



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

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CHEMISTRY

0620/33

Paper 3 (Extended)

May/June 2010

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 16.

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 | |
| 8 | |
| Total | |

This document consists of **13** printed pages and **3** blank pages.



- 1 For each of the following unfamiliar elements predict one physical and one chemical property.

(a) caesium (Cs)

physical property

chemical property

..... [2]

(b) vanadium (V)

physical property

chemical property

..... [2]

(c) fluorine (F)

physical property

chemical property

..... [2]

[Total: 6]

- 2 The hydrolysis of complex carbohydrates to simple sugars is catalysed by enzymes called carbohydrases and also by dilute acids.

(a) (i) They are both catalysts. How do enzymes differ from catalysts such as dilute acids?

..... [1]

(ii) Explain why ethanol, C_2H_6O , is not a carbohydrate but glucose, $C_6H_{12}O_6$, is a carbohydrate.

.....

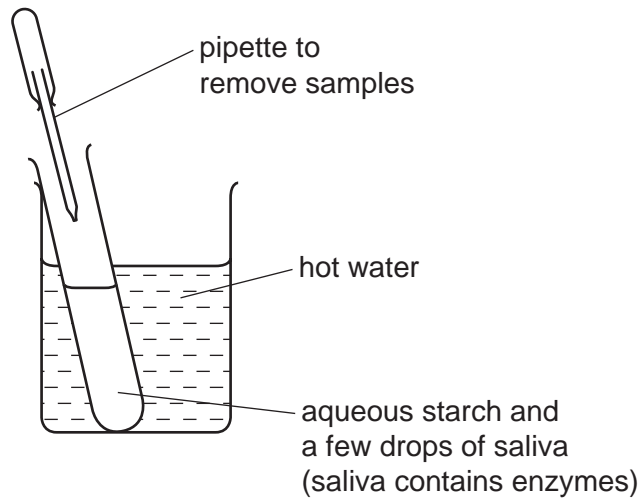
..... [2]

(b) Draw the structure of a complex carbohydrate, such as starch. The formula of a simple sugar can be represented by $HO-\square-OH$.

[3]

(c) Iodine reacts with starch to form a deep blue colour.

(i) In the experiment illustrated below, samples are removed at intervals and tested with iodine in potassium iodide solution.



Typical results of this experiment are shown in the table.

| time / min | colour of sample tested with iodine in potassium iodide solution |
|------------|--|
| 0 | deep blue |
| 10 | pale blue |
| 30 | colourless |

Explain these results.

.....

 [3]

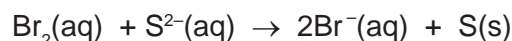
(ii) If the experiment was repeated at a higher temperature, 60 °C, all the samples stayed blue. Suggest an explanation.

..... [1]

[Total: 10]

3 The following are examples of redox reactions.

(a) Bromine water was added to aqueous sodium sulfide.



(i) Describe what you would observe when this reaction occurs.

.....
 [2]

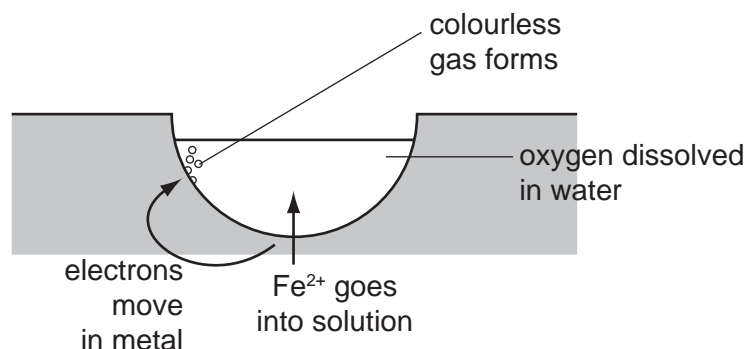
(ii) Write a symbol equation for this reaction.

..... [1]

(iii) Explain, in terms of electron transfer, why bromine is the oxidant (oxidising agent) in this reaction.

.....
 [2]

(b) Iron and steel in the presence of water and oxygen form rust.



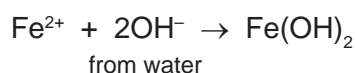
The reactions involved are:

reaction 1



The electrons move through the iron on to the surface where a colourless gas forms.

reaction 2



reaction 3

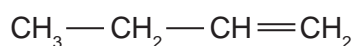


The water evaporates to leave rust.

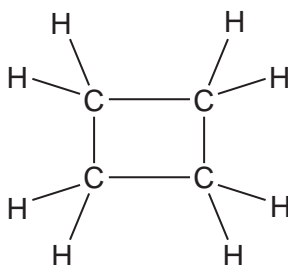
- (i) What type of reaction is **reaction 1**? [1]
- (ii) Deduce the name of the colourless gas mentioned in **reaction 1**.
..... [1]
- (iii) What is the name of the iron compound formed in **reaction 2**?
..... [1]
- (iv) Balance the equation for **reaction 3**.
..... $\text{Fe}(\text{OH})_2 + \text{O}_2 + \dots\dots\dots\text{H}_2\text{O} \rightarrow \dots\dots\dots\text{Fe}(\text{OH})_3$ [1]
- (v) Explain why the change $\text{Fe}(\text{OH})_2$ to $\text{Fe}(\text{OH})_3$ is oxidation.
.....
..... [1]
- (vi) Explain why iron in electrical contact with a piece of zinc does not rust.
.....
.....
..... [3]

[Total: 13]

- 4 But-1-ene is a typical alkene. It has the structural formula shown below.



The structural formula of cyclobutane is given below.



- (a) These two hydrocarbons are isomers.

- (i) Define the term *isomer*.

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

(ii) Draw the structural formula of another isomer of but-1-ene.

[1]

(iii) Describe a test which would distinguish between but-1-ene and cyclobutane.

reagent

result with but-1-ene

.....

result with cyclobutane

..... [3]

(b) Describe how alkenes, such as but-1-ene, can be made from alkanes.

.....

..... [2]

(c) Name the product formed when but-1-ene reacts with:

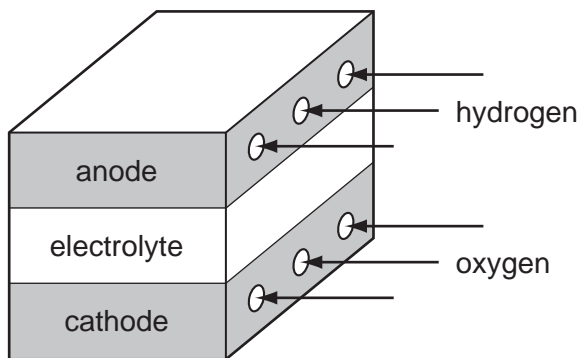
bromine, [1]

hydrogen, [1]

steam. [1]

[Total: 11]

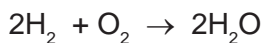
5 Fuel cells are used in spacecraft to produce electrical energy.



(a) How is oxygen obtained from liquid air?

.....
 [2]

(b) Hydrogen and oxygen react to form water.



(i) Give an example of bond breaking in the above reaction.

..... [1]

(ii) Give an example of bond forming in the above reaction.

..... [1]

(iii) Is the change given in (i) exothermic or endothermic?

..... [1]

(c) (i) Give **two** reasons why hydrogen may be considered to be the ideal fuel for the future.

.....

 [2]

(ii) Suggest a reason why hydrogen is not widely used at the moment.

.....
 [1]

[Total: 8]

6 Thallium is a metal in Group III. It has oxidation states of +1 and +3.

(a) Give the formula for the following thallium compounds.

(i) thallium(I) sulfide [1]

(ii) thallium(III) chloride [1]

(b) Thallium(I) chloride is insoluble in water. Complete the description of the preparation of a pure sample of this salt.

Step 1

Mix a solution of sodium chloride with thallium(I) sulfate solution. A white precipitate forms.

Step 2

..... [1]

Step 3

..... [1]

Step 4

..... [1]

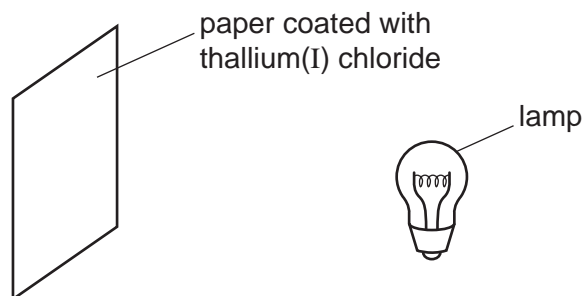
(c) When thallium(I) chloride is exposed to light, a photochemical reaction occurs. It changes from a white solid to a violet solid.

(i) Name another metal halide which changes colour when exposed to light. Give the major use of this metal halide.

name

use [2]

(ii) A piece of paper coated with thallium(I) chloride is exposed to a bright light.



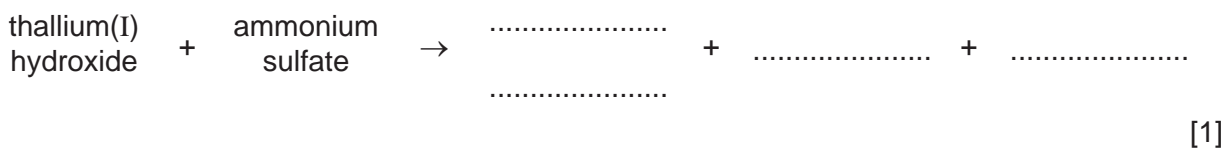
Suggest **two** ways of increasing the time it takes for the violet colour to appear.

.....

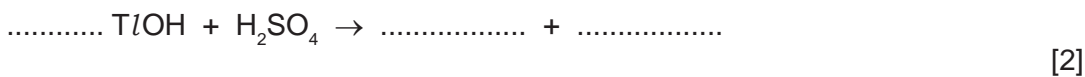
 [2]

(d) Thallium(I) hydroxide is an alkali. It has similar properties to sodium hydroxide.

(i) Complete the following word equation.



(ii) Complete the equation.



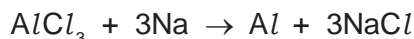
(iii) Aqueous thallium(I) hydroxide was added to aqueous iron(II) sulfate. Describe what you would see and complete the ionic equation for the reaction.

observation [1]



[Total: 14]

7 Aluminium was first isolated in 1827 using sodium.

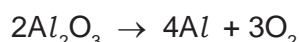


Aluminium, obtained by this method, was more expensive than gold.

(a) Suggest an explanation why aluminium was so expensive.

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

(b) The modern method for extracting aluminium is the electrolysis of a molten electrolyte, aluminium oxide dissolved in cryolite. The aluminium oxide decomposes.



Both electrodes are made of carbon.

(i) Give **two** reasons why the oxide is dissolved in cryolite.

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

(ii) Complete the ionic equation for the reaction at the anode.



(iii) Why do the carbon anodes need to be replaced frequently?

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

(c) The electrolysis of a molten electrolyte is one method of extracting a metal from its ore. Other methods are the electrolysis of an aqueous solution and the reduction of the oxide by carbon. Explain why these last two methods cannot be used to extract aluminium.

electrolysis of an aqueous solution

.....

using carbon

..... [2]

[Total: 8]

- 8 Nitrogen dioxide is a brown gas. It can be made by heating certain metal nitrates.



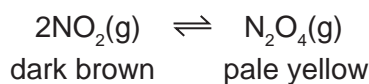
- (a) (i) Name another metal whose nitrate decomposes to give the metal oxide, nitrogen dioxide and oxygen.

..... [1]

- (ii) Complete the word equation for a metal whose nitrate does not give nitrogen dioxide on decomposition.

metal nitrate → + oxygen [1]

- (b) At most temperatures, samples of nitrogen dioxide are equilibrium mixtures.



- (i) At 25 °C, the mixture contains 20 % of nitrogen dioxide. At 100 °C this has risen to 90 %. Is the forward reaction exothermic or endothermic? Give a reason for your choice.

.....

 [2]

- (ii) Explain why the colour of the equilibrium mixture becomes lighter when the pressure on the mixture is increased.

.....

 [2]

- (c) A 5.00g sample of impure lead(II) nitrate was heated. The volume of oxygen formed was 0.16 dm³ measured at r.t.p. The impurities did not decompose. Calculate the percentage of lead(II) nitrate in the sample.



Number of moles of O₂ formed =

Number of moles of Pb(NO₃)₂ in the sample =

Mass of one mole of Pb(NO₃)₂ = 331 g

Mass of lead(II) nitrate in the sample = g

Percentage of lead(II) nitrate in sample =

[4]

[Total: 10]

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DATA SHEET
The Periodic Table of the Elements

| | | Group | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| I | II | III | IV | V | VI | VII | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 Li Lithium 3 | 9 Be Beryllium 4 | 1 H Hydrogen 1 | 11 B Boron 5 | 12 C Carbon 6 | 13 Al Aluminium 13 | 14 N Nitrogen 7 | 15 O Oxygen 8 | 16 F Fluorine 9 | 17 Ne Neon 10 | 18 Ar Argon 18 | 19 K Potassium 19 | 20 Ca Calcium 20 | 21 Sc Scandium 21 | 22 Ti Titanium 22 | 23 V Vanadium 23 | 24 Cr Chromium 24 | 25 Mn Manganese 25 | 26 Fe Iron 26 | 27 Co Cobalt 27 | 28 Ni Nickel 28 | 29 Cu Copper 29 | 30 Zn Zinc 30 | 31 Ga Gallium 31 | 32 Ge Germanium 32 | 33 As Arsenic 33 | 34 Se Selenium 34 | 35 Br Bromine 35 | 36 Kr Krypton 36 | 37 Rb Rubidium 37 | 38 Sr Strontium 38 | 39 Y Yttrium 39 | 40 Zr Zirconium 40 | 41 Nb Niobium 41 | 42 Mo Molybdenum 42 | 43 Tc Technetium 43 | 44 Ru Ruthenium 44 | 45 Rh Rhodium 45 | 46 Pd Palladium 46 | 47 Ag Silver 47 | 48 Cd Cadmium 48 | 49 In Indium 49 | 50 Sn Tin 50 | 51 Sb Antimony 51 | 52 Te Tellurium 52 | 53 I Iodine 53 | 54 Xe Xenon 54 | 55 Cs Caesium 55 | 56 Ba Barium 56 | 57 La Lanthanum 57 | 72 Hf Hafnium 72 | 73 Ta Tantalum 73 | 74 W Tungsten 74 | 75 Re Rhenium 75 | 76 Os Osmium 76 | 77 Ir Iridium 77 | 78 Pt Platinum 78 | 79 Au Gold 79 | 80 Hg Mercury 80 | 81 Tl Thallium 81 | 82 Pb Lead 82 | 83 Bi Bismuth 83 | 84 Po Polonium 84 | 85 At Astatine 85 | 86 Rn Radon 86 | 87 Fr Francium 87 | 88 Ra Radium 88 | 89 Ac Actinium 89 | 90 Th Thorium 90 | 91 Pa Protactinium 91 | 92 U Uranium 92 | 93 Np Neptunium 93 | 94 Pu Plutonium 94 | 95 Am Americium 95 | 96 Cm Curium 96 | 97 Bk Berkelium 97 | 98 Cf Californium 98 | 99 Es Einsteinium 99 | 100 Fm Fermium 100 | 101 Md Mendelevium 101 | 102 No Nobelium 102 | 103 Lr Lawrencium 103 | 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 | 212 Po Polonium 84 | 214 At Astatine 85 | 216 Rn Radon 86 | 226 Ra Radium 88 | 227 Ac Actinium 89 | 232 Th Thorium 90 | 238 U Uranium 92 | 238 Np Neptunium 93 | 238 Pu Plutonium 94 | 238 Am Americium 95 | 238 Cm Curium 96 | 238 Bk Berkelium 97 | 238 Cf Californium 98 | 238 Es Einsteinium 99 | 238 Fm Fermium 100 | 238 Md Mendelevium 101 | 238 No Nobelium 102 | 238 Lr Lawrencium 103 | 140 Ce Cerium 58 | 141 Pr Praseodymium 59 | 144 Nd Neodymium 60 | 146 Pm Promethium 61 | 150 Sm Samarium 62 | 152 Eu Europium 63 | 157 Gd Gadolinium 64 | 162 Dy Dysprosium 66 | 165 Ho Holmium 67 | 167 Er Erbium 68 | 169 Tm Thulium 69 | 173 Yb Ytterbium 70 | 175 Lu Lutetium 71 |

*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 dm³ at room temperature and pressure (r.t.p.).

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