



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--



CHEMISTRY

0620/33

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 11 printed pages and 1 blank page.



1 Use your copy of the Periodic Table to answer these questions.

(a) Choose an element from the Periodic Table to match each description.
You may give either the name or the symbol.

- (i) It is the most reactive metal. [1]
- (ii) It is the only non-metal which is a liquid at r.t.p.. [1]
- (iii) An isotope of this element is used as a fuel in nuclear reactors. [1]
- (iv) This Group VII element is a solid at r.t.p.. [1]
- (v) This element is in Group V and Period 4. [1]
- (vi) This unreactive gas is used to fill lamps. [1]

(b) Predict the formula of each of the following compounds.

- (i) germanium oxide [1]
- (ii) tellurium bromide [2]

(c) Give the formula of each of the following ions.

- (i) strontium [1]
- (ii) fluoride [2]

[Total: 10]

2 Starch, a complex carbohydrate, is a natural macromolecule or polymer. It can be formed from its monomer by condensation polymerisation.

(a) (i) Explain the terms:

monomer

.....

condensation polymerisation

..... [2]

(ii) Draw the structural formula of starch to include three monomer units.

Glucose, the monomer, can be represented as HO——OH .

[3]

(b) Starch can be hydrolysed to simple sugars by heating with dilute sulfuric acid or by warming with a dilute solution of saliva. The reaction can be catalysed by H⁺ ions from the acid or by the enzymes in saliva.

(i) What is an enzyme?

..... [1]

(ii) Explain why, if the saliva/starch mixture is heated above 70 °C, the hydrolysis stops.

..... [1]

(iii) The complete acid-catalysed hydrolysis of starch forms only glucose. The partial acid-catalysed hydrolysis of starch forms a mixture of sugars which includes glucose. Describe how you could identify the different sugars in this mixture.

.....

.....

..... [3]

[Total: 10]

- 3** Fertilisers are used to promote plant growth. Two fertilisers are ammonium phosphate, $(\text{NH}_4)_3\text{PO}_4$, and calcium dihydrogenphosphate, $\text{Ca}(\text{H}_2\text{PO}_4)_2$.

(a) Describe a test to distinguish between these two fertilisers.

test
..... [2]

result
..... [1]

(b) Many fertilisers are manufactured from ammonia. Describe how ammonia is made in the Haber process. Give the essential conditions and an equation for the process.

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

(c) State the essential plant nutrient not supplied by ammonium phosphate.

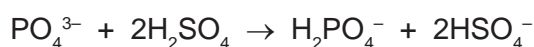
..... [1]

(d) The soluble compound, calcium dihydrogenphosphate is made by heating the insoluble mineral rock phosphate, $\text{Ca}_3(\text{PO}_4)_2$, with sulfuric acid.

(i) Why would rock phosphate not be effective as a fertiliser?

..... [1]

(ii) The phosphate ion, PO_4^{3-} , from the rock phosphate is changed into the dihydrogenphosphate ion, H_2PO_4^- .



What type of reagent is the phosphate ion? Give a reason for your choice.

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

(e) The extensive use of fertilisers and possibly the effect of acid rain tend to increase the acidity of the soil. State why it is necessary to control soil acidity and explain how this can be done.

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

[Total: 13]

4 (a) Steel rusting is an example of an oxidation reaction.

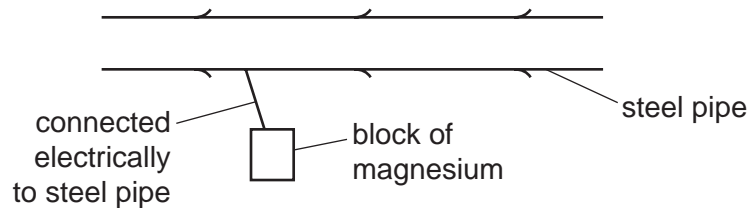
(i) Define the term *steel*.

.....
 [2]

(ii) Define oxidation in terms of electron transfer.

..... [1]

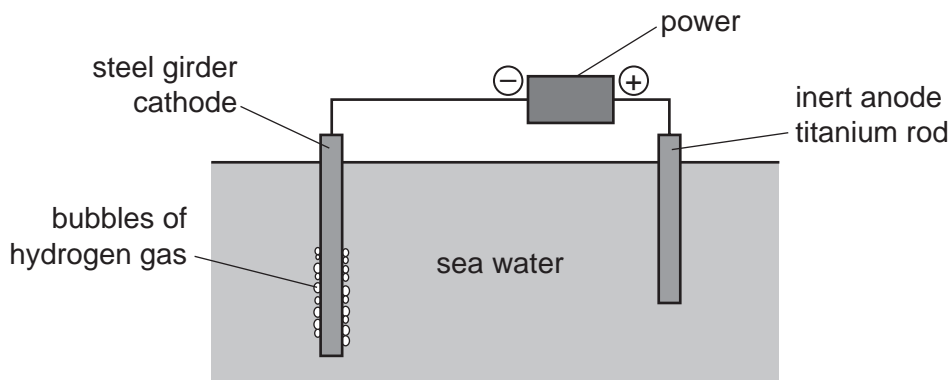
(b) A method of preventing steel rusting is sacrificial protection.



Give an explanation, in terms of electron transfer, why the steel does not rust.

.....
 [2]

(c) Another method of preventing steel rusting is cathodic protection.



(i) Write an equation for the formation of the gas given off at the steel cathode during cathodic protection.

..... [2]

(ii) Give **one** difference between the two methods.

.....
 [2]

[Total: 9]

5 The reactions in this question are all examples of photochemical reactions.

(a) Explain the phrase *photochemical reaction*.

.....
 [2]

(b) Many millions of years ago, the Earth's atmosphere was rich in carbon dioxide and contained negligible amounts of oxygen. After the appearance of green plant-like bacteria, the proportions of these two gases in the atmosphere changed.

(i) What are the approximate percentages of these two gases in the atmosphere now?

carbon dioxide = [1]

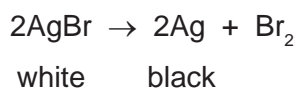
oxygen = [1]

(ii) Explain how the green plant-like bacteria changed the composition of the atmosphere.

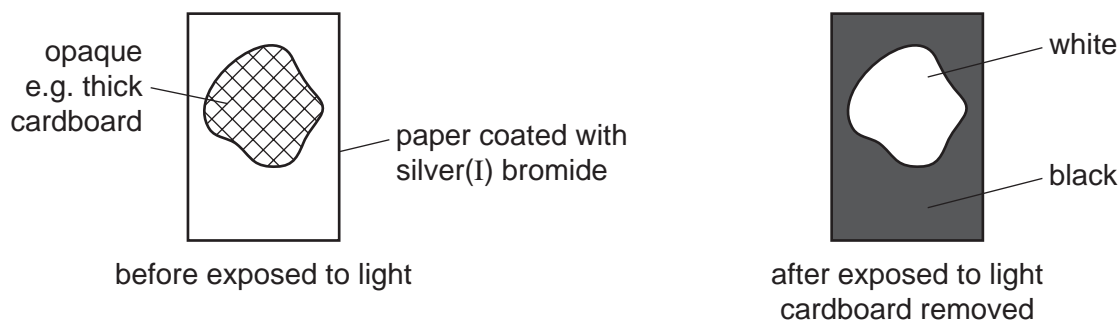
.....

 [4]

(c) The reduction of silver(I) bromide to silver is the basis of film photography.



An opaque object is placed on a piece of paper coated with silver(I) bromide which is then exposed to a bright light. The light is switched off and the opaque object removed.



Explain how the image is formed.

.....

 [4]

[Total: 12]

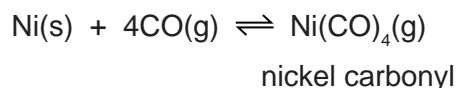
6 Nickel is a transition element.

(a) Predict **three** differences in the chemical properties of nickel and barium.

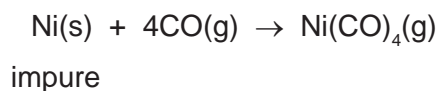
.....

 [3]

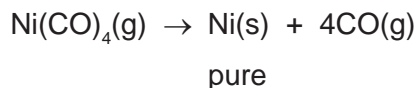
(b) Nickel ores are converted into nickel(II) oxide. This can be reduced to impure nickel by heating with carbon. The nickel is purified by the following reversible reaction.



(i) Impure nickel is heated at 60 °C. The forward reaction occurs.



The nickel carbonyl, a gas, moves into a hotter chamber at 200 °C. The backward reaction occurs and the nickel carbonyl decomposes.



Is the forward reaction exothermic or endothermic? Give a reason for your answer.

.....

 [2]

(ii) Explain why the forward reaction is favoured by an increase in pressure.

.....
 [2]

(iii) Suggest what happens to the impurities.

..... [1]

- (iv) Suggest another method of refining nickel. Give a brief description of the method which you have suggested. A labelled diagram is acceptable.

*For
Examiner's
Use*

[4]

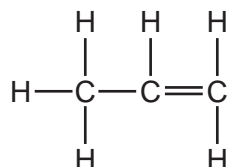
[Total: 12]

7 The alkenes are a series of unsaturated hydrocarbons. They have the general molecular formula C_nH_{2n} .

- (a) Deduce the molecular formula of an alkene which has a relative molecular mass of 126. Show your working.

.....
 [2]

- (b) The structural formula of propene is drawn below.



- (i) Draw a diagram showing the arrangement of the valency electrons in one molecule of this covalent compound.
 Use x to represent an electron from an atom of carbon.
 Use o to represent an electron from an atom of hydrogen.

[3]

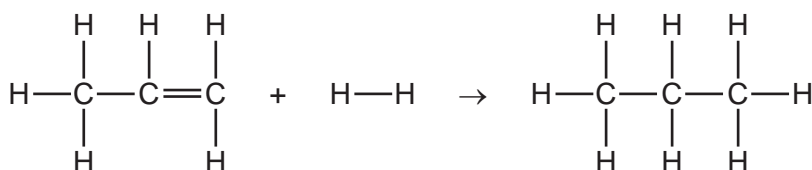
- (ii) Draw the structure of the polymer formed from propene

[2]

- (iii) Bond energy is the amount of energy, in kJ, which must be supplied to break one mole of the bond.

bond	bond energy in kJ/mol
H—H	+436
C=C	+610
C—C	+346
C—H	+415

Use the data in the table to show that the following reaction is exothermic.



.....

 [3]

- (c) This question is concerned with some of the addition reactions of but-1-ene.

- (i) Name the product formed when but-1-ene reacts with water.

..... [1]

- (ii) Complete the equation.



- (iii) Deduce the formula of the compound which reacts with but-1-ene to form 1-iodobutane.

..... [1]

[Total: 14]

DATA SHEET
The Periodic Table of the Elements

		Group																																																											
I	II	III	IV	V	VI	VII	0																																																						
		1 H Hydrogen 1																																																											
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		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		93 Nb Niobium 41	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		181 Ta Tantalum 73	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																																															
87 Fr Francium	88 Ra Radium	89 Ac Actinium																																																											
		<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 5%;"></td> <td style="width: 5%;">140 Ce Cerium 58</td> <td style="width: 5%;">141 Pr Praseodymium 59</td> <td style="width: 5%;">144 Nd Neodymium 60</td> <td style="width: 5%;">150 Sm Samarium 62</td> <td style="width: 5%;">152 Eu Europium 63</td> <td style="width: 5%;">157 Gd Gadolinium 64</td> <td style="width: 5%;">162 Dy Dysprosium 66</td> <td style="width: 5%;">165 Ho Holmium 67</td> <td style="width: 5%;">167 Er Erbium 68</td> <td style="width: 5%;">169 Tm Thulium 69</td> <td style="width: 5%;">173 Yb Ytterbium 70</td> <td style="width: 5%;">175 Lu Lutetium 71</td> </tr> <tr> <td></td> <td>232 Th Thorium 90</td> <td>238 U Uranium 92</td> <td>238 Pa Protactinium 91</td> <td>238 Np Neptunium 93</td> <td>238 Pu Plutonium 94</td> <td>238 Am Americium 95</td> <td>238 Cm Curium 96</td> <td>238 Bk Berkelium 97</td> <td>238 Cf Californium 98</td> <td>238 Es Einsteinium 99</td> <td>238 Fm Fermium 100</td> <td>238 Md Mendelevium 101</td> <td>238 No Nobelium 102</td> <td>238 Lr Lawrencium 103</td> </tr> </table>																			140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	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		232 Th Thorium 90	238 U Uranium 92	238 Pa Protactinium 91	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	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																																																	
	232 Th Thorium 90	238 U Uranium 92	238 Pa Protactinium 91	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																																															
		<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 5%;"></td> <td style="width: 5%;"></td> <td style="width: 5%;"></td> <td style="width: 5%;"></td> <td style="width: 5%;"></td> <td style="width: 5%;"></td> <td style="width: 5%;"></td> <td style="width: 5%;"></td> <td style="width: 5%;"></td> <td style="width: 5%;"></td> <td style="width: 5%;"></td> <td style="width: 5%;"></td> <td style="width: 5%;"></td> <td style="width: 5%;"></td> <td style="width: 5%;"></td> <td style="width: 5%;"></td> <td style="width: 5%;"></td> <td style="width: 5%;"></td> <td style="width: 5%;"></td> <td style="width: 5%;"></td> <td style="width: 5%;"></td> </tr> <tr> <td style="text-align: center;">a</td> <td style="text-align: center;">X</td> <td style="text-align: center;">b</td> <td colspan="18"></td> </tr> </table>																																							a	X	b																		
a	X	b																																																											
		<p>*58-71 Lanthanoid series †90-103 Actinoid series</p> <p>Key</p> <p>a = relative atomic mass X = atomic symbol b = proton (atomic) number</p>																																																											

The volume of one mole of any gas is 24 dm³ 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.