Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

Cambridge IGCSE

CANDIDATE NAME	

CENTRE NUMBER						CANDIDATE NUMBER	

0906632911

CHEMISTRY **0620/43**

Paper 4 Theory (Extended) **October/November 2016**

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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1 **(a)** Complete the table.

particle	charge	relative mass
proton	+1	
neutron		1
electron		

[2]

(b) The following are isotopes of carbon.

$^{12}_{6}C$ $^{13}_{6}C$ $^{14}_{6}C$

(i) In terms of numbers of protons, neutrons and electrons, how are these **three** isotopes the same and how are they different?

They are the same because ....

....

They are different because ....

....
[3]

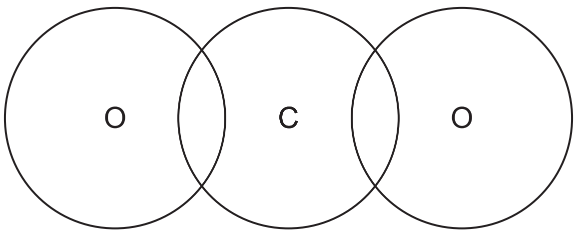
(ii) Why do all isotopes of carbon have the same chemical properties?

.... [1]

(c) Name **two** forms of the element carbon which have giant covalent structures.

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

(d) Complete the diagram to show the electron arrangement in a carbon dioxide molecule.
Show the outer shell electrons only.



[2]

[Total: 9]

2 Beryllium is a metallic element in Group II.

(a) Give the electronic structure of a beryllium atom.

.... [1]

(b) Give the formula of beryllium oxide.

.... [1]

(c) **(i)** Describe the bonding in a metallic element such as beryllium.
Include a labelled diagram and any appropriate charges in your answer.

....

....

.... [3]

(ii) Explain why metallic elements, such as beryllium, are good conductors of electricity.

....

.... [1]

(d) Beryllium hydroxide is amphoteric.
Beryllium hydroxide reacts with acids. The salts formed contain positive beryllium ions.

(i) Give the formula of the positive beryllium ion.

.... [1]

(ii) Write a chemical equation for the reaction between beryllium hydroxide and hydrochloric acid.

.... [2]

(iii) Beryllium hydroxide also reacts with alkalis. The salts formed contain beryllate ions, BeO_2^{2-}.

Suggest a chemical equation for the reaction between beryllium hydroxide and sodium hydroxide solution.

.... [2]

[Total: 11]

3 When lead(II) nitrate is heated, two gases are given off and solid lead(II) oxide remains. The equation for the reaction is shown.

$$2Pb(NO_3)_2(s) \rightarrow 2PbO(s) + 4NO_2(g) + O_2(g)$$

(a) Calculate the M_r of lead(II) nitrate.

.... [1]

(b) 6.62 g of lead(II) nitrate are heated until there is no further change in mass.

(i) Calculate the mass of lead(II) oxide produced.

.... g [2]

(ii) Calculate the volume of oxygen, O_2, produced at room temperature and pressure (r.t.p.).

.... dm^3 [2]

(c) Describe a test for oxygen.

test ....

result ....

[2]

(d) Lead(II) oxide is insoluble. A student adds solid lead(II) oxide to dilute nitric acid until the lead(II) oxide is in excess. Aqueous lead(II) nitrate and water are produced.

(i) What is meant by the term *excess*?

.... [1]

(ii) How would the student know when the lead(II) oxide is in excess?

.... [1]

(iii) Write a chemical equation for the reaction.

.... [1]

[Total: 10]

4 Silicon(IV) oxide and sodium chloride have different types of bonding and structure.

(a) Name the type of bonding present in

silicon(IV) oxide, ...

sodium chloride. ....
[2]

(b) Name the type of structure present in silicon(IV) oxide.

.... [1]

(c) **(i)** Silicon(IV) oxide has a high melting point. Explain why.

....

.... [2]

(ii) Silicon(IV) oxide is a poor conductor of electricity. Explain why.

.... [1]

(d) Solid sodium chloride does not conduct electricity. However, it conducts electricity when molten.

Explain why solid sodium chloride does **not** conduct electricity, whereas molten sodium chloride does conduct electricity.

....

....

....

.... [3]

(e) A **concentrated** aqueous solution of sodium chloride is electrolysed using carbon electrodes.

(i) Name the products formed at the electrodes.

product at the positive electrode (anode) ....

product at the negative electrode (cathode) ....
[2]

(ii) Write an ionic half-equation for the reaction occurring at the negative electrode.

.... [1]

(f) A **dilute** aqueous solution of sodium chloride is electrolysed using carbon electrodes.

Name the main product formed at the positive electrode.

.... [1]

(g) Molten sodium chloride is electrolysed using carbon electrodes.

(i) Name the product formed at the negative electrode.

.... [1]

(ii) Write an ionic half-equation for the reaction occurring at the negative electrode.

.... [1]

(iii) Chlorine is produced at the positive electrode.

Give the test for chlorine.

test ....

result ....
[2]

[Total: 17]

5 Sulfuric acid can be manufactured from the raw materials sulfur, air and water. The process can be divided into four stages.

stage 1 converting sulfur into sulfur dioxide

stage 2 converting sulfur dioxide into sulfur trioxide

stage 3 converting sulfur trioxide into oleum, $H_2S_2O_7$

stage 4 converting oleum into sulfuric acid

stage 1

(a) **(i)** Describe how sulfur is converted into sulfur dioxide.

.... [1]

(ii) Write a chemical equation for the conversion of sulfur into sulfur dioxide.

.... [1]

stage 2

(b) Sulfur dioxide is converted into sulfur trioxide according to the following equation.

$$2SO_2 + O_2 \rightleftharpoons 2SO_3$$

The reaction is carried out at a temperature of 450 °C and a pressure of 1–2 atmospheres using a catalyst. The energy change, ΔH, for the reaction is –196 kJ / mol.

(i) What is the meaning of the symbol $\rightleftharpoons$?

.... [1]

(ii) Name the catalyst used in this reaction.

.... [1]

(iii) Why is a catalyst used?

.... [1]

(iv) If a temperature higher than 450 °C were used, what would happen to the amount of sulfur trioxide produced? Give a reason for your answer.

....

.... [2]

(v) Suggest a reason why a temperature lower than 450 °C is **not** used.

....

.... [1]

(vi) If a pressure higher than 1–2 atmospheres were used, what would happen to the amount of sulfur trioxide produced? Give a reason for your answer.

....

.... [2]

stage 3

(c) (i) What is added to sulfur trioxide to convert it into oleum?

.... [1]

(ii) Write a chemical equation for the conversion of sulfur trioxide into oleum.

.... [1]

stage 4

(d) (i) What is added to oleum to convert it into sulfuric acid?

.... [1]

(ii) Write a chemical equation for the conversion of oleum into sulfuric acid.

.... [1]

(e) Give **one** use of sulfuric acid.

.... [1]

(f) Sulfuric acid reacts with a hydrocarbon called benzene to produce benzenesulfonic acid, $C_6H_5SO_3H$. Benzenesulfonic acid is a strong acid which ionises to produce hydrogen ions, H^+, and benzenesulfonate ions, $C_6H_5SO_3^-$.

(i) What is meant by the term *strong acid*?

.... [1]

(ii) Describe how to show that a 1 mol / dm^3 solution of benzenesulfonic acid is a strong acid.

....

.... [2]

(iii) Write a chemical equation for the reaction between benzenesulfonic acid and sodium carbonate, Na_2CO_3.

.... [2]

[Total: 20]

6 Synthetic polyamides are made by condensation polymerisation.

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

....

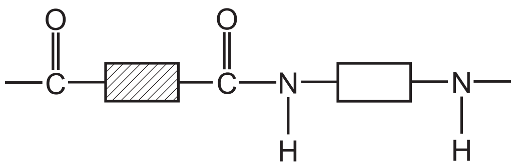
....

.... [3]

(ii) Name another type of polymerisation.

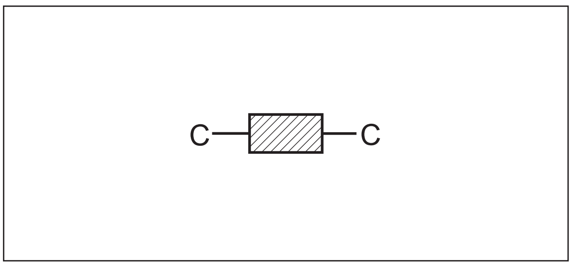
.... [1]

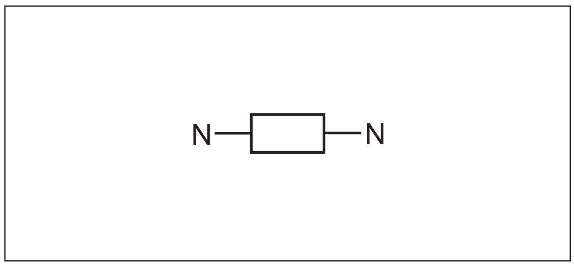
(b) One repeat unit of a synthetic polyamide is represented by the following structure.



(i) Draw a ring around the amide link. [1]

(ii) Complete the diagrams to show the structures of the monomers used to produce the synthetic polyamide. Show all the missing atoms and bonds.





[2]

(iii) Name an example of a synthetic polyamide.

.... [1]

(c) Proteins and synthetic polyamides have similarities and differences.

(i) Name the type of compounds that are the monomers used to make up proteins.

.... [1]

(ii) Starting with a sample of protein, describe how to produce, separate, detect and identify the monomers which make it up.

Your answer should include

- the name of the process used to break down the protein into its monomers,
- the name of the process used to separate the monomers,
- the method used to detect the monomers after they have been separated,
- the method used to identify the monomers after they have been separated.

....

....

....

....

.... [4]

[Total: 13]

The Periodic Table of Elements

Key

atomic number
atomic symbol
name
relative atomic mass

Group																	
I	II											III	IV	V	VI	VII	VIII
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium –	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).