UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

3659885698

CHEMISTRY **0620/23**

Paper 2 **October/November 2012**

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.

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1	
2	
3	
4	
5	
6	
7	
8	
Total	

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

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1 Part of the Periodic Table of elements is shown below.

H				He
	N	O	F	Ne
	P	S	Cl	Ar
			Br	
			I	

(a) Answer the following questions using **only** the elements shown in the table above.

Write the symbol for an element which

(i) is used to fill light bulbs, ... [1]

(ii) is in Group VI and Period 3 of the Periodic Table, ... [1]

(iii) is a greyish-black solid, ... [1]

(iv) forms about 79 % of the air, ... [1]

(v) consists of single atoms with a full outer shell of electrons, ... [1]

(vi) is liberated at the cathode when concentrated hydrochloric acid is electrolysed. ..... [1]

(b) Hydrogen reacts with chlorine to form hydrogen chloride.

(i) Complete the equation for this reaction.

$$H_2 + \text{.....} \rightarrow \text{.....}HC\mathit{l}$$

[2]

(ii) Draw the electronic structure of a chlorine molecule.
Show only the outer shell electrons.

[2]

[Total: 10]

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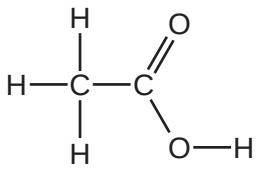
2 Vinegar contains ethanoic acid. The formula of ethanoic acid is shown below.



(a) **(i)** On the formula above, put a ring around the carboxylic acid functional group. [1]

(ii) Write the simplest formula for a molecule of ethanoic acid.

[1]

(b) Ethanoic acid reacts with sodium hydroxide to form the salt sodium ethanoate.

ethanoic acid + sodium hydroxide $\rightarrow$ sodium ethanoate + water

What type of chemical reaction is this?

..... [1]

(c) Sodium ethanoate is soluble in water.
What do you understand by the term *soluble*?

..... [1]

(d) Which **one** of the following is the most likely pH value of ethanoic acid?
Put a ring around the correct answer.

pH 3 **pH 7** **pH 9** **pH 13**

[1]

(e) All acids react with carbonates.
Complete the general equation for this reaction.

acid + carbonate $\rightarrow$ salt + ... + ...

.....

[2]

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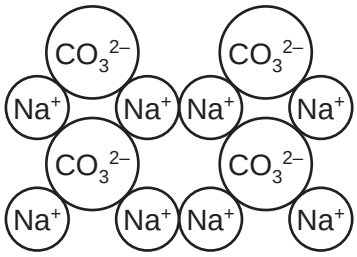
(f) The structure of sodium carbonate is shown below.



Write the simplest formula for sodium carbonate.

..... [1]

[Total: 8]

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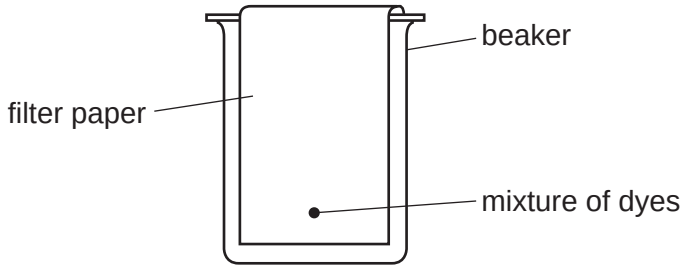
3 A student used the apparatus shown below to separate a mixture of coloured dyes. The solvent is not shown.



(a) On the diagram above, draw and label the position of the solvent at the start of the experiment. [1]

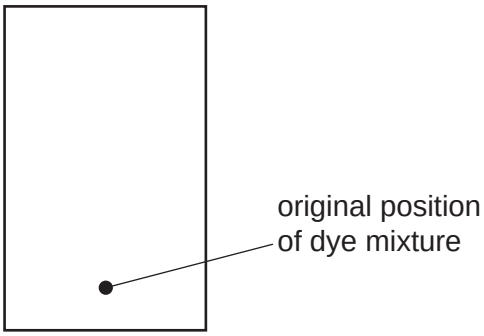
(b) The student let the solvent move up the filter paper to separate the dyes.

(i) State the name of this method of separation.

..... [1]

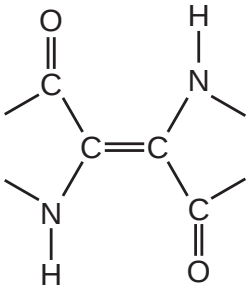
(ii) The student found that four different dyes had been separated by this method. On the diagram below draw

- the position of four separated dyes (show as spots)
- the solvent front (show as a line).



[3]

(c) Part of the structure of a dye called indigo is shown below.



Is this a saturated or unsaturated compound?
Give a reason for your answer.

..... [1]

[Total: 6]

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4 Hydrogen can be manufactured by heating methane with steam.

$$CH_4 + H_2O \xrightarrow{400\,^{\circ}C + \text{catalyst}} CO + 3H_2$$

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

[1]

(ii) Methane is a greenhouse gas.
What do you understand by the term *greenhouse gas*?

..... [1]

(iii) State **one** source of the methane in the atmosphere.

..... [1]

(iv) When 16 g of methane reacts completely with an excess of steam, 6 g of hydrogen are produced.
Calculate the mass of methane required to produce 300 g of hydrogen.

Answer = ... [1]

(b) More hydrogen can be formed by reacting the carbon monoxide with more steam at 500 °C.

$$CO + H_2O \rightleftharpoons CO_2 + H_2$$

This reaction is reversible.

(i) How do you know from this equation that the reaction is reversible?

..... [1]

(ii) What do you understand by the term *reversible reaction*?

..... [1]

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(iii) Carbon monoxide is a common atmospheric pollutant.
State a source of the carbon monoxide in the atmosphere other than from the manufacture of hydrogen.

..... [1]

(iv) Carbon dioxide is a product of the reaction between carbon monoxide and steam.
Is carbon dioxide an acidic or a basic oxide?
Give a reason for your answer.

..... [1]

[Total: 8]

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5 Ethanol can be made by

- an addition reaction with ethene or
- by fermentation.

(a) (i) State the name of the substance that needs to be added to ethene to make ethanol.

..... [1]

(ii) What conditions are needed to make ethanol from ethene?

.....

..... [2]

(b) (i) Complete the word equation for fermentation in the presence of yeast.

..... → ethanol + ...

.....

[2]

(ii) The yeast contains enzymes.
What do you understand by the term *enzyme*?

.....

..... [2]

(c) The speed of ethanol formation during fermentation depends on the temperature.

(i) Use the information in the table below to describe how the speed of this reaction changes with temperature.

temperature / °C	speed of reaction / g ethanol formed per hr
10	1
20	3
30	7
40	11
50	6
60	2
70	0

.....

.....

..... [3]

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(ii) State **two** factors which should be kept constant during this experiment.

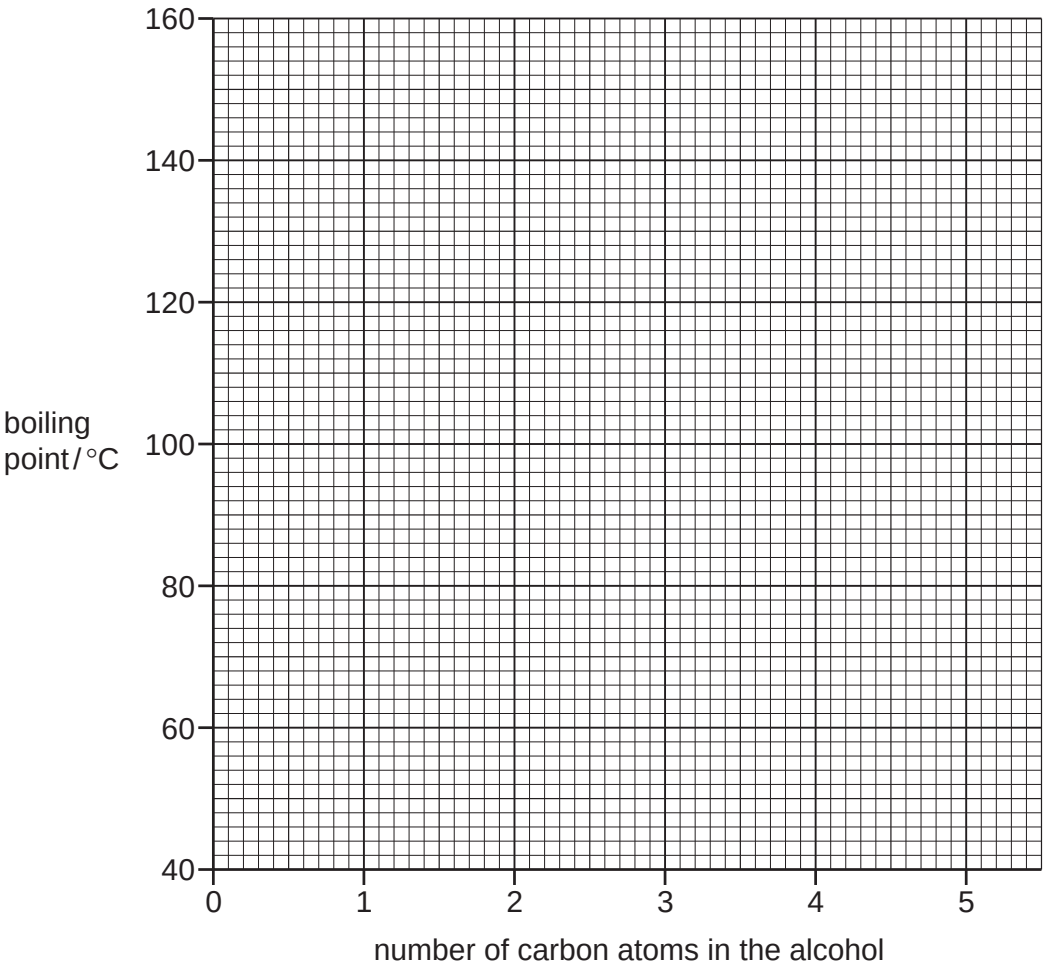
.....

..... [2]

(d) Ethanol belongs to the alcohol homologous series.
The boiling points of some alcohols are given in the table below.

alcohol	number of carbon atoms in the alcohol	boiling point / °C
methanol	1	65
ethanol	2	79
propanol	3	98
butanol	4	117

(i) On the grid below, plot a graph of boiling point against the number of carbon atoms.
Join the points with a smooth line.



[3]

(ii) Use your graph to estimate the boiling point of the alcohol having five carbon atoms.

boiling point = ...°C [1]

[Total: 16]

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6 Lead and lead compounds are common pollutants of the air.

(a) (i) State **one** source of lead in the air.

..... [1]

(ii) State **one** effect of lead on human health.

..... [1]

(b) Lead(II) oxide can be reduced by heating with carbon.

$$PbO + C \xrightarrow{heat} Pb + CO$$

(i) Write a word equation for this reaction.

..... [1]

(ii) Explain how you know that lead(II) oxide is reduced in this reaction.

.....

..... [1]

(iii) Explain why this reaction is described as endothermic.

..... [1]

(c) Lead nitrate solution reacts with sodium iodide solution.

lead nitrate + sodium iodide → lead iodide + sodium nitrate

Lead iodide is insoluble in water but the reactants and sodium nitrate are soluble.
Draw a labelled diagram to explain how you can separate lead iodide from the rest of the reaction mixture.

[2]

(d) Complete the table below to show the number of protons, electrons and neutrons in the isotope of lead $^{204}_{82}Pb$.

number of protons	
number of electrons	
number of neutrons	

[2]

[Total: 9]

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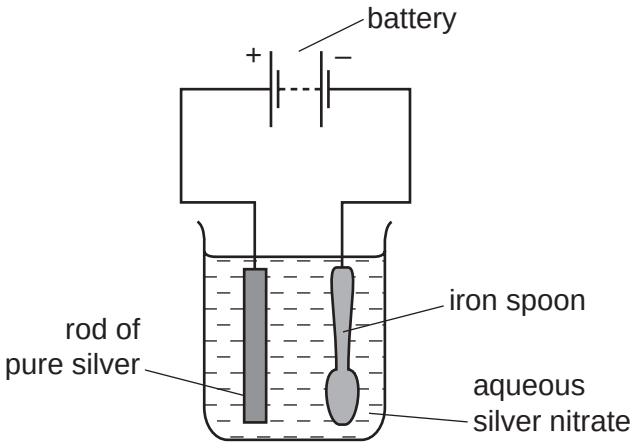
7 The diagram below shows the apparatus used to electroplate a spoon with silver.



(a) Which is the anode?
Put a ring around the correct answer in the list below.

aqueous silver nitrate

battery

iron spoon

rod of pure silver

[1]

(b) Describe what happens to the silver rod and the iron spoon during electroplating.

silver rod .....

iron spoon ..... [2]

(c) Why are metal objects electroplated?

..... [1]

(d) During the electroplating, silver atoms are converted to silver ions.
Which one of the following statements about this reaction is correct?
Tick **one** box.

Silver atoms gain electrons. ☐

Silver atoms lose neutrons. ☐

Silver atoms lose electrons. ☐

Silver atoms gain protons. ☐

[1]

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(e) A student is given a slightly alkaline solution which contains chloride ions.
Describe how the student could use aqueous silver nitrate to show that chloride ions are present in the solution.

.....

.....

..... [3]

(f) Silver is a shiny metallic solid with a high melting point and boiling point.
Describe two **other** physical properties of silver.

1 .....

2 ..... [2]

[Total: 10]

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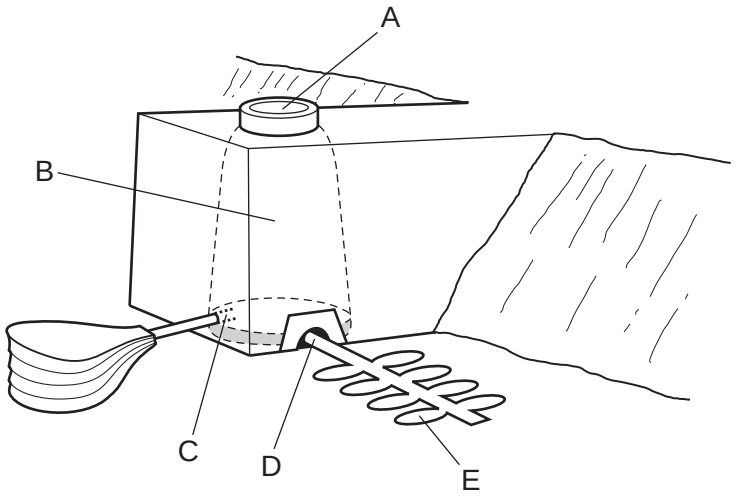
8 The diagram shows a type of blast furnace built about 230 years ago. It was used to extract iron from iron ore.



(a) Which letter on the diagram shows

(i) where the solid raw materials are put into the furnace, ... [1]

(ii) where air is blown into the furnace, ... [1]

(iii) where iron is removed from the furnace? ..... [1]

(b) Describe the main reactions occurring in a blast furnace for extracting iron from iron ore. In your answer, include

- the names of the raw materials used
- the main chemical reactions which occur
- relevant word equations.

.....

.....

.....

.....

.....

.....

..... [5]

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(c) Iron reacts with hydrochloric acid.

(i) Complete the word equation for this reaction.

iron + hydrochloric acid → ..... + ...

.....

[2]

(ii) Iron(II) ions are formed in this reaction.
Describe a test for iron(II) ions.

test .....

result ..... [2]

(d) Steel is an alloy of iron.
Which one of the following statements about steel is correct?
Tick **one** box.

Steel is a mixture of iron with sulfur atoms.	☐
Stainless steel is commonly used to make car bodies.	☐
The physical properties of steel are exactly the same as those of iron.	☐
Steel is made by blowing oxygen through the molten iron obtained from the blast furnace.	☐

[1]

[Total: 13]

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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	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 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	Rn Radon 86
226 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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