



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
International General Certificate of Secondary Education

CANDIDATE  
NAME

CENTRE  
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.

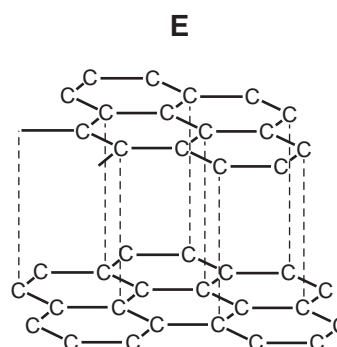
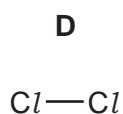
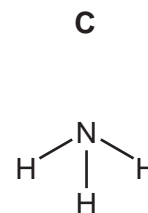
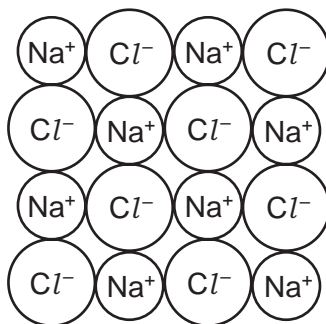
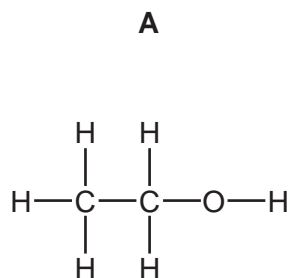
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This document consists of **14** printed pages and **2** blank pages.



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

For  
Examiner's  
Use



(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 <sup>3</sup>	4.50		7.20	7.20	7.86	8.90	8.90	8.92

For  
Examiner's  
Use

- (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]

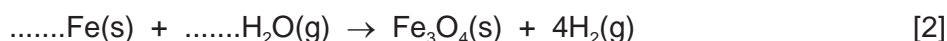
- (d) Describe **three** properties of transition metals, apart from catalytic activity, which make them different from Group I metals.

1. ....

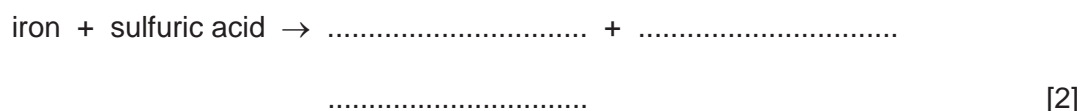
2. ....

3. .... [3]

- (e) Iron reacts with steam to form an oxide with the formula Fe<sub>3</sub>O<sub>4</sub>.  
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.

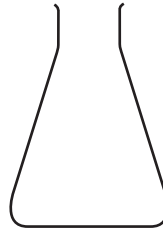
A



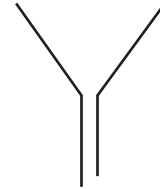
B



C



D



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

A .....

B .....

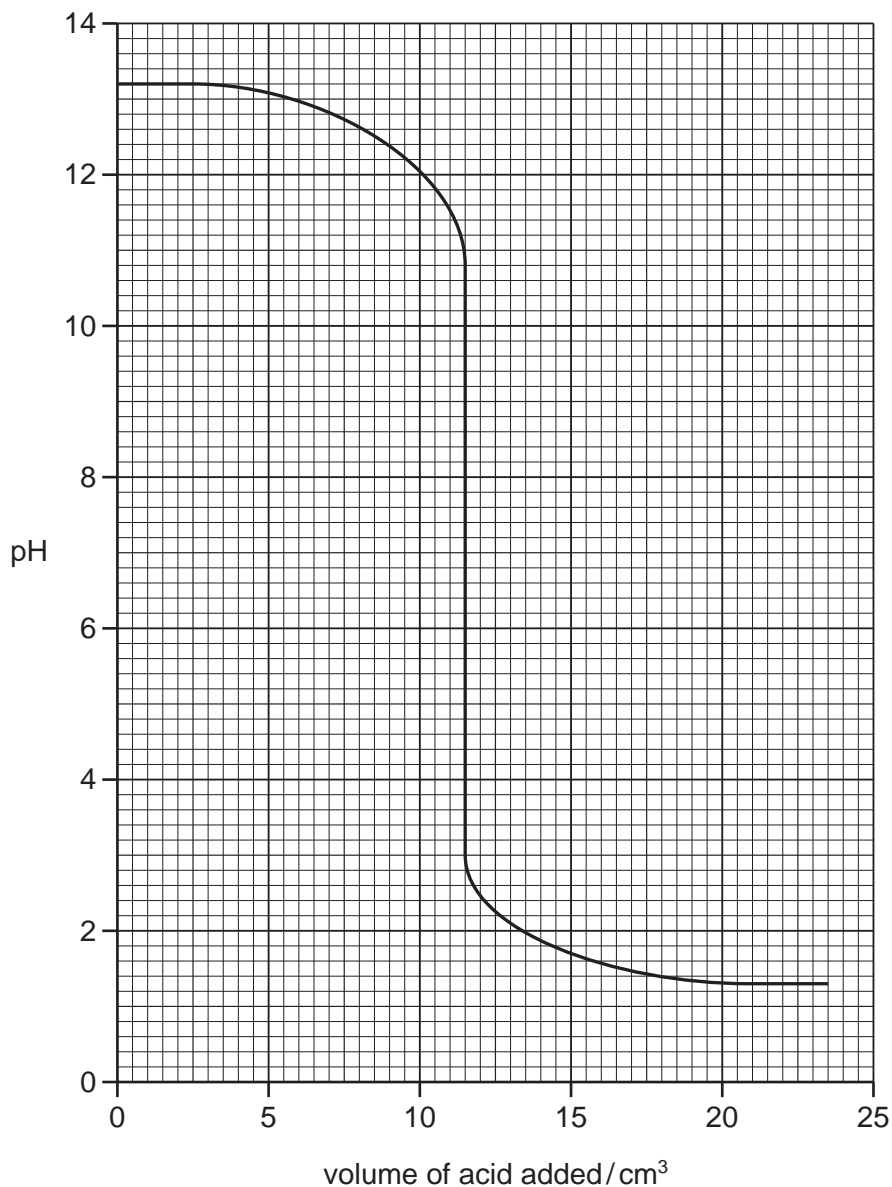
C .....

D .....

[4]

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

For  
Examiner's  
Use



(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?

..... cm<sup>3</sup> [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]

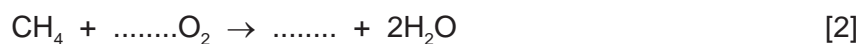
(ii) State the name of **one** other member of the alkane homologous series.

..... [1]

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

..... [1]

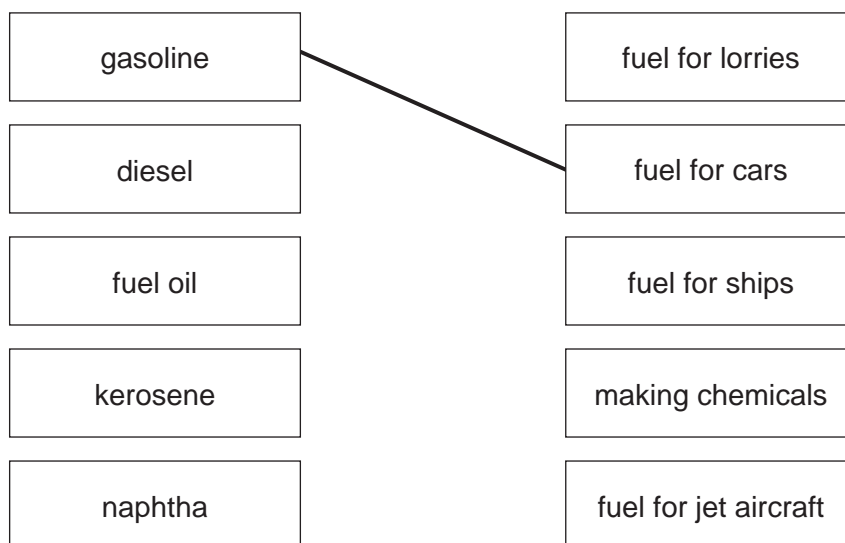
(iv) Methane burns in excess oxygen to form carbon dioxide and water.  
Complete the symbol equation for this reaction.



(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]

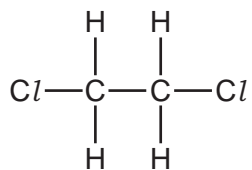
[Total: 10]





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

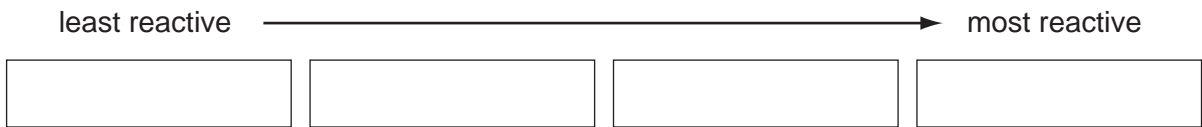
[2]

[Total: 12]

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

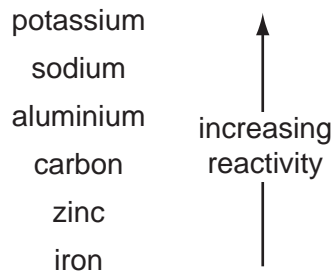
metal	reaction
calcium	reacts rapidly with cold water producing many bubbles of gas
magnesium	reacts very slowly with cold water but reacts rapidly with steam
rubidium	reacts very rapidly with cold water producing many bubbles of gas and will explode
zinc	only reacts with steam when in powdered form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

Put these metals in order of their reactivity.



[2]

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

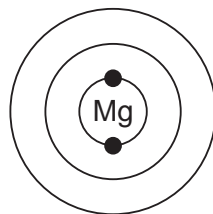


Give the names of **two** metals from this list that can be extracted from their oxide ores by heating with carbon.

..... 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]

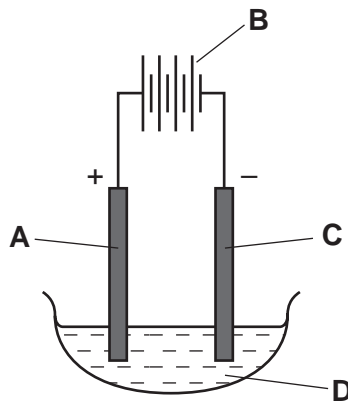
- (b) Suggest why an aqueous solution of sucrose does **not** conduct electricity.

..... [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]

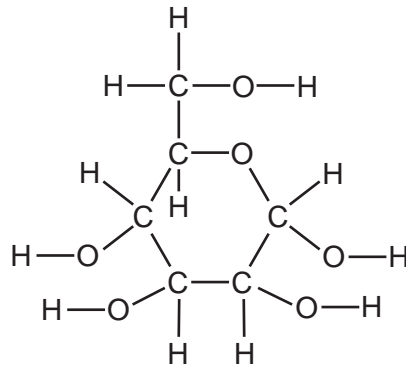
[Total: 11]

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		I	II	III	IV	V	VI	VII	0																		
		1 <b>H</b> Hydrogen 1							2 <b>He</b> Helium 2																		
3	4	7 <b>Li</b> Lithium	9 <b>Be</b> Beryllium		11 <b>B</b> Boron	12 <b>C</b> Carbon	13 <b>Al</b> Aluminium	14 <b>Si</b> Silicon	15 <b>P</b> Phosphorus	16 <b>S</b> Sulfur	17 <b>Cl</b> Chlorine	18 <b>Ar</b> Argon															
11	12	23 <b>Na</b> Sodium	24 <b>Mg</b> Magnesium		27 <b>Fe</b> Iron	28 <b>Ni</b> Nickel	29 <b>Cu</b> Copper	30 <b>Zn</b> Zinc	31 <b>Ga</b> Gallium	32 <b>Ge</b> Germanium	33 <b>As</b> Arsenic	34 <b>Se</b> Selenium	35 <b>Br</b> Bromine	36 <b>Kr</b> Krypton													
19	20	39 <b>K</b> Potassium	40 <b>Ca</b> Calcium		44 <b>Ru</b> Ruthenium	45 <b>Rh</b> Rhodium	46 <b>Pd</b> Palladium	47 <b>Ag</b> Silver	48 <b>Cd</b> Cadmium	49 <b>In</b> Indium	50 <b>Sn</b> Tin	51 <b>Sb</b> Antimony	52 <b>Te</b> Tellurium	53 <b>I</b> Iodine	54 <b>Xe</b> Xenon												
37	38	85 <b>Rb</b> Rubidium	88 <b>Sr</b> Strontium		101 <b>Ru</b> Ruthenium	102 <b>Rh</b> Rhodium	103 <b>Pd</b> Palladium	104 <b>Ag</b> Silver	105 <b>Cd</b> Cadmium	106 <b>In</b> Indium	107 <b>Sn</b> Tin	108 <b>Sb</b> Antimony	109 <b>Te</b> Tellurium	110 <b>I</b> Iodine	111 <b>Xe</b> Xenon												
55	56	133 <b>Cs</b> Caesium	137 <b>Ba</b> Barium		186 <b>Re</b> Rhenium	187 <b>Rh</b> Rhodium	188 <b>Pt</b> Platinum	189 <b>Au</b> Gold	190 <b>Hg</b> Mercury	191 <b>Tl</b> Thallium	192 <b>Pb</b> Lead	193 <b>Bi</b> Bismuth	194 <b>Po</b> Polonium	195 <b>At</b> Astatine	196 <b>Rn</b> Radon												
87	88	226 <b>Fr</b> Francium	226 <b>Ra</b> Radium		227 <b>Ac</b> Actinium	227 <b>Ac</b> Actinium	227 <b>Ac</b> Actinium	227 <b>Ac</b> Actinium	227 <b>Ac</b> Actinium	227 <b>Ac</b> Actinium	227 <b>Ac</b> Actinium	227 <b>Ac</b> Actinium	227 <b>Ac</b> Actinium	227 <b>Ac</b> Actinium	227 <b>Ac</b> Actinium	227 <b>Ac</b> Actinium											
		*58-71 Lanthanoid series																									
		†90-103 Actinoid series																									
		Key																									
		a	X	b																							
					a = relative atomic mass	X = atomic symbol	b = proton (atomic) number																				
					140 <b>Ce</b> Cerium	141 <b>Pr</b> Praseodymium	142 <b>Nd</b> Neodymium	143 <b>Pm</b> Promethium	144 <b>Sm</b> Samarium	145 <b>Eu</b> Europium	146 <b>Gd</b> Gadolinium	147 <b>Tb</b> Terbium	148 <b>Dy</b> Dysprosium	149 <b>Ho</b> Holmium	150 <b>Er</b> Erbium	151 <b>Tm</b> Thulium	152 <b>Yb</b> Ytterbium	153 <b>Lu</b> Lutetium									
		232 <b>Th</b> Thorium	232 <b>Pa</b> Protactinium	238 <b>U</b> Uranium	238 <b>Np</b> Neptunium	238 <b>Pu</b> Plutonium	238 <b>Am</b> Americium	238 <b>Cm</b> Curium	238 <b>Bk</b> Berkelium	238 <b>Cf</b> Californium	238 <b>Es</b> Einsteinium	238 <b>Fm</b> Fermium	238 <b>Md</b> Mendelevium	238 <b>No</b> Nobelium	238 <b>Lr</b> Lawrencium	238 <b>U</b> Uranium	238 <b>Np</b> Neptunium	238 <b>Pu</b> Plutonium	238 <b>Am</b> Americium	238 <b>Cm</b> Curium	238 <b>Bk</b> Berkelium	238 <b>Cf</b> Californium	238 <b>Es</b> Einsteinium	238 <b>Fm</b> Fermium	238 <b>Md</b> Mendelevium	238 <b>No</b> Nobelium	238 <b>Lr</b> Lawrencium

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

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