



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

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CENTRE
NUMBER

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CHEMISTRY

0620/21

Paper 2

May/June 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 in the spaces at the top of this page.

Write in dark blue or black pen.

You may need to 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.

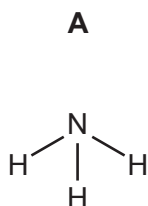
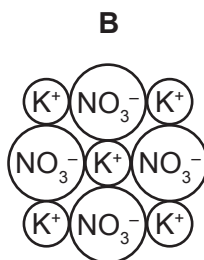
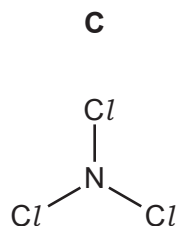
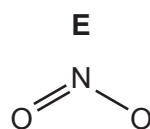
For Examiner's Use

1	
2	
3	
4	
5	
6	
7	
8	
Total	

This document consists of **15** printed pages and **1** blank page.



- 1 The structures of some substances containing nitrogen are shown below.



Answer the following questions by choosing from the structures **A**, **B**, **C**, **D** or **E**.
You can use each structure once, more than once or not at all.

Which structure represents

- | | |
|--|--------------------------|
| (a) an acidic oxide, | ☐ |
| (b) an ionic giant structure, | ☐ |
| (c) a gas which turns moist litmus paper blue, | ☐ |
| (d) a compound which is formed under conditions of high temperature and pressure in car engines, | ☐ |
| (e) a molecule containing halogen atoms, | ☐ |
| (f) a salt? | ☐ |

[Total: 6]

2 Vanadium has two isotopes.



(a) Define the term *isotope*.

.....
..... [1]

(b) An atom contains protons, electrons and neutrons.

Complete the table to show the number of protons, electrons and neutrons in these two isotopes of vanadium.

isotope	number of protons	number of electrons	number of neutrons
${}_{23}^{50}\text{V}$	23	23	
${}_{23}^{51}\text{V}$			28

[3]

(c) Complete these sentences using words from the list.

cancer extra industry influenza medicine non

Two types of isotopes are radioactive and-radioactive. Radioactive isotopes are used in for treating patients with [3]

(d) Vanadium is a transition element.

Which two of these statements about vanadium are correct?

Tick **two** boxes.

vanadium is a non-metal

☐

vanadium conducts electricity

☐

vanadium has a low melting point

☐

vanadium is less dense than sodium

☐

compounds of vanadium are coloured

☐

[2]

[Total: 9]

3 Water is present in the atmosphere, the seas and in ice and snow.

(a) Describe a chemical test for water.

test

result [2]

(b) State **one** use of water in industry.

..... [1]

(c) Water is a good solvent.

What do you understand by the term *solvent*?

..... [1]

(d) Water vapour in the atmosphere reacts with sulfur dioxide, SO_2 , to produce acid rain.

(i) State **one** source of sulfur dioxide.

..... [1]

(ii) State **two** adverse effects of acid rain.

1.

2. [2]

(iii) Calculate the relative molecular mass of sulfur dioxide.

[1]

(e) Water from lakes and rivers can be treated to make the water safer to drink.

Describe **two** of the steps in water purification.

For each of these steps, give an explanation of its purpose.

step 1

.....

step 2

..... [4]

(f) Water is formed when hydrogen burns in air.

(i) State the percentage of oxygen present in the air.

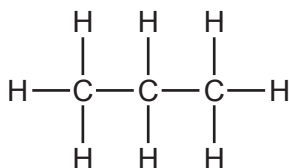
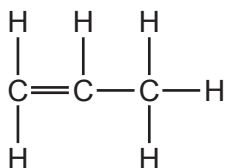
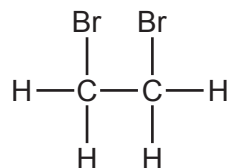
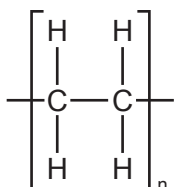
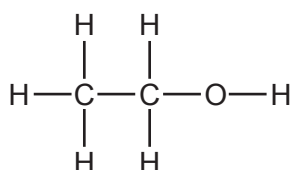
..... [1]

(ii) When 8 g of hydrogen is burned in excess air, 72 g of water is formed.
What mass of hydrogen needs to be burnt to produce 252 g of water?

[1]

[Total: 14]

4 The structures of some organic compounds are shown below.

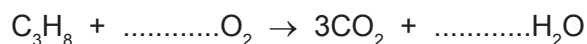
A**B****C****D****E**

(a) Which one of these structures represents

- (i) a polymer, ☐
 (ii) an unsaturated hydrocarbon, ☐
 (iii) the product of the catalytic addition of steam to ethene, ☐
 (iv) a product of the addition of aqueous bromine to ethene? ☐

[4]

(b) (i) Balance the equation for the complete combustion of compound **A**, C_3H_8 .

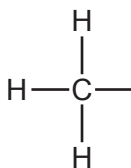


[2]

(ii) State the name of **two** substances formed when compound **A** undergoes incomplete combustion.

..... and [2]

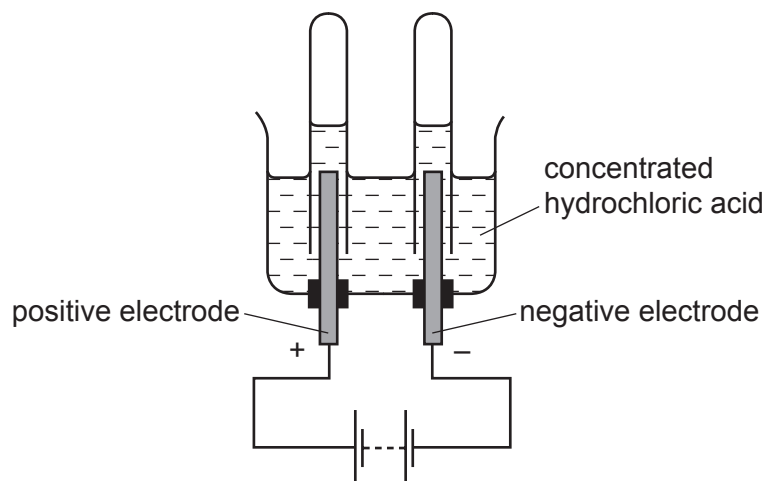
(c) Complete the structure of ethanoic acid to show all atoms and bonds.



[1]

[Total: 9]

- 5 Concentrated hydrochloric acid can be electrolysed using the apparatus shown.



- (a) What do you understand by the term *electrolysis*?

.....
 [1]

- (b) What is the name given to the positive electrode?
 Put a ring around the correct answer.

anion **anode** **cathode** **cation** **electrolyte** [1]

- (c) State the name of the gas given off at the negative electrode.

..... [1]

- (d) Complete the following sentence about electrolysis using words from the list.

inert **magnesium** **platinum** **reactive** **solid**

Electrodes made of graphite or are generally used in electrolysis
 because they are [2]

- (e) When concentrated hydrochloric acid is electrolysed, chlorine is released at the positive electrode.

(i) Draw the arrangement of the electrons in an atom of chlorine.

[1]

(ii) Draw the electronic structure of a chlorine molecule.
Show only the outer electron shells.

[2]

(iii) Describe a test for chlorine.

test

result [2]

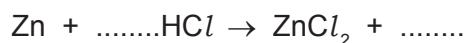
(f) Hydrochloric acid reacts with the base calcium hydroxide.

(i) Complete the word equation for this reaction.

hydrochloric acid + calcium hydroxide $\rightarrow$ +
.....

[2]

(ii) Hydrochloric acid also reacts with zinc.
Complete the symbol equation for this reaction.



[2]

[Total: 14]

- 6 A student observed the reaction of various metals with both cold water and steam. Her results are shown below.

metal	reaction with cold water	reaction with steam
calcium	reacts rapidly	reacts very rapidly
copper	no reaction	no reaction
magnesium	reacts very slowly	reacts rapidly
zinc	no reaction	reacts

- (a) (i) Put these metals in order of their reactivity.

least reactive $\longrightarrow$ most reactive

--	--	--	--

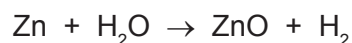
[1]

- (ii) Iron is a metal between zinc and copper in the reactivity series.
Predict the reactivity of iron with

cold water,

steam. [2]

- (b) The equation for the reaction of zinc with steam is:



Write a word equation for this reaction.

[1]

- (c) State **three** physical properties which are characteristic of **most** metals.

1.

2.

3. [3]

(d) Some properties of the Group I metals are shown in the table.

metal	melting point /°C	hardness	density /g per cm ³
lithium		fairly hard	0.53
sodium	98	fairly soft	
potassium	63	soft	
rubidium	39	very soft	1.53
caesium	29	extremely soft	1.88

(i) Estimate the melting point of lithium.

..... [1]

(ii) How does the hardness of these metals change down the group?

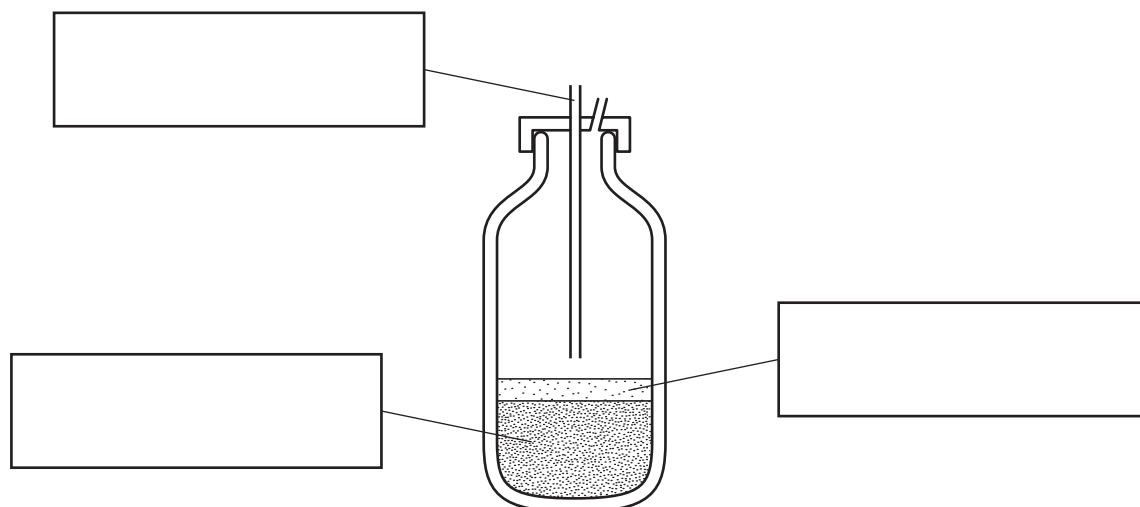
..... [1]

(iii) Estimate the density of potassium.

..... [1]

[Total: 10]

- 7 The diagram shows a basic oxygen converter. This is used to convert impure iron from the blast furnace into steel. During this process, some of the impurities in the iron are converted into a slag.



- (a) Label the diagram to show each of the following:

- where the oxygen enters;
- the slag;
- the molten steel.

[3]

- (b) In the converter, the oxygen oxidises sulfur, carbon and phosphorus to their oxides.

- (i) Explain why sulfur dioxide and carbon dioxide are easily removed from the converter.

..... [1]

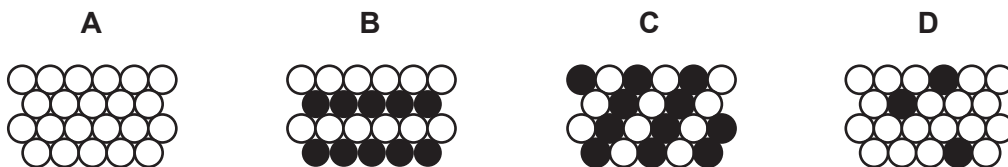
- (ii) Explain how calcium oxide is used to remove phosphorus(V) oxide from the converter.

.....

 [3]

(c) Stainless steel is an alloy.

- (i) Which **one** of the diagrams, **A**, **B**, **C** or **D**, best represents an alloy?
Put a ring around the correct answer.



[1]

- (ii) State **one** use of stainless steel.

..... [1]

[Total: 9]

8 Bromine is a red-brown liquid. When warmed, it forms an orange vapour.

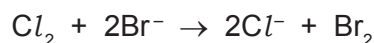
- (a) Describe what happens to the arrangement and motion of the particles when bromine changes state from a liquid to a vapour.

.....

 [3]

(b) Bromine can be obtained from bromide ions in seawater.

- (i) The symbol equation for this reaction is:



Complete the word equation for this reaction.

..... + bromide ions $\rightarrow$ + [1]

- (ii) Bromine is very volatile, so it can be removed from solution by bubbling air through the solution.

What do you understand by the term *volatile*?

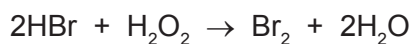
..... [1]

(c) Hydrogen reacts with bromine in the presence of a hot platinum catalyst to form hydrogen bromide.

- (i) Define the term *catalyst*.

..... [1]

- (ii) Hydrogen bromide reduces hydrogen peroxide, H_2O_2 .



Explain how this equation shows that hydrogen peroxide is reduced.

.....
 [1]

- (iii) A solution of hydrogen bromide in water is called hydrobromic acid. Hydrobromic acid has similar reactions to hydrochloric acid.

State the names of **three** products formed when hydrobromic acid reacts with sodium carbonate.

..... [2]

[Total: 9]

DATA SHEET

The Periodic Table of the Elements

Group																		
I	II											III	IV	V	VI	VII	0	
		<div>1H Hydrogen 1</div>																
7Li Lithium 3	9Be Beryllium 4											11B Boron 5	12C Carbon 6	14N Nitrogen 7	16O Oxygen 8	19F Fluorine 9	20Ne Neon 10	
23Na Sodium 11	24Mg Magnesium 12											27Al Aluminium 13	28Si Silicon 14	31P Phosphorus 15	32S Sulfur 16	35.5Cl Chlorine 17	40Ar Argon 18	
39K Potassium 19	40Ca Calcium 20	45Sc Scandium 21	48Ti Titanium 22	51V Vanadium 23	52Cr Chromium 24	55Mn Manganese 25	56Fe Iron 26	59Co Cobalt 27	59Ni Nickel 28	64Cu Copper 29	65Zn Zinc 30	70Ga Gallium 31	73Ge Germanium 32	75As Arsenic 33	79Se Selenium 34	80Br Bromine 35	84Kr Krypton 36	
85Rb Rubidium 37	88Sr Strontium 38	89Y Yttrium 39	91Zr Zirconium 40	93Nb Niobium 41	96Mo Molybdenum 42	101Ru Ruthenium 44	101Rh Rhodium 45	106Pd Palladium 46	108Ag Silver 47	112Cd Cadmium 48	115In Indium 49	119Sn Tin 50	122Sb Antimony 51	127I Iodine 53	128Te Tellurium 52	131Xe Xenon 54		
133Cs Caesium 55	137Ba Barium 56	139La Lanthanum 57	178Hf Hafnium 72	181Ta Tantalum 73	184W Tungsten 74	186Re Rhenium 75	190Os Osmium 76	192Ir Iridium 77	195Pt Platinum 78	197Au Gold 79	201Hg Mercury 80	204Tl Thallium 81	207Pb Lead 82	209Bi Bismuth 83	210Po Polonium 84	210At Astatine 85	222Rn Radon 86	
Fr Francium 87	226Ra Radium 88	227Ac Actinium 89																
58-71 Lanthanoid series																		
90-103 Actinoid series																		
175Lu Lutetium 71																		
173Yb Ytterbium 70																		
169Tm Thulium 69																		
167Er Erbium 68																		
165Ho Holmium 67																		
162Dy Dysprosium 66																		
159Tb Terbium 65																		
157Gd Gadolinium 64																		
152Eu Europium 63																		
150Sm Samarium 62																		
144Nd Neodymium 60																		
141Pr Praseodymium 59																		
140Ce Cerium 58																		
238U Uranium 92																		
238Pu Plutonium 94																		
235Np Neptunium 93																		
232Pa Protactinium 91																		
232Th Thorium 90																		
210Po Mendelevium 101																		
210No Nobelium 102																		
210Lr Lawrencium 103																		

a

X

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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