



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
International General Certificate of Secondary Education

CANDIDATE  
NAME

CENTRE  
NUMBER

--	--	--	--	--

CANDIDATE  
NUMBER

--	--	--	--



\* 7 9 5 3 7 6 7 0 7 \*

**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	
<b>Total</b>	

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.

.....

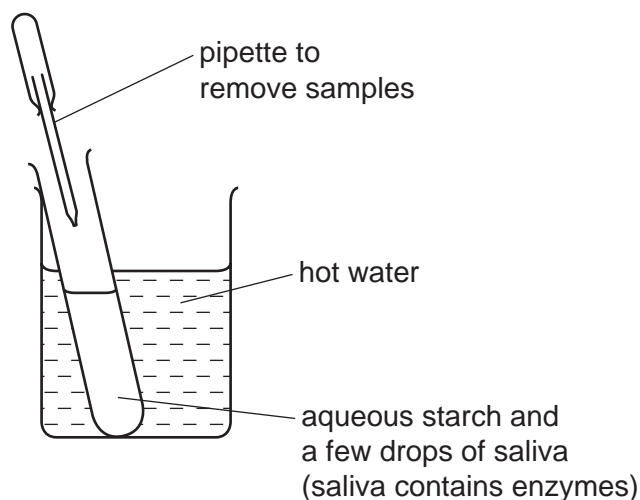
..... [2]

(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]

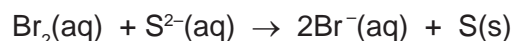
(ii) If the experiment was repeated at a higher temperature, 60 °C, all the samples stayed blue. Suggest an explanation.

..... [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]

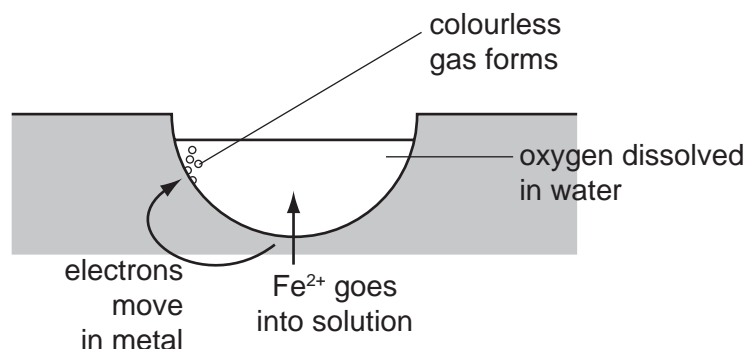
(ii) Write a symbol equation for this reaction.

..... [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.



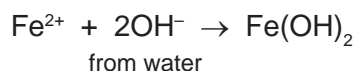
The reactions involved are:

**reaction 1**



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

**reaction 2**



**reaction 3**

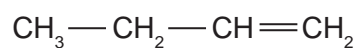


The water evaporates to leave rust.

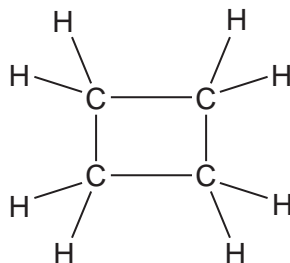
- (i) What type of reaction is **reaction 1**? ..... [1]
- (ii) Deduce the name of the colourless gas mentioned in **reaction 1**.  
..... [1]
- (iii) What is the name of the iron compound formed in **reaction 2**?  
..... [1]
- (iv) Balance the equation for **reaction 3**.  
..... $\text{Fe}(\text{OH})_2 + \text{O}_2 + \text{.....H}_2\text{O} \rightarrow \text{.....Fe}(\text{OH})_3$  [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]

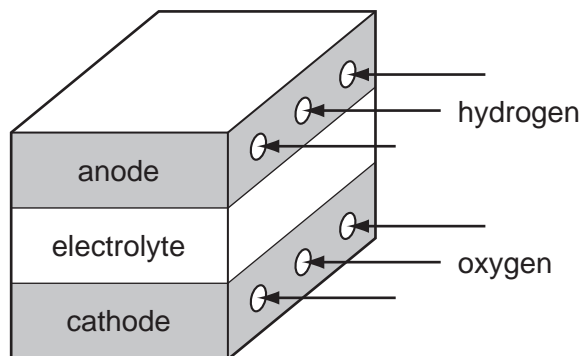
hydrogen, ..... [1]

steam. .... [1]

[Total: 11]

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

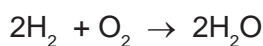
For  
Examiner's  
Use



- (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.

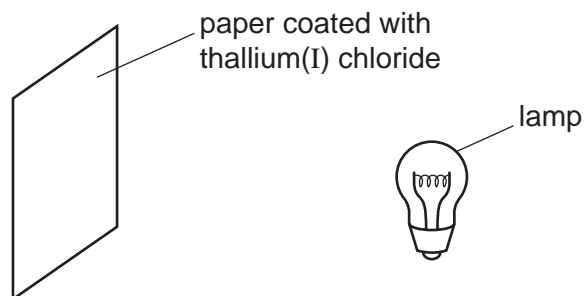
(i) Name another metal halide which changes colour when exposed to light. Give the major use of this metal halide.

name .....

use ..... [2]



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

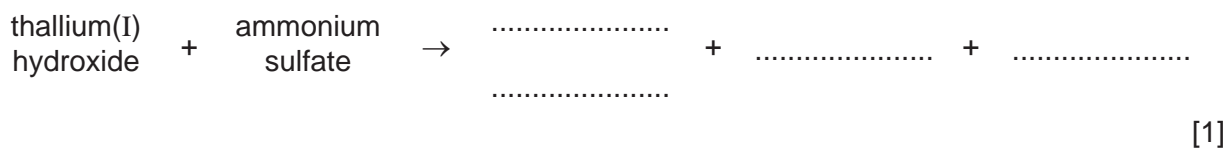


Suggest **two** ways of increasing the time it takes for the violet colour to appear.

.....  
 .....  
 ..... [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.



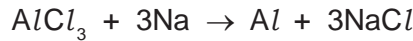
- (iii) Aqueous thallium(I) hydroxide was added to aqueous iron(II) sulfate. Describe what you would see and complete the ionic equation for the reaction.

observation ..... [1]



[Total: 14]

7 Aluminium was first isolated in 1827 using sodium.

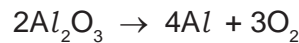


Aluminium, obtained by this method, was more expensive than gold.

(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.



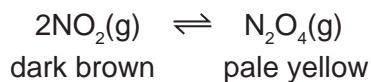
- (a) (i) Name another metal whose nitrate decomposes to give the metal oxide, nitrogen dioxide and oxygen.

..... [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 5.00 g sample of impure lead(II) nitrate was heated. The volume of oxygen formed was 0.16 dm<sup>3</sup> measured at r.t.p. The impurities did not decompose. Calculate the percentage of lead(II) nitrate in the sample.



Number of moles of O<sub>2</sub> formed = .....

Number of moles of Pb(NO<sub>3</sub>)<sub>2</sub> in the sample = .....

Mass of one mole of Pb(NO<sub>3</sub>)<sub>2</sub> = 331 g

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

Percentage of lead(II) nitrate in sample = .....

[4]

[Total: 10]







**DATA SHEET**  
**The Periodic Table of the Elements**

		Group																																																																														
I	II	III	IV	V	VI	VII	0																																																																									
		1 <b>H</b> Hydrogen 1					4 <b>He</b> Helium 2																																																																									
7 <b>Li</b> Lithium 3	9 <b>Be</b> Beryllium 4		11 <b>B</b> Boron 5	12 <b>C</b> Carbon 6	13 <b>Al</b> Aluminium 13	14 <b>Si</b> Silicon 14	15 <b>P</b> Phosphorus 15	16 <b>S</b> Sulfur 16	17 <b>Cl</b> Chlorine 17	18 <b>Ar</b> Argon 18	19 <b>F</b> Fluorine 9	20 <b>Ne</b> Neon 10																																																																				
23 <b>Na</b> Sodium 11	24 <b>Mg</b> Magnesium 12		27 <b>Al</b> Aluminium 13	28 <b>Si</b> Silicon 14	29 <b>Co</b> Cobalt 27	30 <b>Zn</b> Zinc 30	31 <b>Ga</b> Gallium 31	32 <b>Ge</b> Germanium 32	33 <b>As</b> Arsenic 33	34 <b>Se</b> Selenium 34	35 <b>Br</b> Bromine 35	36 <b>Kr</b> Krypton 36																																																																				
39 <b>K</b> Potassium 19	40 <b>Ca</b> Calcium 20		48 <b>Ti</b> Titanium 22	51 <b>V</b> Vanadium 23	55 <b>Mn</b> Manganese 25	56 <b>Fe</b> Iron 26	59 <b>Ni</b> Nickel 28	64 <b>Cu</b> Copper 29	65 <b>Zn</b> Zinc 30	70 <b>Ga</b> Gallium 31	73 <b>Ge</b> Germanium 32	75 <b>As</b> Arsenic 33	79 <b>Se</b> Selenium 34	84 <b>Kr</b> Krypton 36																																																																		
85 <b>Rb</b> Rubidium 37	88 <b>Sr</b> Strontium 38		91 <b>Zr</b> Zirconium 40	93 <b>Nb</b> Niobium 41	96 <b>Mo</b> Molybdenum 42	101 <b>Ru</b> Ruthenium 44	103 <b>Rh</b> Rhodium 45	106 <b>Pd</b> Palladium 46	108 <b>Ag</b> Silver 47	112 <b>Cd</b> Cadmium 48	115 <b>In</b> Indium 49	122 <b>Sb</b> Antimony 51	128 <b>Te</b> Tellurium 52	131 <b>Xe</b> Xenon 54																																																																		
133 <b>Cs</b> Caesium 55	137 <b>Ba</b> Barium 56		178 <b>Hf</b> Hafnium 72	181 <b>Ta</b> Tantalum 73	184 <b>W</b> Tungsten 74	190 <b>Os</b> Osmium 76	192 <b>Ir</b> Iridium 77	195 <b>Pt</b> Platinum 78	197 <b>Au</b> Gold 79	201 <b>Hg</b> Mercury 80	204 <b>Tl</b> Thallium 81	209 <b>Pb</b> Lead 82	210 <b>Po</b> Polonium 84	210 <b>Rn</b> Radon 86																																																																		
87 <b>Fr</b> Francium	226 <b>Ra</b> Radium		227 <b>Ac</b> Actinium																																																																													
													*58-71 Lanthanoid series †90-103 Actinoid series																																																																			
													<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="padding: 2px;">a</td> <td style="padding: 2px;"><b>X</b></td> </tr> <tr> <td style="padding: 2px;">b</td> <td style="padding: 2px;"></td> </tr> </table>		a	<b>X</b>	b																																																															
a	<b>X</b>																																																																															
b																																																																																
													<p>a = relative atomic mass  <b>X</b> = atomic symbol  b = proton (atomic) number</p>																																																																			
													<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="padding: 2px;">140</td> <td style="padding: 2px;"><b>Ce</b> Cerium 58</td> <td style="padding: 2px;">141</td> <td style="padding: 2px;"><b>Pr</b> Praseodymium 59</td> <td style="padding: 2px;">144</td> <td style="padding: 2px;"><b>Nd</b> Neodymium 60</td> <td style="padding: 2px;">150</td> <td style="padding: 2px;"><b>Sm</b> Samarium 62</td> <td style="padding: 2px;">152</td> <td style="padding: 2px;"><b>Eu</b> Europium 63</td> <td style="padding: 2px;">157</td> <td style="padding: 2px;"><b>Gd</b> Gadolinium 64</td> <td style="padding: 2px;">162</td> <td style="padding: 2px;"><b>Dy</b> Dysprosium 66</td> <td style="padding: 2px;">165</td> <td style="padding: 2px;"><b>Ho</b> Holmium 67</td> <td style="padding: 2px;">169</td> <td style="padding: 2px;"><b>Tm</b> Thulium 69</td> <td style="padding: 2px;">173</td> <td style="padding: 2px;"><b>Yb</b> Ytterbium 70</td> <td style="padding: 2px;">175</td> <td style="padding: 2px;"><b>Lu</b> Lutetium 71</td> </tr> <tr> <td style="padding: 2px;">232</td> <td style="padding: 2px;"><b>Th</b> Thorium 90</td> <td style="padding: 2px;">238</td> <td style="padding: 2px;"><b>U</b> Uranium 92</td> <td style="padding: 2px;">238</td> <td style="padding: 2px;"><b>Pa</b> Protactinium 91</td> <td style="padding: 2px;">150</td> <td style="padding: 2px;"><b>Sm</b> Samarium 62</td> <td style="padding: 2px;">152</td> <td style="padding: 2px;"><b>Eu</b> Europium 63</td> <td style="padding: 2px;">157</td> <td style="padding: 2px;"><b>Gd</b> Gadolinium 64</td> <td style="padding: 2px;">162</td> <td style="padding: 2px;"><b>Dy</b> Dysprosium 66</td> <td style="padding: 2px;">165</td> <td style="padding: 2px;"><b>Ho</b> Holmium 67</td> <td style="padding: 2px;">169</td> <td style="padding: 2px;"><b>Tm</b> Thulium 69</td> <td style="padding: 2px;">173</td> <td style="padding: 2px;"><b>Yb</b> Ytterbium 70</td> <td style="padding: 2px;">175</td> <td style="padding: 2px;"><b>Lu</b> Lutetium 71</td> </tr> <tr> <td style="padding: 2px;"></td> <td style="padding: 2px;"><b>Fr</b> Francium</td> <td style="padding: 2px;"></td> <td style="padding: 2px;"><b>Ac</b> Actinium</td> <td style="padding: 2px;"></td> <td style="padding: 2px;"></td> <td style="padding: 2px;"></td> <td style="padding: 2px;"></td> <td style="padding: 2px;"></td> <td style="padding: 2px;"></td> <td style="padding: 2px;"></td> <td style="padding: 2px;"></td> <td style="padding: 2px;"></td> <td style="padding: 2px;"></td> <td style="padding: 2px;"></td> <td style="padding: 2px;"></td> <td style="padding: 2px;"></td> <td style="padding: 2px;"></td> <td style="padding: 2px;"></td> <td style="padding: 2px;"></td> <td style="padding: 2px;"></td> <td style="padding: 2px;"></td> </tr> </table>		140	<b>Ce</b> Cerium 58	141	<b>Pr</b> Praseodymium 59	144	<b>Nd</b> Neodymium 60	150	<b>Sm</b> Samarium 62	152	<b>Eu</b> Europium 63	157	<b>Gd</b> Gadolinium 64	162	<b>Dy</b> Dysprosium 66	165	<b>Ho</b> Holmium 67	169	<b>Tm</b> Thulium 69	173	<b>Yb</b> Ytterbium 70	175	<b>Lu</b> Lutetium 71	232	<b>Th</b> Thorium 90	238	<b>U</b> Uranium 92	238	<b>Pa</b> Protactinium 91	150	<b>Sm</b> Samarium 62	152	<b>Eu</b> Europium 63	157	<b>Gd</b> Gadolinium 64	162	<b>Dy</b> Dysprosium 66	165	<b>Ho</b> Holmium 67	169	<b>Tm</b> Thulium 69	173	<b>Yb</b> Ytterbium 70	175	<b>Lu</b> Lutetium 71		<b>Fr</b> Francium		<b>Ac</b> Actinium																		
140	<b>Ce</b> Cerium 58	141	<b>Pr</b> Praseodymium 59	144	<b>Nd</b> Neodymium 60	150	<b>Sm</b> Samarium 62	152	<b>Eu</b> Europium 63	157	<b>Gd</b> Gadolinium 64	162	<b>Dy</b> Dysprosium 66	165	<b>Ho</b> Holmium 67	169	<b>Tm</b> Thulium 69	173	<b>Yb</b> Ytterbium 70	175	<b>Lu</b> Lutetium 71																																																											
232	<b>Th</b> Thorium 90	238	<b>U</b> Uranium 92	238	<b>Pa</b> Protactinium 91	150	<b>Sm</b> Samarium 62	152	<b>Eu</b> Europium 63	157	<b>Gd</b> Gadolinium 64	162	<b>Dy</b> Dysprosium 66	165	<b>Ho</b> Holmium 67	169	<b>Tm</b> Thulium 69	173	<b>Yb</b> Ytterbium 70	175	<b>Lu</b> Lutetium 71																																																											
	<b>Fr</b> Francium		<b>Ac</b> Actinium																																																																													

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

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included the publisher will be pleased to make amends at the earliest possible opportunity.

University of Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.