.....

.....

..... [2]

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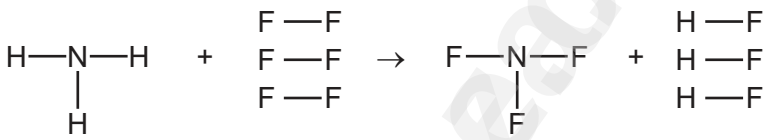
(d) The equilibrium mixture leaving the reaction chamber contains 15% ammonia. Suggest how the ammonia could be separated from the mixture.

	boiling point / °C
hydrogen	–253
nitrogen	–196
ammonia	–33

.....

..... [2]

(e) Ammonia is used to make nitrogen trifluoride, NF_3.
Nitrogen trifluoride is essential to the electronics industry. It is made by the following reaction.



Determine if the above reaction is exothermic or endothermic using the following bond energies and by completing the following table. The first line has been done as an example.
Bond energy is the amount of energy, in kJ / mole, needed to break or make one mole of the bond.

bond	bond energy in kJ / mole
N – H	390
F – F	155
N – F	280
H – F	565

bond	energy change / kJ
N – H	(3 × 390) = 1170
F – F	
N – F	
H – F	

.....

..... [4]

[Total: 16]

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6 The alkanes are a family of saturated hydrocarbons. Their reactions include combustion, cracking and substitution.

(a) **(i)** What is meant by the term *hydrocarbon*?

..... [1]

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

..... [1]

(b) **(i)** What is the general formula for the homologous series of alkanes?

..... [1]

(ii) Calculate the mass of one mole of an alkane with 14 carbon atoms.

.....

..... [2]

(c) The complete combustion of hydrocarbons produces carbon dioxide and water only.

(i) Write the equation for the complete combustion of nonane, C_9H_{20}.

..... [2]

(ii) 20 cm^3 of a gaseous hydrocarbon was mixed with an excess of oxygen, 200 cm^3. The mixture was ignited. After cooling, 40 cm^3 of oxygen and 100 cm^3 of carbon dioxide remained. Deduce the formula of the hydrocarbon and the equation for its combustion. All volumes were measured at r.t.p..

.....

.....

.....

.....

..... [3]

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(d) Cracking is used to obtain short-chain alkanes, alkenes and hydrogen from long-chain alkanes.

(i) Give a use for each of the three products listed above.

short-chain alkanes .....

alkenes .....

hydrogen ..... [3]

(ii) Write an equation for the cracking of decane, $C_{10}H_{22}$, which produces two different alkenes and hydrogen as the only products.

..... [1]

(e) Chlorine reacts with propane in a substitution reaction to form 1-chloropropane.

$$CH_3-CH_2-CH_3 + Cl_2 \rightarrow CH_3-CH_2-CH_2-Cl + HCl$$

(i) What is the essential condition for the above reaction?

..... [1]

(ii) There is more than one possible substitution reaction between chlorine and propane. Suggest the structural formula of a different product.

..... [1]

[Total: 16]

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7 Aluminium is obtained from purified alumina, Al_2O_3, by electrolysis.

(a) Alumina is obtained from the main ore of aluminium.
State the name of this ore.

..... [1]

(b) Describe the extraction of aluminium from alumina. Include the electrolyte, the electrodes and the reactions at the electrodes.

.....

.....

.....

.....

.....

.....

..... [6]

(c) Aluminium is resistant to corrosion. It is protected by an oxide layer on its surface.
The thickness of this oxide layer can be increased by anodising.

(i) State a use of aluminium due to its resistance to corrosion.

..... [1]

(ii) Anodising is an electrolytic process. Dilute sulfuric acid is electrolysed with an aluminium object as the anode. The thickness of the oxide layer is increased. Complete the equations for the reactions at the aluminium anode.

.....OH^- $\rightarrow$ O_2 + $2H_2O$ + ...e^-

....Al + ... $\rightarrow$ .....Al_2O_3 [4]

[Total: 12]

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DATA SHEET
The Periodic Table of the Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 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.).

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