UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

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.

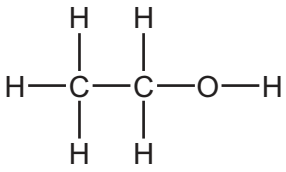
This document consists of **14** printed pages and **2** blank pages.

UNIVERSITY of CAMBRIDGE International Examinations

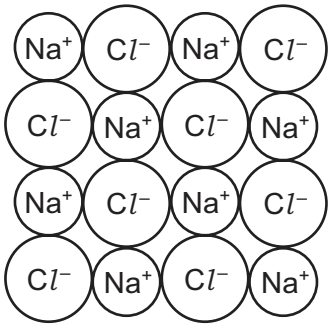
For Examiner's Use

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

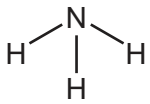
A



B

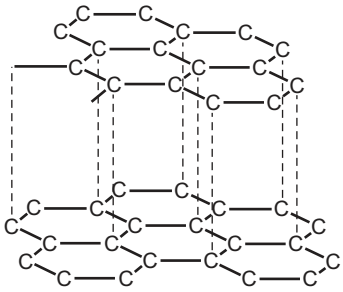


C



D

E



(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]

For Examiner's Use

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 Fe_3O_4.
Complete the symbol equation for this reaction.

$$.....Fe(s) + ...H_2O(g) \rightarrow Fe_3O_4(s) + 4H_2(g)$$ [2]

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

iron + sulfuric acid → ..... + ...

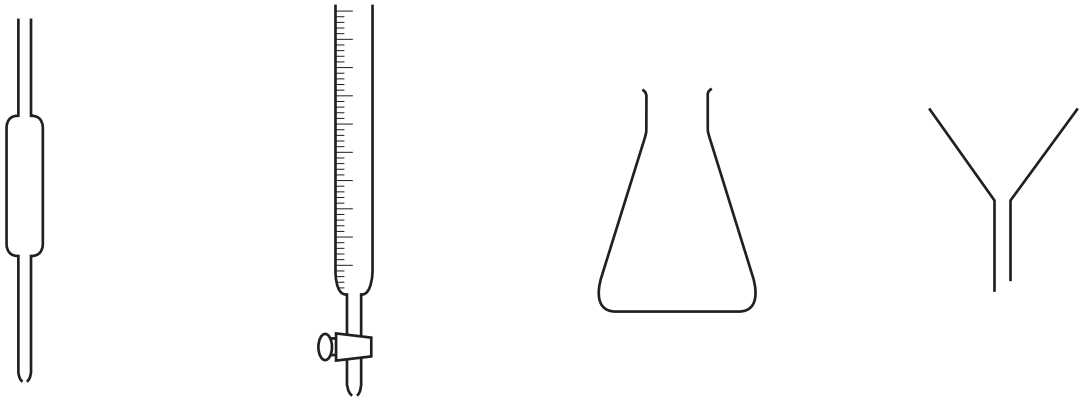
..... [2]

[Total: 10]

For Examiner's Use

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 .....

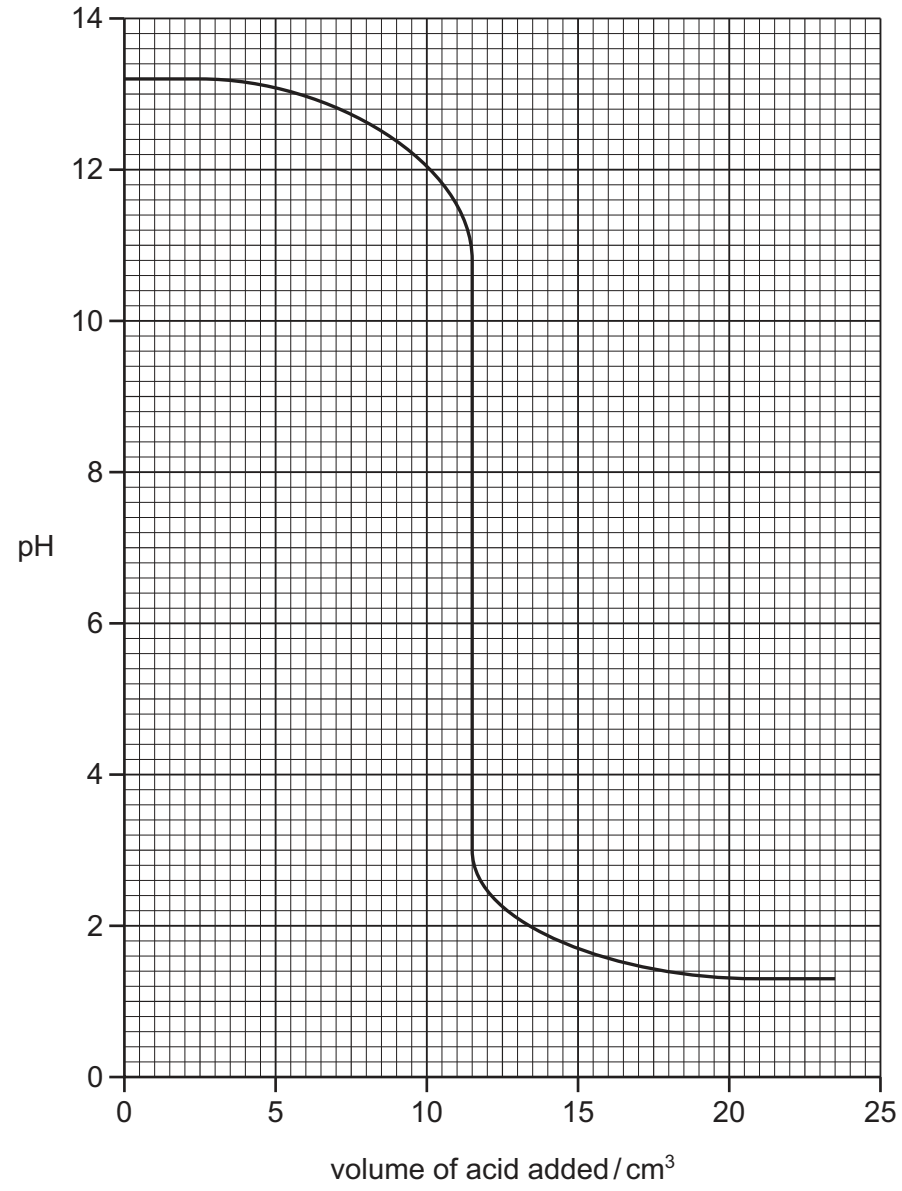
B .....

C .....

D ..... [4]

For Examiner's Use

(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?

..... cm^3 [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]

For Examiner's Use

(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]

For Examiner's Use

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]

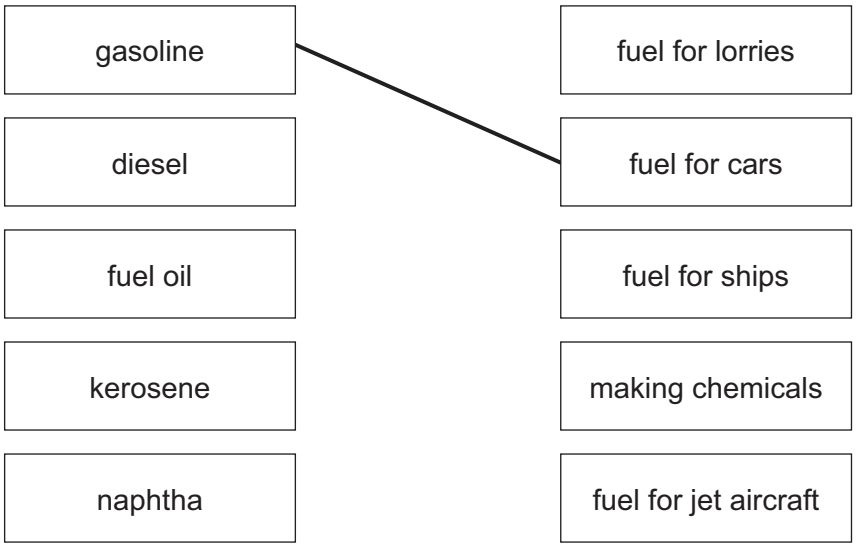
(iv) Methane burns in excess oxygen to form carbon dioxide and water.
Complete the symbol equation for this reaction.

$$CH_4 + ...O_2 \rightarrow ..... + 2H_2O$$ [2]

(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]

For Examiner's Use

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.

.....

.....

.....

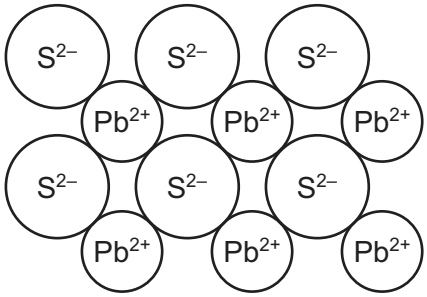
.....

.....

..... [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]

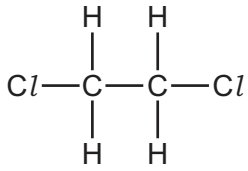
(ii) The last stage in extracting lead involves reducing lead(II) oxide with carbon.

$$PbO + C \rightarrow Pb + CO$$

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 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.

least reactive ⟶ most reactive

[2]

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

potassium
sodium
aluminium
carbon
zinc
iron

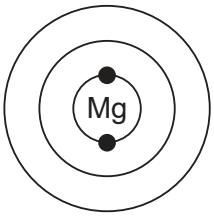
increasing reactivity ↑

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]

For Examiner's Use

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]

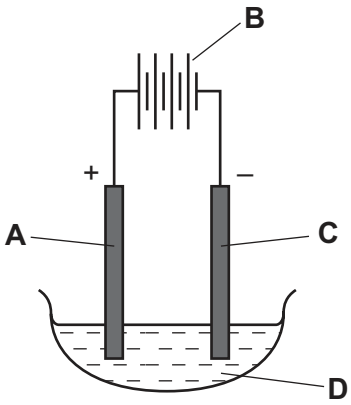
(c) Suggest how you could separate a mixture of solid sucrose and solid sulfur.

.....

.....

..... [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.

at the start after 2 minutes after 10 minutes

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

.....

.....

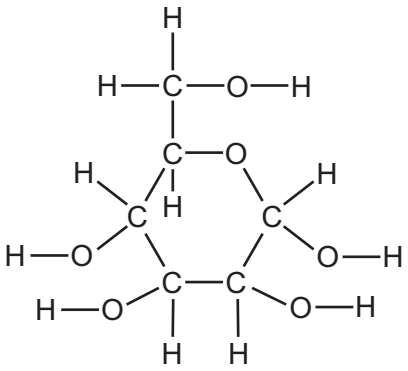
.....

.....

..... [4]

For Examiner's Use

(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]

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DATA SHEET
The Periodic Table of the Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H Hydrogen 1										4 He Helium 2
7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
23 Na Sodium 11	24 Mg Magnesium 12											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
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	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
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	Rn Radon 86
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 X b

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

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