



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)

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.

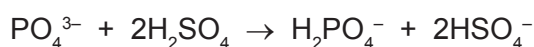
..... [1]

(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.

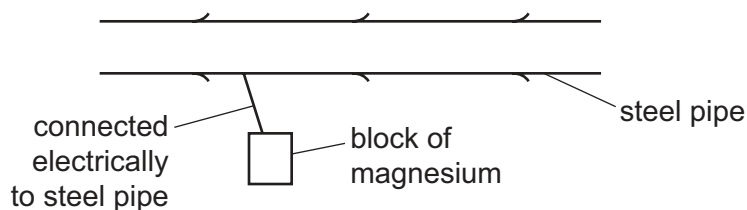
(i) Define the term *steel*.

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

(ii) Define oxidation in terms of electron transfer.

..... [1]

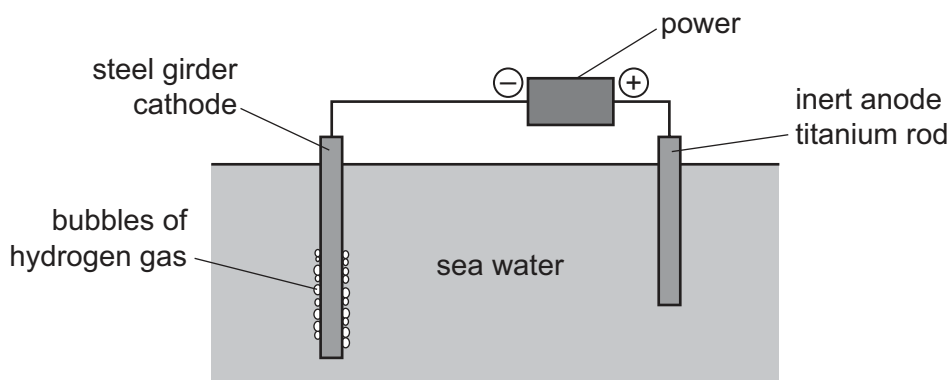
(b) A method of preventing steel rusting is sacrificial protection.



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?

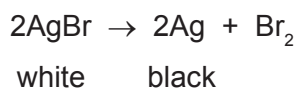
carbon dioxide = [1]

oxygen = [1]

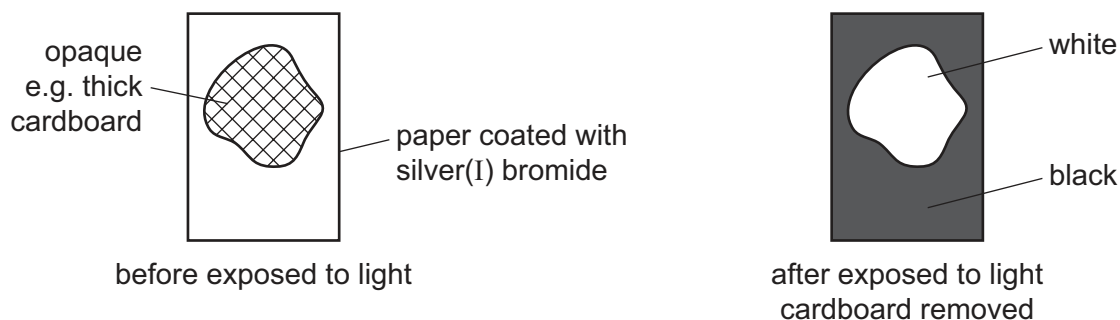
(ii) Explain how the green plant-like bacteria changed the composition of the atmosphere.

.....
.....
.....
..... [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]

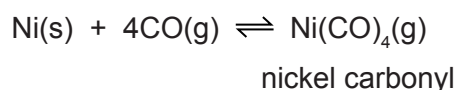
6 Nickel is a transition element.

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

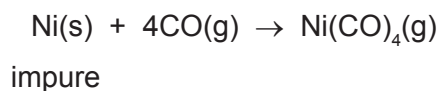
.....

 [3]

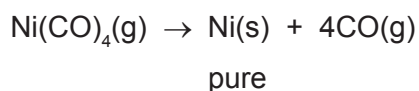
(b) Nickel ores are converted into nickel(II) oxide. This can be reduced to impure nickel by heating with carbon. The nickel is purified by the following reversible reaction.



(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.

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Use*

[4]

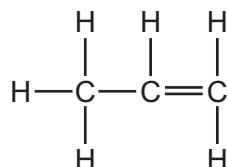
[Total: 12]

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]

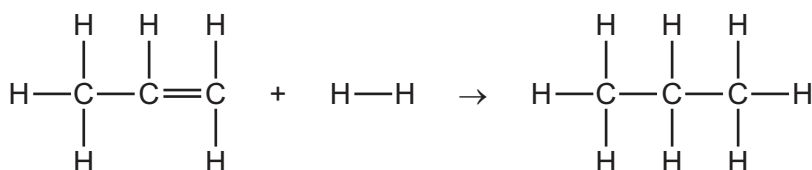
- (ii) Draw the structure of the polymer formed from propene

[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																																																																																																																																																																																																																																																																															
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	104 Rf Rutherfordium 104	105 Db Dubnium 105	106 Sg Seaborgium 106	107 Bh Bohrium 107	108 Hs Hassium 108	109 Mt Meitnerium 109	110 Ds Darmstadtium 110	111 Rg Roentgenium 111	112 Cn Copernicium 112	113 Nh Nihonium 113	114 Fl Flerovium 114	115 Lv Livermorium 115	116 Ts Tennessine 116	117 Og Oganesson 117	118 Uu Ununseptium 118	119 Uub Ununseptium 119	120 Uuo Ununseptium 120	121 Uut Ununtrium 121	122 Uuq Ununquadium 122	123 Uuq Ununquadium 123	124 Uuq Ununquadium 124	125 Uuq Ununquadium 125	126 Uuq Ununquadium 126	127 Uuq Ununquadium 127	128 Uuq Ununquadium 128	129 Uuq Ununquadium 129	130 Uuq Ununquadium 130	131 Uuq Ununquadium 131	132 Uuq Ununquadium 132	133 Uuq Ununquadium 133	134 Uuq Ununquadium 134	135 Uuq Ununquadium 135	136 Uuq Ununquadium 136	137 Uuq Ununquadium 137	138 Uuq Ununquadium 138	139 Uuq Ununquadium 139	140 Uuq Ununquadium 140	141 Uuq Ununquadium 141	142 Uuq Ununquadium 142	143 Uuq Ununquadium 143	144 Uuq Ununquadium 144	145 Uuq Ununquadium 145	146 Uuq Ununquadium 146	147 Uuq Ununquadium 147	148 Uuq Ununquadium 148	149 Uuq Ununquadium 149	150 Uuq Ununquadium 150	151 Uuq Ununquadium 151	152 Uuq Ununquadium 152	153 Uuq Ununquadium 153	154 Uuq Ununquadium 154	155 Uuq Ununquadium 155	156 Uuq Ununquadium 156	157 Uuq Ununquadium 157	158 Uuq Ununquadium 158	159 Uuq Ununquadium 159	160 Uuq Ununquadium 160	161 Uuq Ununquadium 161	162 Uuq Ununquadium 162	163 Uuq Ununquadium 163	164 Uuq Ununquadium 164	165 Uuq Ununquadium 165	166 Uuq Ununquadium 166	167 Uuq Ununquadium 167	168 Uuq Ununquadium 168	169 Uuq Ununquadium 169	170 Uuq Ununquadium 170	171 Uuq Ununquadium 171	172 Uuq Ununquadium 172	173 Uuq Ununquadium 173	174 Uuq Ununquadium 174	175 Uuq Ununquadium 175	176 Uuq Ununquadium 176	177 Uuq Ununquadium 177	178 Uuq Ununquadium 178	179 Uuq Ununquadium 179	180 Uuq Ununquadium 180	181 Uuq Ununquadium 181	182 Uuq Ununquadium 182	183 Uuq Ununquadium 183	184 Uuq Ununquadium 184	185 Uuq Ununquadium 185	186 Uuq Ununquadium 186	187 Uuq Ununquadium 187	188 Uuq Ununquadium 188	189 Uuq Ununquadium 189	190 Uuq Ununquadium 190	191 Uuq Ununquadium 191	192 Uuq Ununquadium 192	193 Uuq Ununquadium 193	194 Uuq Ununquadium 194	195 Uuq Ununquadium 195	196 Uuq Ununquadium 196	197 Uuq Ununquadium 197	198 Uuq Ununquadium 198	199 Uuq Ununquadium 199	200 Uuq Ununquadium 200	201 Uuq Ununquadium 201	202 Uuq Ununquadium 202	203 Uuq Ununquadium 203	204 Uuq Ununquadium 204	205 Uuq Ununquadium 205	206 Uuq Ununquadium 206	207 Uuq Ununquadium 207	208 Uuq Ununquadium 208	209 Uuq Ununquadium 209	210 Uuq Ununquadium 210	211 Uuq Ununquadium 211	212 Uuq 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Ununquadium 295	296 Uuq Ununquadium 296	297 Uuq Ununquadium 297	298 Uuq Ununquadium 298	299 Uuq Ununquadium 299	300 Uuq Ununquadium 300

*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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