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.

For Examiner's Use	
1	
2	
3	
4	
5	
6	
7	
8	
Total	

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

UNIVERSITY of CAMBRIDGE International Examinations

For Examiner's Use

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.

$$H_2 + \text{.....} \rightarrow \text{.....}HCl$$

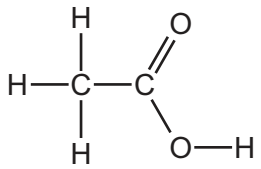
[2]

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

[2]

[Total: 10]

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 → 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]

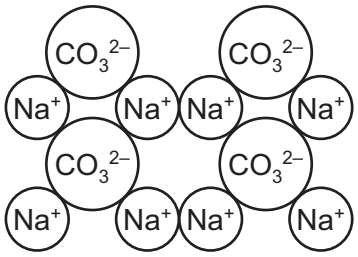
(e) All acids react with carbonates.
Complete the general equation for this reaction.

acid + carbonate → salt + ... + ...

.....

[2]

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

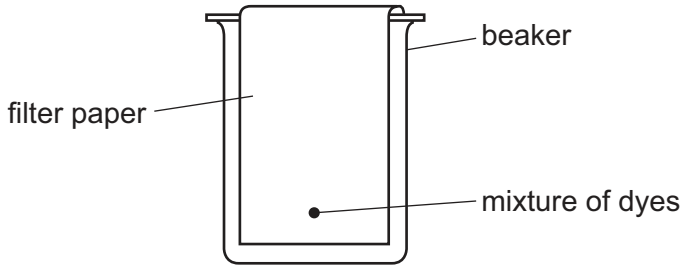


Write the simplest formula for sodium carbonate.

..... [1]

[Total: 8]

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]

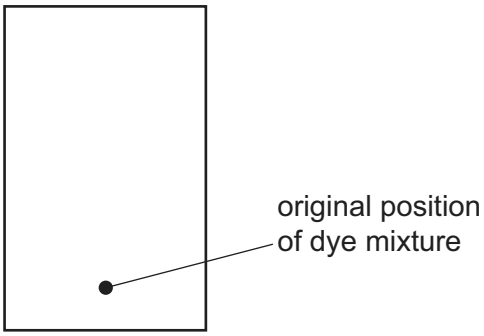
(b) The student let the solvent move up the filter paper to separate the dyes.

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

..... [1]

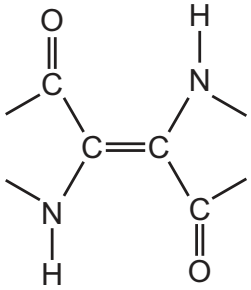
(ii) The student found that four different dyes had been separated by this method. On the diagram below draw

- 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]

(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]

[Turn over

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]

For Examiner's Use

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

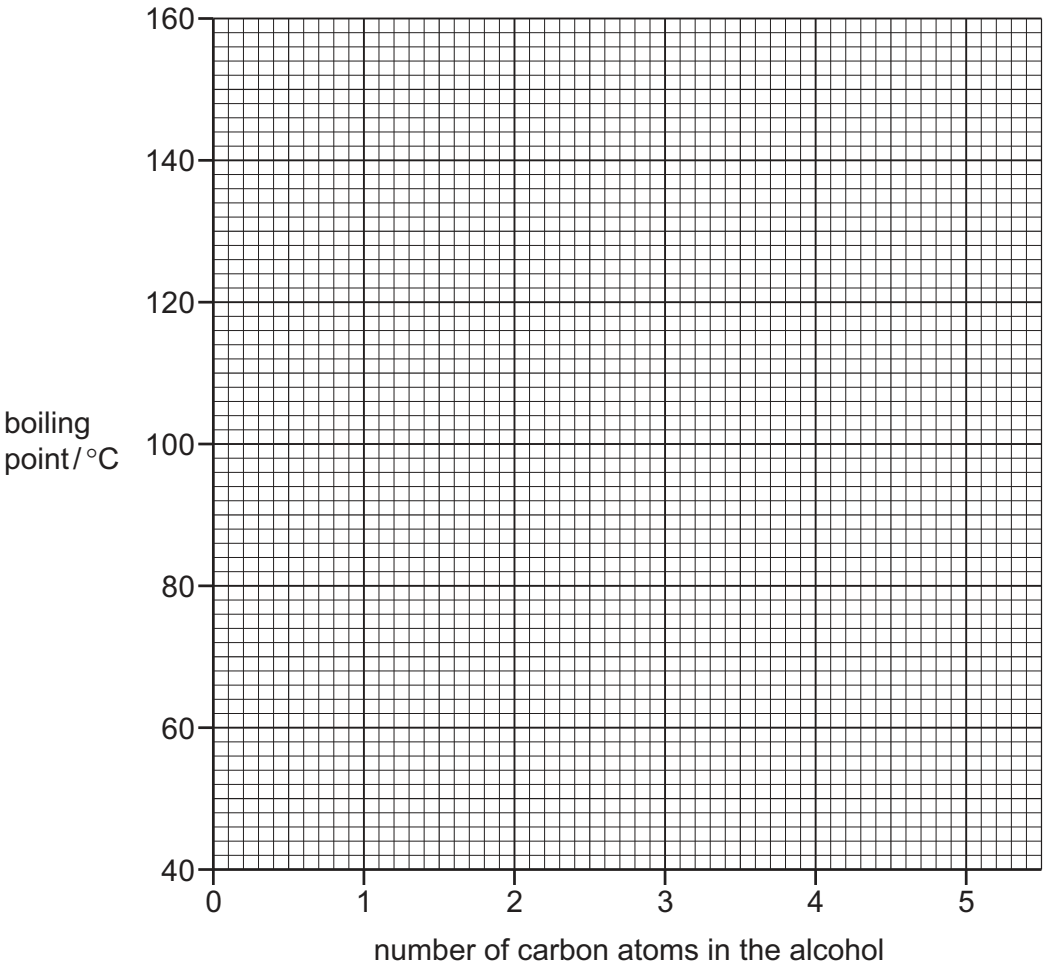
.....

..... [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]

For Examiner's Use

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 $^{204}_{82}Pb$.

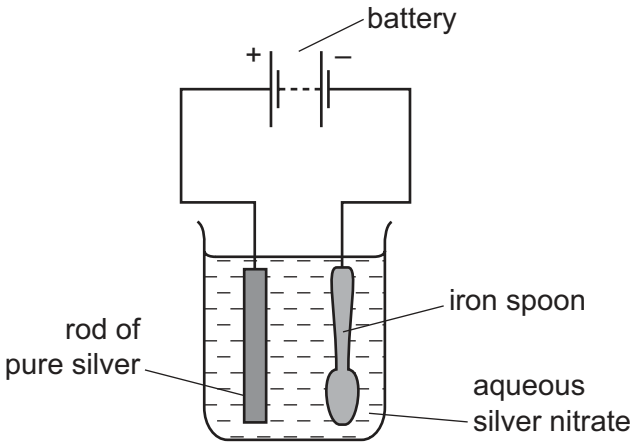
number of protons	
number of electrons	
number of neutrons	

[2]

[Total: 9]

For Examiner's Use

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]

(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.

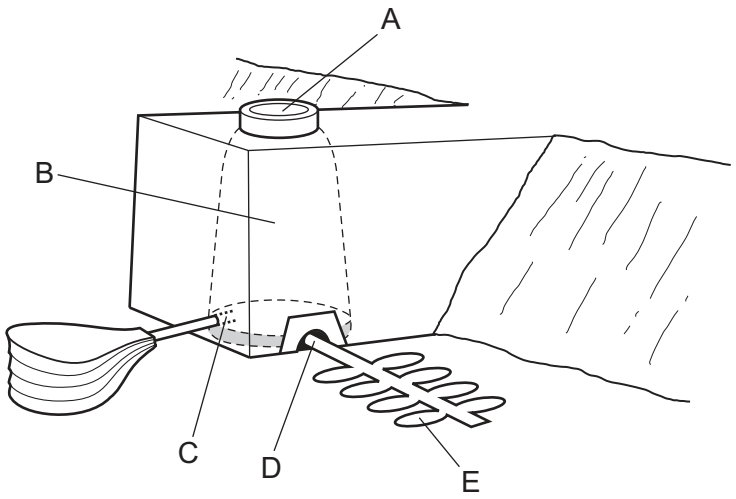
1 .....

2 ..... [2]

[Total: 10]

For Examiner's Use

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]

(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	119 **In** Indium 49	122 **Sn** Tin 50	128 **Sb** Antimony 51	127 **Te** Tellurium 52	131 **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
	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.).