Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME	
CENTER NUMBER	
CANDIDATE NUMBER	

5045090557

CHEMISTRY (US) **0439/31**

Paper 3 (Extended) **October/November 2015**

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 **(a)** The symbols of six particles are shown below.

Na^+ Ca^{2+} Kr P Si O^{2-}

Select from the list of particles to answer the following questions. A particle may be selected once, more than once or not at all.

(i) Which **two** ions have the same electronic structure? ..... [1]

(ii) Which ion has the same electronic structure as an atom of argon? ..... [1]

(iii) Which atom can form an ion of the type X^{3-}? ..... [1]

(iv) Which atom can form a hydride which has a formula of the type XH_4? ..... [1]

(b) **(i)** How many protons, neutrons and electrons are there in one copper(II) ion $^{64}_{29}Cu^{2+}$?

number of protons .....

number of neutrons .....

number of electrons .....

[2]

(ii) $^{45}_{21}Sc$ represents an atom of scandium.

How many nucleons and how many charged particles are there in one atom of scandium?

number of nucleons .....

number of charged particles .....

[2]

(c) Two different atoms of sodium are $^{23}_{11}Na$ and $^{24}_{11}Na$.

(i) Explain why these two atoms are isotopes.

.....

..... [2]

(ii) $^{24}_{11}Na$ is radioactive. It changes into an atom of a different element which has one more proton.

Identify this element.

..... [1]

(iii) State **two** uses of radioactive isotopes.

.....

..... [2]

[Total: 13]

2 Describe how to separate the following. In each example, give a description of the procedure used and explain why this method works.

(a) Copper powder from a mixture containing copper and zinc powders.

procedure .....

.....

explanation .....

.....

[3]

(b) Nitrogen from a mixture of nitrogen and oxygen.

procedure .....

.....

explanation .....

.....

[3]

(c) Glycine from a mixture of the two amino acids glycine and alanine. Glycine has the lower R_f value.

procedure .....

.....

explanation .....

.....

[2]

(d) Magnesium hydroxide from a mixture of magnesium hydroxide and zinc hydroxide.

procedure .....

.....

explanation .....

.....

[3]

[Total: 11]

[Turn over

3 Sulfuric acid is made by the Contact process.

(a) Sulfur is burned by spraying droplets of molten sulfur into air.

Suggest and explain an advantage of using this method.

.....

..... [2]

(b) The following equation represents the equilibrium in the Contact process.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

Oxygen is supplied from the air.
The composition of the reaction mixture is 1 volume of sulfur dioxide to 1 volume of oxygen.

What volume of air contains 1 dm^3 of oxygen?

..... dm^3 [1]

(c) Sulfur dioxide is more expensive than air.

What is the advantage of using an excess of air?

.....

..... [2]

(d) The forward reaction is exothermic. The reaction is usually carried out at a temperature between 400 and 450 °C.

(i) What is the effect on the position of equilibrium of using a temperature above 450 °C?
Explain your answer.

.....

.....

..... [2]

(ii) What is the effect on the rate of using a temperature below 400 °C?
Explain your answer.

.....

.....

..... [3]

(e) A low pressure, 2 atmospheres, is used. At equilibrium, about 98% SO_3 is present.

(i) What is the effect on the position of equilibrium of using a higher pressure?

..... [1]

(ii) Explain why a higher pressure is **not** used.

..... [1]

(f) Name the catalyst used in the Contact process.

..... [1]

(g) Describe how concentrated sulfuric acid is made from sulfur trioxide.

.....

.....

.....

..... [2]

[Total: 15]

4 **(a)** Synthetic polymers are disposed of in landfill sites and by burning.

(i) Describe **two** problems caused by the disposal of synthetic polymers in landfill sites.

.....

..... [2]

(ii) Describe **one** problem caused by burning synthetic polymers.

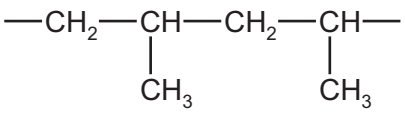
..... [1]

(b) State **two** uses of synthetic polymers.

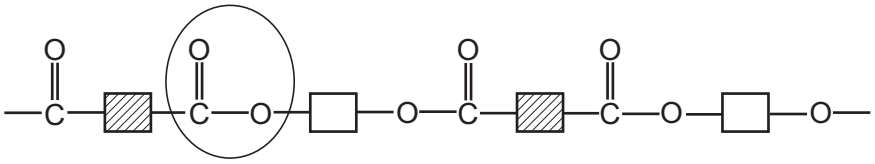
.....

..... [1]

(c) The structural formulae of two synthetic polymers are given below.



polymer **A**



polymer **B**

(i) Draw the structural formula of the monomer of polymer **A**.

[2]

(ii) Identify the functional group circled in polymer **B**.

..... [1]

(iii) Deduce the **two** types of organic compound which have reacted to form polymer **B**.

..... [2]

(d) Explain the difference between addition and condensation polymers. Classify **A** and **B** as either addition or condensation polymers.

.....

.....

.....

..... [3]

[Total: 12]

5 **(a)** A compound, **X**, contains 55.85% carbon, 6.97% hydrogen and 37.18% oxygen.

(i) How does this prove that compound **X** contains only carbon, hydrogen and oxygen?

..... [1]

(ii) Use the above percentages to calculate the empirical formula of compound **X**.

..... [2]

(iii) The M_r of **X** is 86.

What is its molecular formula?

..... [2]

(b) **(i)** Bromine water changes from brown to colorless when added to **X**.

What does this tell you about the structure of **X**?

..... [1]

(ii) Magnesium powder reacts with an aqueous solution of **X**. Hydrogen is evolved.

What does this tell you about the structure of **X**?

..... [1]

(iii) **X** contains two different functional groups.

Draw a structural formula of **X**.

[1]

[Total: 8]

6 Carbon and silicon are elements in Group IV. They both form oxides of the type XO_2.

(a) Silicon(IV) oxide, SiO_2, has a macromolecular structure.

(i) Describe the structure of silicon(IV) oxide.

.....

.....

.....

.....

..... [3]

(ii) State **three** properties which silicon(IV) oxide and diamond have in common.

.....

.....

..... [3]

(iii) How could you show that silicon(IV) oxide is acidic and not basic or amphoteric?

.....

.....

..... [2]

(b) Explain why the physical properties of carbon dioxide are different from those of diamond and silicon(IV) oxide.

.....

..... [1]

[Total: 9]

[Turn over

7 The rate of a photochemical reaction is affected by light.

(a) The decomposition of silver bromide is the basis of film photography. This is a redox reaction.

$$\underset{\text{cream}}{2AgBr} \rightarrow \underset{\text{black}}{2Ag} + Br_2$$

step 1 $2Br^- \rightarrow Br_2 + 2e^-$

step 2 $Ag^+ + e^- \rightarrow Ag$

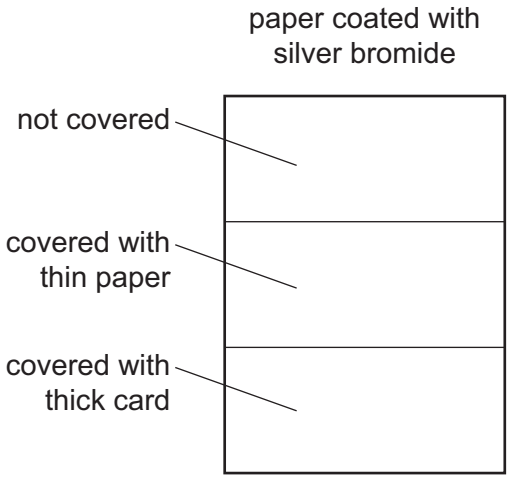
(i) Which step is reduction? Explain your answer.

..... [1]

(ii) Which ion is the oxidizing agent? Explain your answer.

..... [1]

(b) A piece of white paper was coated with silver bromide and exposed to the light. Sections of the paper were covered as shown in the diagram.



Predict the appearance of the different sections of the paper after exposure to the light and the removal of the card. Explain your predictions.

.....

.....

.....

.....

.....

..... [4]

(c) Photosynthesis is another example of a photochemical reaction. Green plants can make simple carbohydrates, such as glucose. These can polymerize to make more complex carbohydrates, such as starch.

(i) Write a word equation for photosynthesis.

..... [2]

(ii) Name the substance which is responsible for the color in green plants and is essential for photosynthesis.

..... [1]

(iii) The structural formula of glucose can be represented by H—O—□—O—H .

Draw part of the structural formula of starch which contains two glucose units.

[2]

(iv) Living organisms need carbohydrates for respiration.

What is meant by *respiration*?

..... [1]

[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** Cesium 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.).