



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
International General Certificate of Secondary Education

CANDIDATE  
NAME

CENTRE  
NUMBER

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CANDIDATE  
NUMBER

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**CHEMISTRY**

**0620/32**

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.

.....

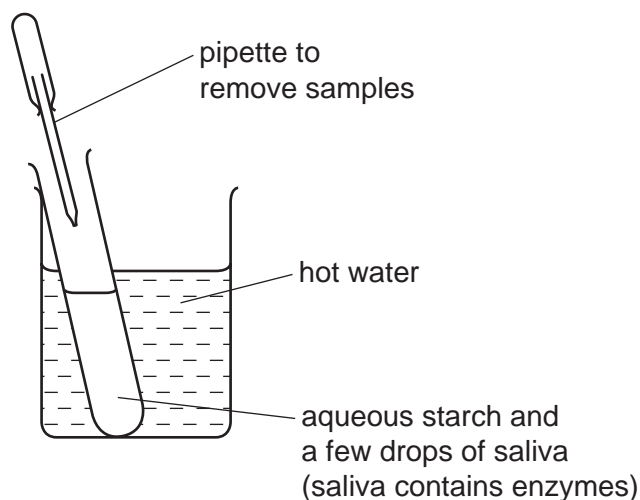
..... [2]

(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]

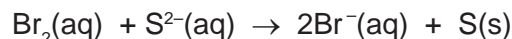
(ii) If the experiment was repeated at a higher temperature, 60 °C, all the samples stayed blue. Suggest an explanation.

..... [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]

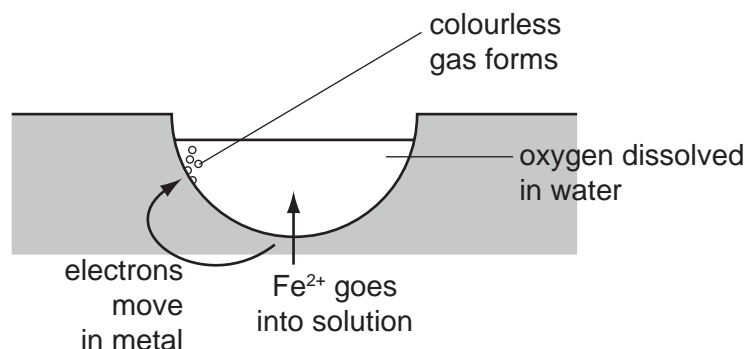
(ii) Write a symbol equation for this reaction.

..... [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.



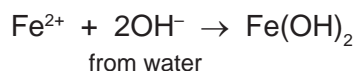
The reactions involved are:

**reaction 1**



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

**reaction 2**



**reaction 3**

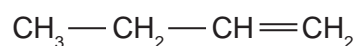


The water evaporates to leave rust.

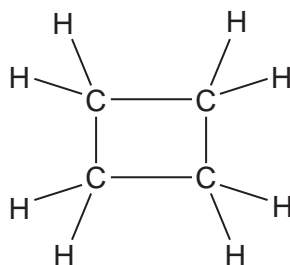
- (i) What type of reaction is **reaction 1**? ..... [1]
- (ii) Deduce the name of the colourless gas mentioned in **reaction 1**.  
..... [1]
- (iii) What is the name of the iron compound formed in **reaction 2**?  
..... [1]
- (iv) Balance the equation for **reaction 3**.  
..... $\text{Fe}(\text{OH})_2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

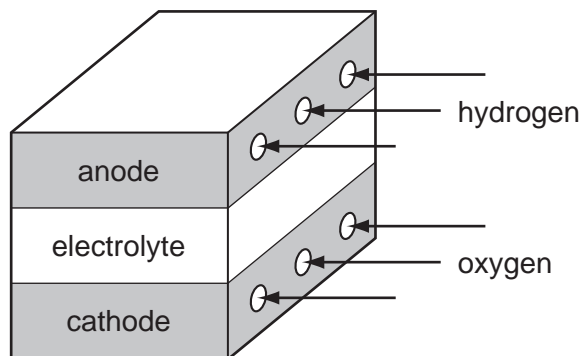
hydrogen, ..... [1]

steam. .... [1]

[Total: 11]

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

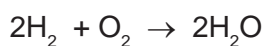
For  
Examiner's  
Use



- (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.

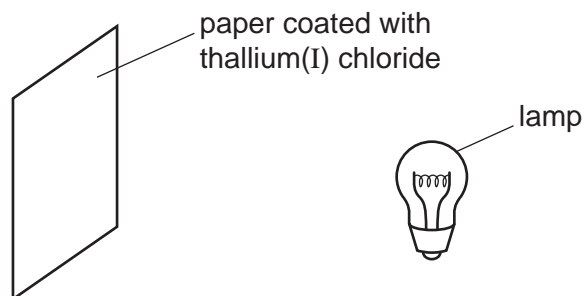
(i) Name another metal halide which changes colour when exposed to light. Give the major use of this metal halide.

name .....

use ..... [2]



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

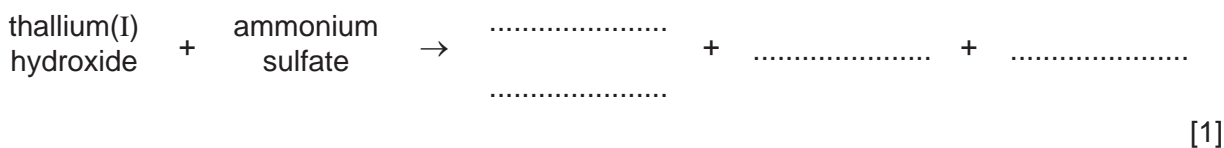


Suggest **two** ways of increasing the time it takes for the violet colour to appear.

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



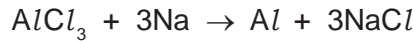
- (iii) Aqueous thallium(I) hydroxide was added to aqueous iron(II) sulfate. Describe what you would see and complete the ionic equation for the reaction.

observation ..... [1]



[Total: 14]

7 Aluminium was first isolated in 1827 using sodium.

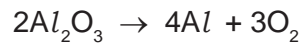


Aluminium, obtained by this method, was more expensive than gold.

(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.



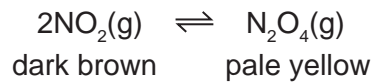
- (a) (i) Name another metal whose nitrate decomposes to give the metal oxide, nitrogen dioxide and oxygen.

..... [1]

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

metal nitrate  $\rightarrow$  ..... + 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					0																																																											
		1 <b>H</b> Hydrogen 1									2 <b>He</b> Helium 2																																																												
3 7 <b>Li</b> Lithium 4	4 9 <b>Be</b> Beryllium 4											5 11 <b>B</b> Boron 5																																																											
11 23 <b>Na</b> Sodium 12	12 24 <b>Mg</b> Magnesium 12	13 27 <b>Al</b> Aluminium 13	14 28 <b>Si</b> Silicon 14	15 31 <b>P</b> Phosphorus 15	16 32 <b>S</b> Sulfur 16	17 35.5 <b>Cl</b> Chlorine 17	18 40 <b>Ar</b> Argon 18					19 39.9 <b>K</b> Potassium 19																																																											
19 39 <b>K</b> Potassium 19	20 40 <b>Ca</b> Calcium 20	21 45 <b>Sc</b> Scandium 21	22 48 <b>Ti</b> Titanium 22	23 51 <b>V</b> Vanadium 23	24 52 <b>Cr</b> Chromium 24	25 55 <b>Mn</b> Manganese 25	26 56 <b>Fe</b> Iron 26	27 59 <b>Co</b> Cobalt 27	28 59 <b>Ni</b> Nickel 28	29 64 <b>Cu</b> Copper 29	30 65 <b>Zn</b> Zinc 30	31 70 <b>Ga</b> Gallium 31	32 73 <b>Ge</b> Germanium 32	33 75 <b>As</b> Arsenic 33	34 79 <b>Se</b> Selenium 34	35 80 <b>Br</b> Bromine 35	36 84 <b>Kr</b> Krypton 36	37 85 <b>Rb</b> Rubidium 37	38 88 <b>Sr</b> Strontium 38	39 89 <b>Y</b> Yttrium 39	40 91 <b>Zr</b> Zirconium 40	41 93 <b>Nb</b> Niobium 41	42 96 <b>Mo</b> Molybdenum 42	43 101 <b>Ru</b> Ruthenium 44	44 103 <b>Rh</b> Rhodium 45	45 106 <b>Pd</b> Palladium 46	46 108 <b>Ag</b> Silver 47	47 112 <b>Cd</b> Cadmium 48	48 115 <b>In</b> Indium 49	49 119 <b>Sn</b> Tin 50	50 122 <b>Sb</b> Antimony 51	51 127 <b>I</b> Iodine 53	52 128 <b>Te</b> Tellurium 52	53 131 <b>Xe</b> Xenon 54	54 133 <b>Cs</b> Caesium 55	55 137 <b>Ba</b> Barium 56	56 139 <b>La</b> Lanthanum 57	57 178 <b>Hf</b> Hafnium 72	72 181 <b>Ta</b> Tantalum 73	73 184 <b>W</b> Tungsten 74	74 186 <b>Re</b> Rhenium 75	75 190 <b>Os</b> Osmium 76	76 192 <b>Ir</b> Iridium 77	77 195 <b>Pt</b> Platinum 78	78 197 <b>Au</b> Gold 79	79 201 <b>Hg</b> Mercury 80	80 204 <b>Tl</b> Thallium 81	81 207 <b>Pb</b> Lead 82	82 209 <b>Bi</b> Bismuth 83	83 210 <b>Po</b> Polonium 84	84 210 <b>At</b> Astatine 85	85 222 <b>Rn</b> Radon 86	86 226 <b>Fr</b> Francium 87	87 226 <b>Ra</b> Radium 88	88 227 <b>Ac</b> Actinium 89	89 227 <b>Th</b> Thorium 90	90 232 <b>Pa</b> Protactinium 91	91 141 <b>Pr</b> Praseodymium 59	92 144 <b>Nd</b> Neodymium 60	93 150 <b>Pm</b> Promethium 61	94 150 <b>Sm</b> Samarium 62	95 152 <b>Eu</b> Europium 63	96 157 <b>Gd</b> Gadolinium 64	97 159 <b>Tb</b> Terbium 65	98 162 <b>Dy</b> Dysprosium 66	99 165 <b>Ho</b> Holmium 67	100 167 <b>Er</b> Erbium 68	101 169 <b>Tm</b> Thulium 69	102 173 <b>Yb</b> Ytterbium 70	103 175 <b>Lu</b> Lutetium 71	104 175 <b>Lr</b> Lawrencium 103

\*58-71 Lanthanoid series  
†90-103 Actinoid series

a	<b>X</b>
b	

Key  
a = relative atomic mass  
X = atomic symbol  
b = proton (atomic) number

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

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