



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

0620/22

Paper 2

May/June 2013

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.

Electronic calculators may be used.

A copy of the Periodic Table is printed on page 16.

You may lose marks if you do not show your working or if you do not use appropriate units.

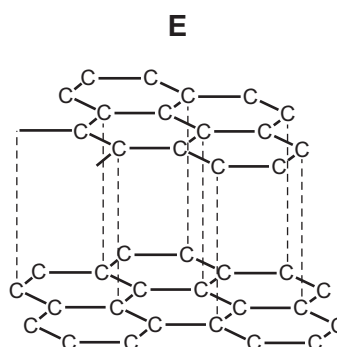
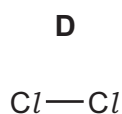
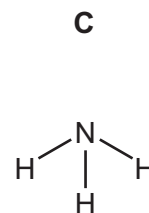
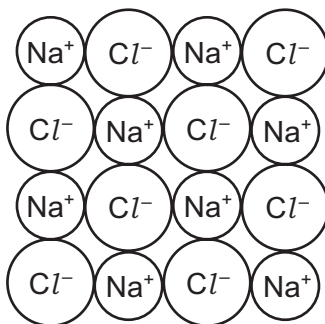
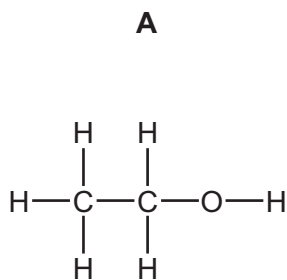
At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

This document consists of **14** printed pages and **2** blank pages.



1 The structures of five substances, **A**, **B**, **C**, **D** and **E**, are shown below.



(a) Answer the following questions about these substances. Each substance may be used once, more than once or not at all.

- (i) Which **two** substances are elements? and
- (ii) Which substance has a giant covalent structure?
- (iii) Which substance turns damp red litmus blue?
- (iv) Which substance is a product of fermentation?
- (v) Which substance is used as a lubricant? [6]

(b) Complete the following sentences about compounds using words from the list below.

atom combined copper covalent
ionic metals molecules separated

A compound is a substance containing two or more types of chemically

Compounds such as water and sulfur dioxide exist as simple

Others, such as sodium chloride, are giant structures. [4]

[Total: 10]

- 2 The table shows how the density of the transition elements varies across Period 4.

element	Ti	V	Cr	Mn	Fe	Co	Ni	Cu
density in g per cm ³	4.50		7.20	7.20	7.86	8.90	8.90	8.92

- (a) Describe the **general** trend in density of the transition elements across Period 4.

..... [1]

- (b) Suggest a value for the density of vanadium, V.

..... [1]

- (c) Many transition elements and their compounds are catalysts.
What is the meaning of the term *catalyst*?

..... [1]

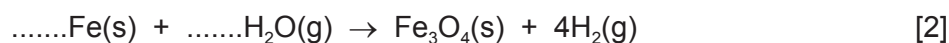
- (d) Describe **three** properties of transition metals, apart from catalytic activity, which make them different from Group I metals.

1.

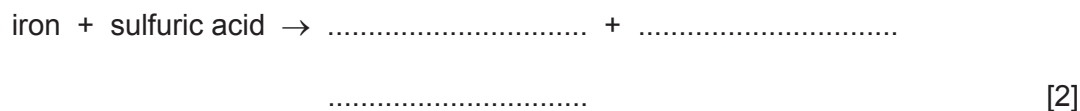
2.

3. [3]

- (e) Iron reacts with steam to form an oxide with the formula Fe₃O₄.
Complete the symbol equation for this reaction.

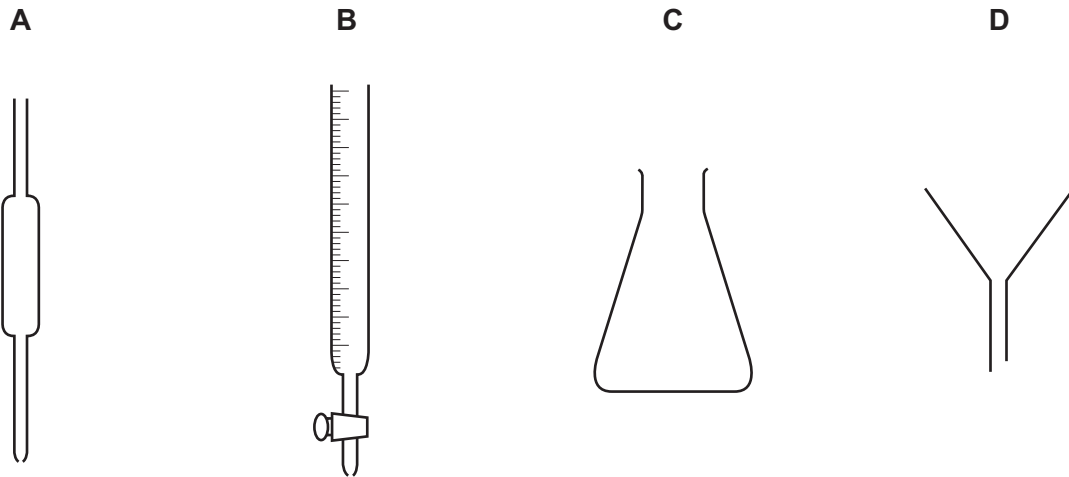


- (f) Iron reacts with sulfuric acid.
Complete the word equation for this reaction.



[Total: 10]

- 3 The concentration of alkali in a solution can be determined from the results of a titration. The apparatus used is shown below.



- (a) State the name of each of these pieces of apparatus.

A

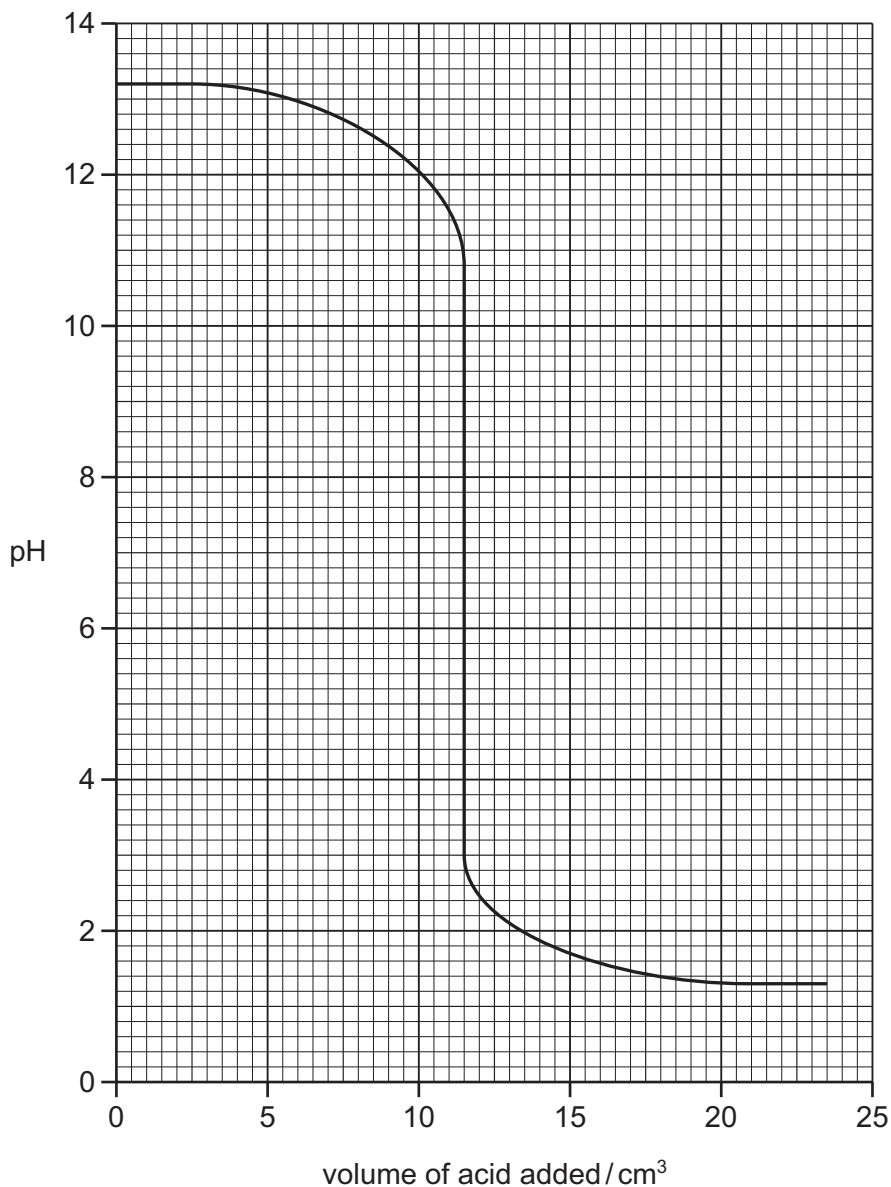
B

C

D

[4]

(b) The graph below shows how the pH changes when an alkali is neutralised by an acid.



(i) What is the pH of the alkali at the start of the experiment?

pH = [1]

(ii) What volume of acid has been added when the pH is 12?

..... cm³ [1]

(iii) What is the value of the pH when the solution is neutral?
Put a ring around the correct answer.

- pH 0 pH 5 pH 7 pH 9 pH 14**

[1]

- (c) (i) Which **two** of the following compounds could a farmer use to control the pH of soils which are too acidic?

Tick **two** boxes.

aluminium chloride

calcium carbonate

calcium oxide

copper sulfate

potassium chloride

[2]

- (ii) Explain why farmers need to control the pH of soils which are too acidic.

.....

..... [1]

[Total: 10]

4 Methane belongs to the alkane homologous series.

(a) (i) Draw the structure of methane showing all atoms and bonds.

[1]

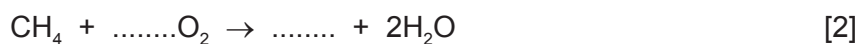
(ii) State the name of **one** other member of the alkane homologous series.

..... [1]

(iii) Methane is an atmospheric pollutant.
Give **one** natural source of methane in the atmosphere.

..... [1]

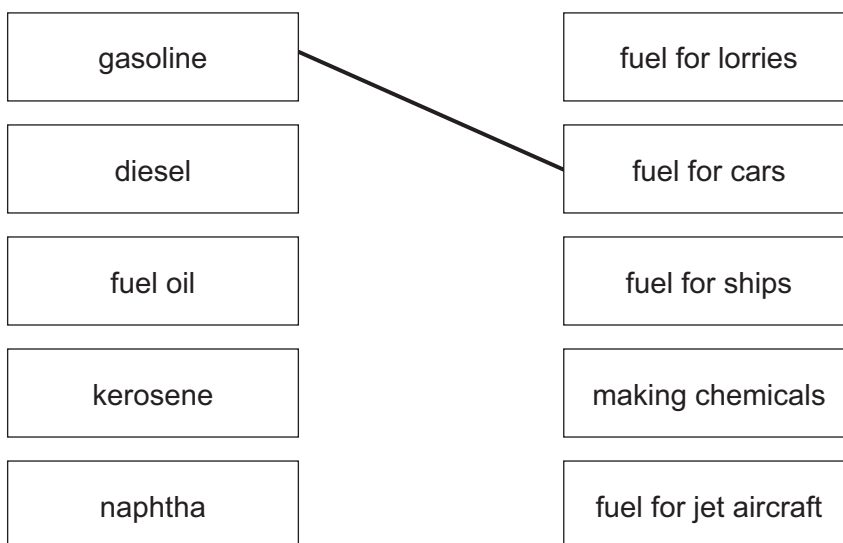
(iv) Methane burns in excess oxygen to form carbon dioxide and water.
Complete the symbol equation for this reaction.



(b) (i) In an oil refinery, hydrocarbons are separated into different fractions. On what physical property does this fractionation depend?

..... [1]

(ii) Match the fraction on the left with the use of the fraction on the right. The first one has been done for you.



[4]

[Total: 10]

5 Clean air is a mixture of gases.

(a) State the composition of clean air and describe how it gets polluted by gases such as sulfur dioxide, carbon monoxide and oxides of nitrogen.

In your answer, include

- the names and percentages of the two main gases present in clean air,
- the source of each of the pollutant gases named above.

.....

.....

.....

.....

.....

.....

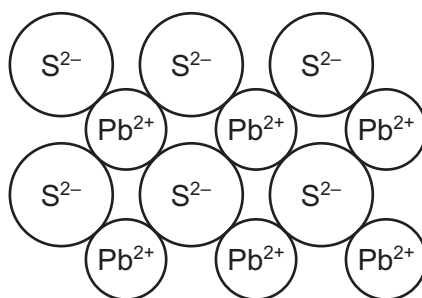
.....

.....

..... [5]

(b) Lead is an atmospheric pollutant. It is extracted by heating ores containing lead sulfide.

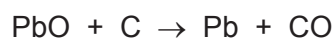
(i) The structure of lead sulfide is shown below.



Deduce the simplest formula for lead sulfide.

..... [1]

(ii) The last stage in extracting lead involves reducing lead(II) oxide with carbon.

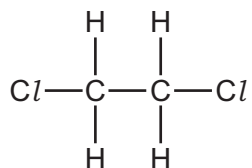


How does this equation show that lead oxide gets reduced?

..... [1]

- (c) Dichloroethane used to be added to petrol to prevent the build-up of lead deposits in engines.

The structure of dichloroethane is shown below.



- (i) Dichloroethane is a liquid.
Describe the arrangement and closeness of the particles in a liquid.

arrangement

closeness [2]

- (ii) Deduce the molecular formula for dichloroethane.

..... [1]

- (iii) Calculate the relative molecular mass of dichloroethane. You must show all your working.

[2]

[Total: 12]

6 (a) The table below describes the reaction of some metals with water.

metal	reaction
calcium	reacts rapidly with cold water producing many bubbles of gas
magnesium	reacts very slowly with cold water but reacts rapidly with steam
rubidium	reacts very rapidly with cold water producing many bubbles of gas and will explode
zinc	only reacts with steam when in powdered form and heated very strongly

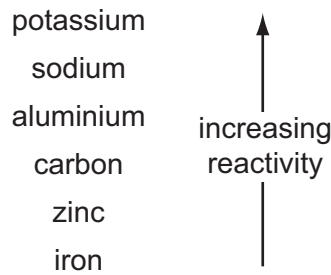
Put these metals in order of their reactivity.

least reactive \longrightarrow most reactive

--	--	--	--

[2]

(b) The list below shows part of the reactivity series.

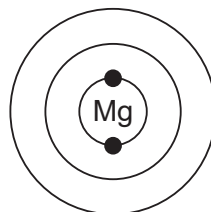


Give the names of **two** metals from this list that can be extracted from their oxide ores by heating with carbon.

..... and [1]

(c) A magnesium atom has 12 electrons.

(i) Complete the diagram below to show the electronic structure of an atom of magnesium.



[2]

(ii) An isotope of magnesium has a nucleon number (mass number) of 26. Deduce the number of neutrons in one atom of this isotope of magnesium.

..... [1]

[Total: 6]

7 The table shows some properties of sulfur, sucrose (sugar) and zinc chloride.

property	sulfur	sucrose	zinc chloride
state at room temperature	solid	solid	solid
solubility in water	insoluble	soluble	soluble
electrical conductivity of aqueous solution		does not conduct	conducts
structure	molecular	molecular	ionic

(a) Suggest why an aqueous solution of zinc chloride conducts electricity.

..... [1]

(b) Suggest why an aqueous solution of sucrose does **not** conduct electricity.

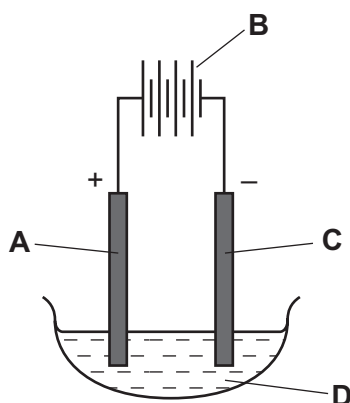
..... [1]

(c) Suggest how you could separate a mixture of solid sucrose and solid sulfur.

.....

 [2]

(d) Molten zinc chloride can be electrolysed using the apparatus shown below.



(i) Which one of the letters, **A**, **B**, **C** or **D**, represents the cathode?

..... [1]

(ii) Which **one** of the following substances is the most suitable for use as an electrode in this electrolysis?
 Put a ring around the correct answer.

- copper** **graphite** **sodium** **sulfur**

[1]

(iii) Predict the products of the electrolysis of molten zinc chloride at
the negative electrode,
the positive electrode. [2]

(iv) Describe a test for chloride ions.
test
result [3]

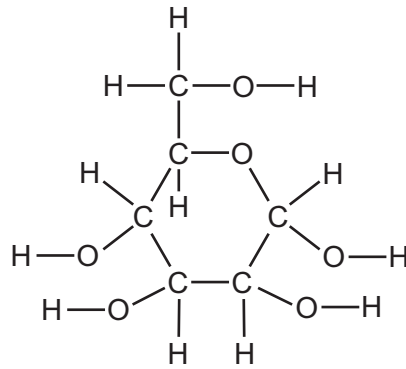
[Total: 11]

8 A student placed a spoonful of sugar in the bottom of a glass of cold tea and left it undisturbed for several minutes.
After 2 minutes, she used a straw to taste some of the tea from the top of the glass. It did not taste sweet.
After 10 minutes, the sugar had disappeared and the solution at the top of the glass tasted sweet.



(a) Use the kinetic particle theory to explain these observations.
.....
.....
.....
.....
..... [4]

(b) Glucose is a sugar. The structure of a glucose molecule is shown below.



(i) How many different types of atom are there in one molecule of glucose?
..... [1]

(ii) How many hydrogen atoms are there in one molecule of glucose?
..... [1]

(iii) On the diagram of the glucose molecule above, put a ring around an alcohol functional group. [1]

(iv) Glucose is oxidised in the body by a process called respiration. Complete the word equation for respiration.

glucose + oxygen → + water
..... [1]

(v) When glucose solution is fermented, ethanol is produced. Describe how you would carry out fermentation in the laboratory.
.....
.....
..... [2]

(vi) State **one** use of ethanol other than in alcoholic drinks.
..... [1]

[Total: 11]

DATA SHEET
The Periodic Table of the Elements

Group		Group										
		I	II	III	IV	V	VI	VII	0			
		1 H Hydrogen 1										
7 Li Lithium 3	9 Be Beryllium 4											
23 Na Sodium 11	24 Mg Magnesium 12	11 B Boron 5	12 C Carbon 6	13 Al Aluminium 13	14 N Nitrogen 7	15 P Phosphorus 15	16 O Oxygen 8	17 S Sulfur 16	18 Cl Chlorine 17	19 F Fluorine 9	20 Ne Neon 10	
39 K Potassium 19	40 Ca Calcium 20	27 Fe Iron 26	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	
85 Rb Rubidium 37	88 Sr Strontium 38	55 Mn Manganese 25	56 Fe Iron 26	57 Co Cobalt 27	58 Ni Nickel 28	59 Cu Copper 29	60 Zn Zinc 30	61 Ga Gallium 31	62 Ge Germanium 32	63 As Arsenic 33	64 Kr Krypton 36	
133 Cs Caesium 55	137 Ba Barium 56	52 Cr Chromium 24	53 V Vanadium 23	54 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	57 Co Cobalt 27	58 Ni Nickel 28	59 Cu Copper 29	60 Zn Zinc 30	61 Ga Gallium 31	
		91 Ti Titanium 22	92 V Vanadium 23	93 Cr Chromium 24	94 Mn Manganese 25	95 Fe Iron 26	96 Co Cobalt 27	97 Ni Nickel 28	98 Cu Copper 29	99 Zn Zinc 30	100 Ga Gallium 31	
		101 Ru Ruthenium 44	102 Rh Rhodium 45	103 Pd Palladium 46	104 Ag Silver 47	105 Cd Cadmium 48	106 In Indium 49	107 Sn Tin 50	108 Sb Antimony 51	109 Te Tellurium 52	110 I Iodine 53	
		109 Ta Tantalum 73	110 Hf Hafnium 72	111 Rf Rutherfordium 104	112 Db Dubnium 105	113 Sg Seaborgium 106	114 Bh Bohrium 107	115 Hs Hassium 108	116 Mt Meitnerium 109	117 Ds Darmstadtium 110	118 Og Oganesson 118	
226 Ra Radium 88	227 Ac Actinium 89 †	140 Ce Cerium 58	141 Pr Praseodymium 59	142 Nd Neodymium 60	143 Pm Promethium 61	144 Sm Samarium 62	145 Eu Europium 63	146 Gd Gadolinium 64	147 Tb Terbium 65	148 Dy Dysprosium 66	149 Ho Holmium 67	
		150 Ce Cerium 58	151 Pr Praseodymium 59	152 Nd Neodymium 60	153 Pm Promethium 61	154 Sm Samarium 62	155 Eu Europium 63	156 Gd Gadolinium 64	157 Tb Terbium 65	158 Dy Dysprosium 66	159 Ho Holmium 67	
		160 Er Erbium 68	161 Tm Thulium 69	162 Yb Ytterbium 70	163 Lu Lutetium 71	164 Hf Hafnium 72	165 Ta Tantalum 73	166 W Tungsten 74	167 Re Rhenium 75	168 Os Osmium 76	169 Ir Iridium 77	
		170 Pt Platinum 78	171 Au Gold 79	172 Hg Mercury 80	173 Tl Thallium 81	174 Pb Lead 82	175 Bi Bismuth 83	176 Po Polonium 84	177 At Astatine 85	178 Rn Radon 86	179 Fr Francium 87	
		180 Ra Radium 88	181 Ac Actinium 89 †	182 Th Thorium 90	183 Pa Protactinium 91	184 U Uranium 92	185 Np Neptunium 93	186 Pu Plutonium 94	187 Am Americium 95	188 Cm Curium 96	189 Bk Berkelium 97	
		190 Th Thorium 90	191 Pa Protactinium 91	192 U Uranium 92	193 Np Neptunium 93	194 Pu Plutonium 94	195 Am Americium 95	196 Cm Curium 96	197 Bk Berkelium 97	198 Cf Californium 98	199 Es Einsteinium 99	
		200 Fm Fermium 100	201 Md Mendelevium 101	202 No Nobelium 102	203 Lr Lawrencium 103	204 Rf Rutherfordium 104	205 Db Dubnium 105	206 Sg Seaborgium 106	207 Bh Bohrium 107	208 Hs Hassium 108	209 Og Oganesson 118	

*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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