First Variant Question Paper

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

*7190250824*

**CHEMISTRY** **0620/31**

Paper 3 (Extended) **May/June 2008**

**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 questions.

| For Examiner's Use | |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | |
| Total | |

This document consists of **11** printed pages and **1** blank page.

For Examiner's Use

**1** For each of the following select an element from Period 4, potassium to krypton, that matches the description.

**(a)** It is a brown liquid at room temperature. .....

**(b)** It forms a compound with hydrogen having the formula $XH_4$. .....

**(c)** A metal that reacts violently with cold water. .....

**(d)** It has a complete outer energy level. .....

**(e)** It has oxidation states of 2 and 3 only. .....

**(f)** It can form an ion of the type $X^-$. .....

**(g)** One of its oxides is the catalyst in the Contact Process. .....

[Total: 7]

For Examiner's Use

**2** **(a)** Complete the table which gives the names, symbols, relative masses and relative charges of the three subatomic particles.

| name | symbol | relative mass | relative charge |
|---|---|---|---|
| electron | $e^-$ | | |
| proton | | 1 | |
| | n | | 0 |

[3]

**(b)** Use the information in the table to explain the following.

**(i)** Atoms contain charged particles but they are electrically neutral because they have no overall charge.

.....

..... [2]

**(ii)** Atoms can form positive ions.

.....

..... [2]

**(iii)** Atoms of the same element can have different masses.

.....

..... [2]

**(iv)** Scientists are certain that there are no undiscovered elements missing from the Periodic Table from hydrogen to lawrencium.

..... [1]

[Total: 10]

3 Copper is purified by electrolysis.

For Examiner's Use

**(a)** Complete the following.

The positive electrode (anode) is made from .....

The negative electrode (cathode) is made from .....

The electrolyte is aqueous ..... [3]

**(b)** Write an ionic equation for the reaction at the positive electrode (anode).

..... [2]

**(c)** **(i)** Give **two** reasons why copper is used,

in electric wiring, .....

..... [2]

in cooking utensils. .....

..... [2]

**(ii)** Give another use of copper.

..... [1]

[Total: 10]

For Examiner's Use

**4** Sulphuric acid is a typical strong acid.

**(a)** Change the equations given into a different format.

**(i)** $Mg + H_2SO_4 \longrightarrow MgSO_4 + H_2$
Change into a word equation.

.....

[1]

**(ii)** lithium oxide + sulphuric acid $\longrightarrow$ lithium sulphate + water
Change into a symbol equation.

.....

[2]

**(iii)** $CuO + 2H^+ \longrightarrow Cu^{2+} + H_2O$
Change the ionic equation into a symbol equation.

.....

[2]

**(iv)** $Na_2CO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + CO_2 + H_2O$
Change into a word equation.

.....

[1]

**(b)** When sulphuric acid dissolves in water, the following reaction occurs.
$H_2SO_4 + H_2O \longrightarrow HSO_4^- + H_3O^+$
Explain why water is behaving as a base in this reaction.

.....

[2]

**(c)** Sulphuric acid is a strong acid, ethanoic acid is a weak acid.
Explain the difference between a strong acid and a weak acid.

.....

.....

[2]

[Total: 10]

For Examiner's Use

**5** Carbonyl chloride, $COCl_2$, is a colourless gas. It is made by the following reaction.

$$CO(g) + Cl_2(g) \underset{\text{heat}}{\overset{\text{cool}}{\rightleftharpoons}} COCl_2(g)$$

**(a)** When the pressure on the equilibrium mixture is decreased, the position of equilibrium moves to left.

**(i)** How does the concentration of each of the three chemicals change?

.....

..... [2]

**(ii)** Explain why the position of equilibrium moves to left.

.....

..... [2]

**(b)** Using the information given with the equation, is the forward reaction exothermic or endothermic? Give a reason for your choice.

.....

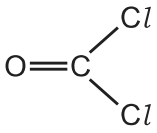
..... [2]

**(c)** Carbonyl chloride reacts with water to form two acidic compounds.
Suggest which acidic compounds are formed.

1. .....

2. ..... [2]

**(d)** The structural formula of carbonyl chloride is given below.




Draw a diagram that shows the arrangement of the valency electrons in one molecule of this covalent compound.
Use x for an electron from a chlorine atom.
Use o for an electron from a carbon atom.
Use ● for an electron from an oxygen atom.

[4]
[Total: 12]

For Examiner's Use

**6** Three of the factors that can influence the rate of a chemical reaction are:

- physical state of the reactants
- light
- the presence of a catalyst

**(a)** The first recorded dust explosion was in a flour mill in Italy in 1785. Flour contains carbohydrates. Explosions are very fast exothermic reactions.

**(i)** Use the collision theory to explain why the reaction between the particles of flour and the oxygen in the air is very fast.

.....

..... [2]

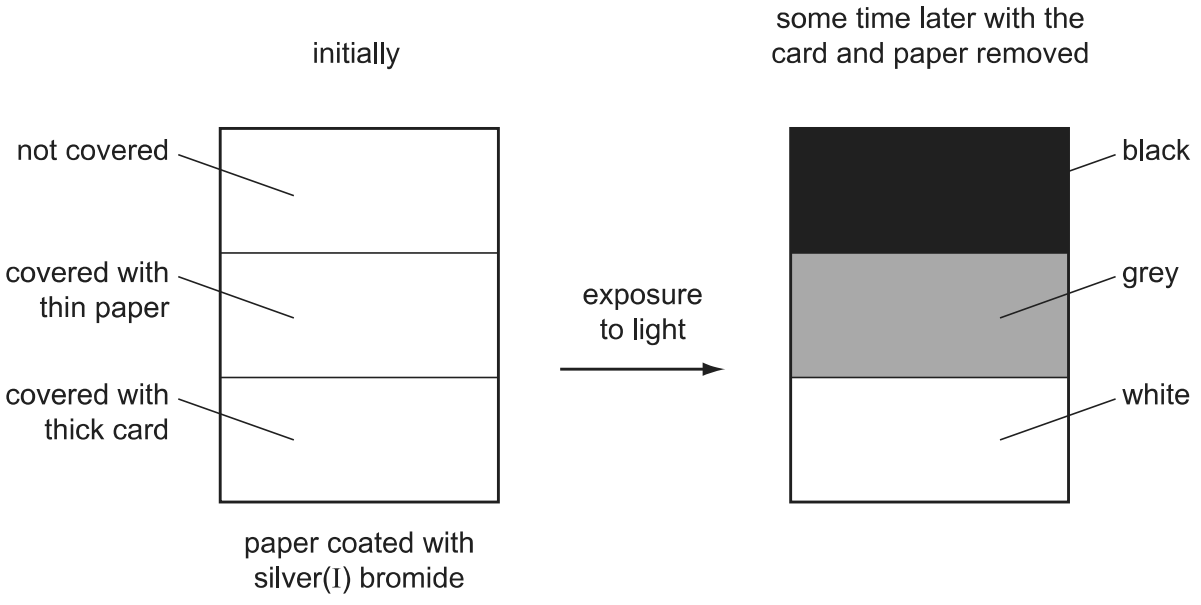
**(ii)** Write a word equation for this exothermic reaction.

..... [1]

The decomposition of silver(I) bromide is the basis of film photography. The equation for this decomposition is:

$$\underset{\text{white}}{2AgBr} \longrightarrow \underset{\text{black}}{2Ag} + Br_2$$

This reaction is photochemical.
A piece of white paper was coated with silver(I) bromide and the following experiment was carried out.




**(b)** Explain the results.

.....

.....

..... [3]

For Examiner's Use

**(c)** The fermentation of glucose is catalysed by enzymes from yeast. Yeast is added to aqueous glucose, the solution starts to bubble and becomes cloudy as more yeast cells are formed.

$$C_6H_{12}O_6(aq) \longrightarrow 2C_2H_5OH(aq) + 2CO_2(g)$$

The reaction is exothermic.

Eventually the fermentation stops when the concentration of ethanol is about 12%.

**(i)** What is an enzyme?

.....

[1]

**(ii)** Pasteur said that fermentation was respiration in the absence of air. Suggest a definition of *respiration*.

.....

.....

[2]

**(iii)** On a large scale, the reaction mixture is cooled. Suggest a reason why this is necessary.

.....

[1]

**(iv)** Why does the fermentation stop? Suggest **two** reasons.

.....

.....

[2]

**(v)** When the fermentation stops, there is a mixture of dilute aqueous ethanol and yeast. Suggest a technique which could be used to remove the cloudiness due to the yeast.

.....

[1]

Name a technique which will separate the ethanol from the ethanol/water mixture.

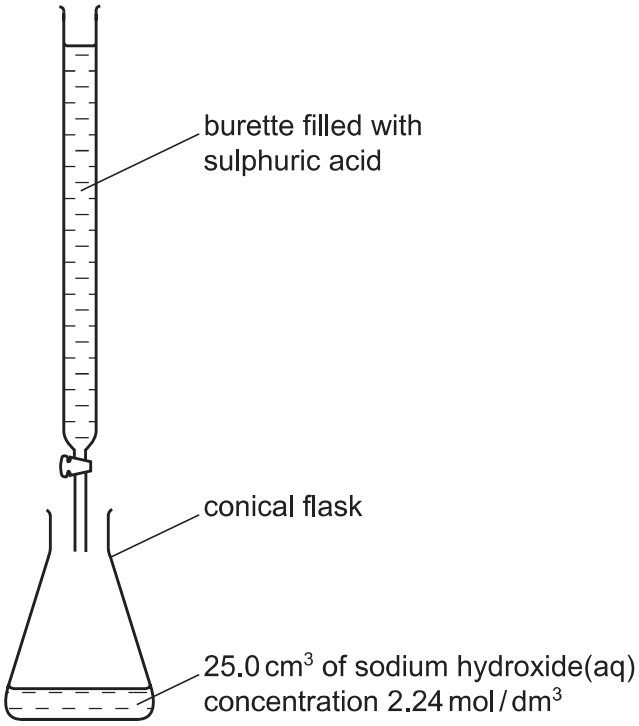
.....

[1]

[Total: 14]

**7** Crystals of sodium sulphate-10-water, $Na_2SO_4.10H_2O$, are prepared by titration.

*For Examiner's Use*




**(a)** 25.0 $cm^3$ of aqueous sodium hydroxide is pipetted into a conical flask. A few drops of an indicator are added. Using a burette, dilute sulphuric acid is slowly added until the indicator just changes colour. The volume of acid needed to neutralise the alkali is noted.

Suggest how you would continue the experiment to obtain pure, dry crystals of sodium sulphate-10-water.

.....

.....

.....

..... [4]

**(b)** Using 25.0 $cm^3$ of aqueous sodium hydroxide, 2.24 mol / $dm^3$, 3.86 g of crystals were obtained. Calculate the percentage yield.

$$2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O$$

$$Na_2SO_4 + 10H_2O \longrightarrow Na_2SO_4.10H_2O$$

Number of moles of NaOH used = .....

Maximum number of moles of $Na_2SO_4.10H_2O$ that could be formed = .....

Mass of one mole of $Na_2SO_4.10H_2O$ = 322 g

Maximum yield of sodium sulphate-10-water = ..... g

Percentage yield = ..... % [4]

[Total: 8]

For Examiner's Use

**8** Large areas of the Amazon rain forest are cleared each year to grow soya beans. The trees are cut down and burnt.

**(a)** Why do these activities increase the percentage of carbon dioxide in the atmosphere?

.....

..... [2]

**(b)** Soya beans contain all three main food groups. Two of which are protein and carbohydrate.

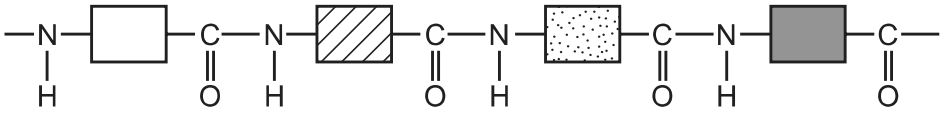
**(i)** What is the third group?

..... [1]

**(ii)** Draw the structural formula of a complex carbohydrate such as starch.

[3]

**(iii)** Compare the structure of a protein with that of a synthetic polyamide. The structure of a typical protein is given below.



How are they similar?

.....

How are they different?

.....

..... [3]

[Total: 9]

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# 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 Aluminium 13 | 28 Si Silicon 14 | 31 P Phosphorus 15 | 32 S Sulphur 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 = 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.).