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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

* 1 8 9 5 3 5 7 6 1 6 *

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.

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1	
2	
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4	
5	
6	
7	
Total	

This document consists of **11** printed pages and **1** blank page.

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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 .....

(ii) tellurium bromide ..... [2]

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

(i) strontium .....

(ii) fluoride ..... [2]

[Total: 10]

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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]

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[Turn over

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3 Fertilisers are used to promote plant growth.
Two fertilisers are ammonium phosphate, $(NH_4)_3PO_4$, and calcium dihydrogenphosphate, $Ca(H_2PO_4)_2$.

(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, $Ca_3(PO_4)_2$, 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, $H_2PO_4^-$.

$$PO_4^{3-} + 2H_2SO_4 \rightarrow H_2PO_4^- + 2HSO_4^-$$

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]

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

(i) Define the term *steel*.

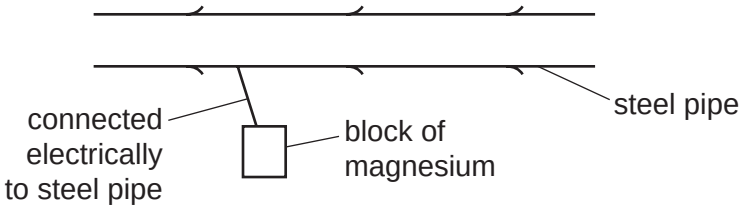
.....

..... [2]

(ii) Define oxidation in terms of electron transfer.

..... [1]

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

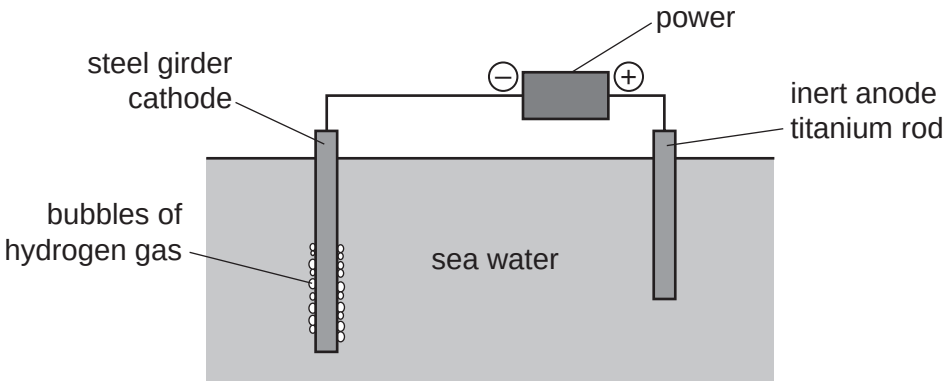


Give an explanation, in terms of electron transfer, why the steel does not rust.

.....

..... [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]

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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.

.....

.....

.....

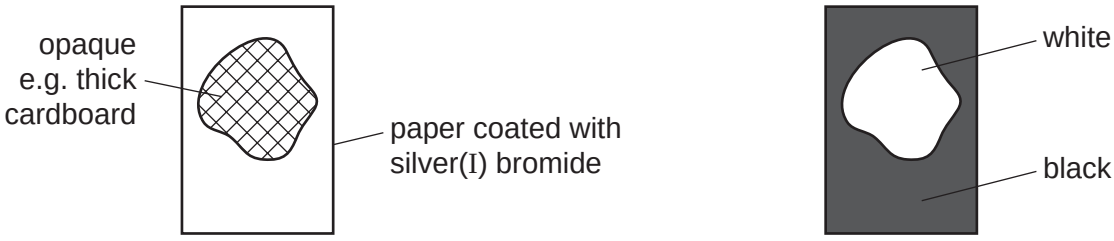
..... [4]

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

$$2AgBr \rightarrow 2Ag + Br_2$$

white black

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.



before exposed to light

after exposed to light
cardboard removed

Explain how the image is formed.

.....

.....

..... [4]

[Total: 12]

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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.

$$Ni(s) + 4CO(g) \rightleftharpoons \underset{\text{nickel carbonyl}}{Ni(CO)_4(g)}$$

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

$$\underset{\text{impure}}{Ni(s)} + 4CO(g) \rightarrow Ni(CO)_4(g)$$

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

$$Ni(CO)_4(g) \rightarrow \underset{\text{pure}}{Ni(s)} + 4CO(g)$$

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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[4]

[Total: 12]

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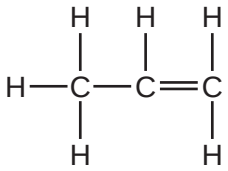
7 The alkenes are a series of unsaturated hydrocarbons. They have the general molecular formula C_nH_{2n}.

(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]

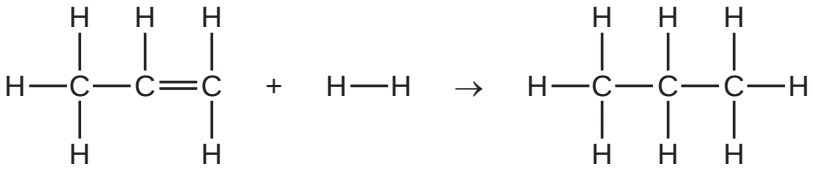
(ii) Draw the structure of the polymer formed from propene

[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.

$CH_3—CH_2—CH═CH_2 + Br_2 \rightarrow$ ..... [2]

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

..... [1]

[Total: 14]

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DATA SHEET
The Periodic Table of the Elements

	Group																	
	I	II									III	IV	V	VI	VII	0
																4 **He** Helium 2
				1 **H** Hydrogen 1							11 **B** Boron 5	12 **C** Carbon 6	14 **N** Nitrogen 7	16 **O** Oxygen 8	19 **F** Fluorine 9	20 **Ne** Neon 10
	7 **Li** Lithium 3	9 **Be** Beryllium 4									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
	23 **Na** Sodium 11	24 **Mg** Magnesium 12									70 **Ga** Gallium 31	73 **Ge** Germanium 32	75 **As** Arsenic 33	79 **Se** Selenium 34	80 **Br** Bromine 35	84 **Kr** Krypton 36
	39 **K** Potassium 19	40 **Ca** Calcium 20	45 **Sc** Scandium 21	48 **Ti** Titanium 22	51 **V** Vanadium 23	52 **Cr** Chromium 24	55 **Mn** Manganese 25	56 **Fe** Iron 26	59 **Co** Cobalt 27	59 **Ni** Nickel 28	64 **Cu** Copper 29	65 **Zn** Zinc 30	112 **Cd** Cadmium 48	119 **In** Indium 49	122 **Sn** Tin 50	128 **Sb** Antimony 51	127 **Te** Tellurium 52	131 **I** Iodine 53	131 **Xe** Xenon 54
	85 **Rb** Rubidium 37	88 **Sr** Strontium 38	89 **Y** Yttrium 39	91 **Zr** Zirconium 40	93 **Nb** Niobium 41	96 **Mo** Molybdenum 42	**Tc** Technetium 43	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	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	**Po** Polonium 84	**At** Astatine 85	222 **Rn** Radon 86
	223 **Fr** Francium 87	226 **Ra** Radium 88	227 **Ac** Actinium 89 †															

140 **Ce** Cerium 58	141 **Pr** Praseodymium 59	144 **Nd** Neodymium 60	**Pm** Promethium 61	150 **Sm** Samarium 62	152 **Eu** Europium 63	157 **Gd** Gadolinium 64	159 **Tb** Terbium 65	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	**Pa** Protactinium 91	238 **U** Uranium 92	**Np** Neptunium 93	**Pu** Plutonium 94	**Am** Americium 95	**Cm** Curium 96	**Bk** Berkelium 97	**Cf** Californium 98	**Es** Einsteinium 99	**Fm** Fermium 100	**Md** Mendelevium 101	**No** Nobelium 102	**Lr** Lawrencium 103

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

Key

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

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

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