Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME

CENTER NUMBER

CANDIDATE NUMBER

8490611688

CHEMISTRY (US) **0439/33**

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 Center 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.

This document consists of **12** printed pages.

CAMBRIDGE International Examinations

[Turn over

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 polymerizes 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 nonmetal. ..... [1]

(f) It is used to kill microorganisms in fruit juice. ..... [1]

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

[Total: 7]

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

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

.....

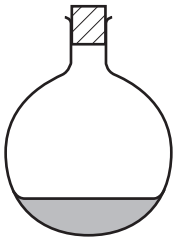
.....

.....

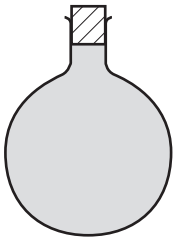
..... [3]

(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.

liquid



gas



.....

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.....

.....

..... [3]

[Total: 6]

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

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

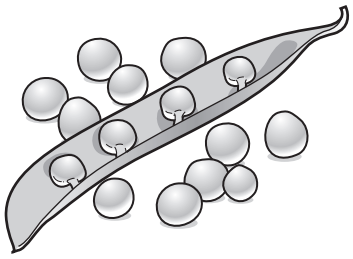
..... [1]

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

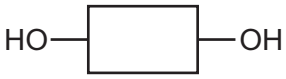
.....

..... [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 polymerization reaction.
You may represent the sugar by the formula:



structural formula of the polymer

other product ..... [3]

(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]

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

.....

.....

[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]

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]

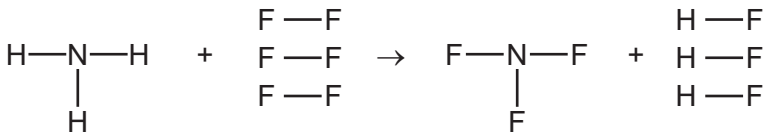
(d) The equilibrium mixture leaving the reaction chamber contains 15% ammonia. [illegible] how the ammonia could be separated from the mixture.

	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]

6 The alkanes are a family of saturated hydrocarbons. Their reactions include combustion 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]

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

(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]

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

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

..... [1]

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

.....

.....

.....

.....

.....

.....

..... [6]

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

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

..... [1]

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

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

$$\text{....}Al + \text{.....} \rightarrow \text{.....}Al_2O_3$$ [4]

[Total: 12]

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** Aluminum 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.).