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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
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CHEMISTRY

0620/32

Paper 3 (Extended)

October/November 2011

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	
Total	

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



1 Cobalt is an element in Period 4 of the Periodic Table.

(a) Use your copy of the Periodic Table to help you complete the table below.

particle	number of protons	number of neutrons	number of electrons
Co			
Co ²⁺			

[2]

(b) ⁶⁰Co is a cobalt isotope.

(i) Explain the term *isotope*.

.....
.....
..... [2]

(ii) Explain why two isotopes of the same element have identical chemical properties.

..... [1]

(iii) State **one** industrial use and **one** medical use of radioactive isotopes.

industrial use [1]

medical use [1]

[Total: 7]

2 Sulfur is needed for the production of sulfuric acid. Two of the major sources of sulfur are

- underground deposits of the element sulfur,
- sulfur compounds from natural gas and petroleum.

(a) Explain why sulfur and its compounds are removed from these fuels before they are burned.

.....
..... [2]

(b) Sulfur dioxide is made by spraying molten sulfur into air. The sulfur ignites and sulfur dioxide is formed.

(i) Suggest why molten sulfur is used in the form of a fine spray.

.....
..... [2]

(ii) Explain why traces of sulfur dioxide act as a preservative in fruit juices.

..... [1]

(iii) State another use of sulfur dioxide.

..... [1]

(c) Describe how sulfur dioxide is changed into sulfur trioxide. Give the reaction conditions and an equation.

.....
.....
.....
..... [4]

(d) Complete the following equations for the formation of sulfuric acid from sulfur trioxide.



[Total: 12]

3 Antimony, Sb, is an element in Group V.

- (a) The main ore of antimony is its sulfide. The extraction of antimony is similar to that of zinc.

Describe how each of these changes in the extraction of antimony is carried out.

- (i) antimony sulfide to antimony oxide

..... [1]

- (ii) antimony oxide to antimony

..... [1]

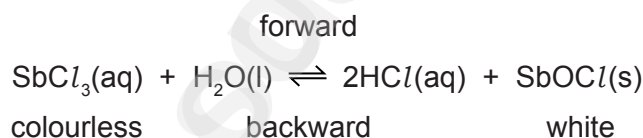
- (b) Antimony oxide is a white powder which is insoluble in water.

Describe how you would find out if it is a basic, an acidic or an amphoteric oxide.

.....

 [4]

- (c) When antimony chloride is added to water, a faint white precipitate forms and the mixture slowly goes cloudy.



- (i) Explain why after some time the appearance of the mixture remains unchanged.

.....
 [2]

- (ii) When a few drops of concentrated hydrochloric acid are added to the mixture, it changes to a colourless solution. Suggest an explanation.

.....
 [1]

- (iii) Suggest how you could make the colourless solution go cloudy.

..... [1]

[Total: 10]

- 4 The structure of an element or compound determines its physical properties. Scandium fluoride and silicon(IV) oxide have giant structures.

(a) Scandium fluoride is an ionic compound.

- (i) The valency of scandium is three. Draw a diagram which shows the formula of the compound, the charges on the ions and the arrangement of the valency electrons around the negative ion.

Use x to represent an electron from a scandium atom.

Use o to represent an electron from a fluorine atom.

[3]

- (ii) The melting point of scandium fluoride is 1552 °C. Explain why scandium fluoride has a high melting point.

.....

..... [1]

(b) Silicon(IV) oxide has a macromolecular structure.

- (i) Describe the structure of silicon(IV) oxide. You may use a diagram.

[3]

- (ii) How does the electrical conductivity of these two compounds differ?

.....

..... [1]

- (iii) Explain the difference in conductivity.

.....

..... [2]

[Total: 10]

- 5 The alcohols form a homologous series. Two characteristics of a homologous series are that the physical properties of the members vary in a predictable way and they have similar chemical properties.

(a) Complete the table.

name	formula	mass of one mole / g	boiling point / °C
methanol	CH_3-OH	32	64
ethanol	$\text{CH}_3-\text{CH}_2-\text{OH}$	46	78
propan-1-ol	$\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{OH}$	60	98
butan-1-ol	$\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{OH}$	74	118
pentan-1-ol			138
hexan-1-ol	$\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{OH}$	102	

[3]

- (b) Give **two** other characteristics of a homologous series.

.....
 [2]

- (c) Draw a diagram showing the arrangement of the valency electrons in one molecule of the covalent compound methanol.

Use x to represent an electron from a carbon atom.

Use o to represent an electron from an oxygen atom.

Use • to represent an electron from a hydrogen atom.

[3]

(d) Alcohols can be oxidised to carboxylic acids by heating with acidic potassium manganate(VII).

(i) Draw the structural formula of the carboxylic acid formed by the oxidation of propan-1-ol. Show all the bonds.

[1]

(ii) Describe how ethanol could be oxidised to ethanoic acid by fermentation.

.....

..... [2]

(e) Propan-1-ol and ethanoic acid react together to form an ester. Give its name and structural formula.

name [1]

formula

[1]

[Total: 13]

- 6** Soluble salts can be made by the neutralisation of an acid by a base. Insoluble salts can be made by precipitation.

- (a)** The following is a brief description of the preparation of the soluble salt, nickel(II) chloride-6-water, from the insoluble base nickel(II) carbonate.

Nickel(II) carbonate is added in small amounts to hot dilute hydrochloric acid until it is in excess. The mixture is filtered. The filtrate is partially evaporated and then allowed to cool until crystals of nickel(II) chloride-6-water form.

- (i)** Why is it necessary to use excess carbonate?

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

- (ii)** Explain why it is necessary to filter.

..... [1]

- (iii)** Why partially evaporate rather than evaporate to dryness?

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

- (iv)** What additional steps are needed to obtain dry crystals?

.....
..... [2]

- (b)** Potassium chloride can be made from hydrochloric acid and potassium carbonate.

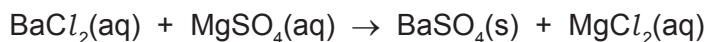
- (i)** Why must a different experimental method be used for this preparation?

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

- (ii)** Give a description of the different method used for this salt preparation.

.....
.....
.....
..... [4]

- (c) Insoluble salts are made by precipitation. An equation for the preparation of barium sulfate is given below.



This reaction can be used to find x in the formula for hydrated magnesium sulfate $\text{MgSO}_4 \cdot x\text{H}_2\text{O}$.

A known mass of hydrated magnesium sulfate, $\text{MgSO}_4 \cdot x\text{H}_2\text{O}$, was dissolved in water. Excess aqueous barium chloride was added. The precipitate of barium sulfate was filtered, washed and dried. Finally it was weighed.

Mass of hydrated magnesium sulfate = 1.476 g

Mass of barium sulfate formed = 1.398 g

The mass of one mole of BaSO_4 = 233 g

The number of moles of BaSO_4 formed = ... [1]

The number of moles of $\text{MgSO}_4 \cdot x\text{H}_2\text{O}$ = ... [1]

The mass of one mole of $\text{MgSO}_4 \cdot x\text{H}_2\text{O}$ = ... g [1]

The mass of one mole of MgSO_4 = 120 g

The mass of $x\text{H}_2\text{O}$ in one mole of $\text{MgSO}_4 \cdot x\text{H}_2\text{O}$ = ... [1]

x = ... [1]

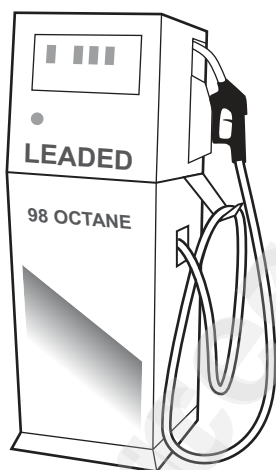
[Total: 15]

- 7 Petrol is a mixture of hydrocarbons and additives. The combustion of petrol in car engines is a major source of air pollution. This is reduced by catalytic converters.

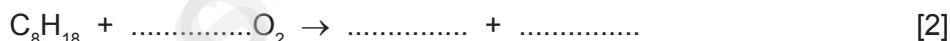
- (a) Petrol is obtained from the gasoline fraction, boiling point range 40 °C to 100 °C, from the distillation of petroleum. Explain the term *fraction*.

.....
 [2]

- (b) In many countries, a lead compound of the type $\text{Pb}(\text{C}_2\text{H}_5)_n$ used to be added to petrol to improve its combustion. After combustion, lead oxide was formed.



- (i) Octane is a constituent of petrol. Write the equation for the complete combustion of octane.



- (ii) Dibromoethane was added to petrol to remove the lead oxide from inside the engine. Lead bromide was formed which escaped into the environment through the exhaust. Leaded petrol cannot be used with a catalytic converter. Give another reason why leaded petrol is no longer used.

..... [1]

- (iii) What does each of the following tell you about the structure of dibromoethane?

dibromo

eth

ane [2]

- (iv) What additional information is needed to draw the structural formula of dibromoethane?

..... [1]

- (c) An analysis of the compound, $\text{Pb}(\text{C}_2\text{H}_5)_n$, showed that 0.026 moles of Pb was combined with 0.104 moles of C_2H_5 groups.
What is the value of n ? Show how you arrived at your answer.

.....
..... [2]

- (d) Some of the pollutants emitted by vehicle exhausts are carbon monoxide, oxides of nitrogen and unburnt hydrocarbons. Explain how the emission of these gases is reduced by a catalytic converter.

.....
.....
..... [3]

[Total: 13]

DATA SHEET
The Periodic Table of the Elements

Group																	
I	II	1 H Hydrogen 1										III	IV	V	VI	VII	0
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	101 Ru Ruthenium 44	101 Rh Rhodium 45	103 Pd Palladium 46	106 Ag Silver 47	108 Cd Cadmium 48	112 In Indium 49	115 Sn Tin 50	119 Sb Antimony 51	122 Te Tellurium 52	128 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	210 Po Polonium 84	210 At Astatine 85	210 Rn Radon 86
Fr Francium 87	Ra Radium 88	Ac Actinium 89															
58-71 Lanthanoid series																	
90-103 Actinoid series																	
a = relative atomic mass X = atomic symbol b = proton (atomic) number																	
Key	X	a															

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).

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