UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

5356166968

CHEMISTRY **0620/23**

Paper 2 **May/June 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	
Total	

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

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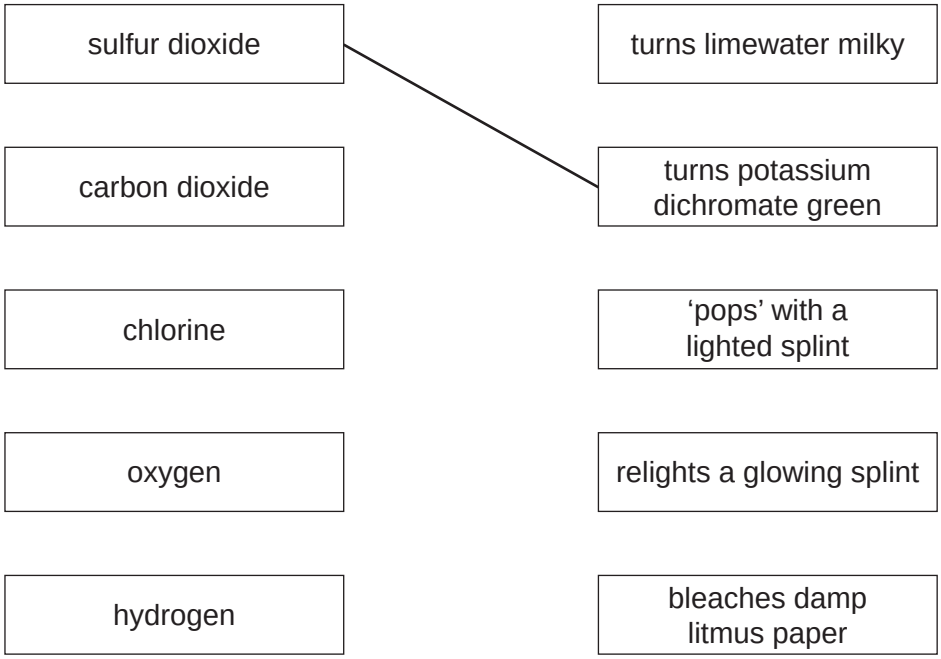
1 **(a)** Gases can be identified by carrying out particular tests.
Some gases and tests to identify them are shown below.

Match the gases on the left with the tests on the right.
The first one has been done for you.



[4]

(b) Chlorine can be prepared by heating hydrochloric acid with manganese(IV) oxide.

$$MnO_2 + 4HCl \rightarrow MnCl_2 + Cl_2 + 2H_2O$$

(i) Write a word equation for this reaction.

[3]

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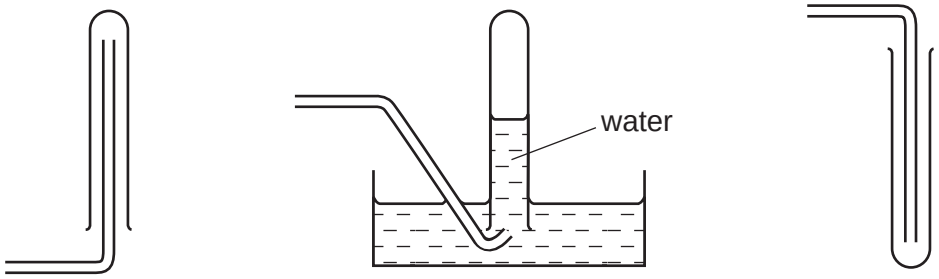
(ii) Chlorine is

- denser than air
- soluble in water.

Which **one** of the following diagrams, **A**, **B** or **C**, best describes how chlorine gas is collected?

A **B** **C**



Answer = ... [1]

(c) Hydrogen reacts with oxygen to form water.

(i) Complete the equation for this reaction.

$$2H_2 + ... \rightarrow .....H_2O$$

[2]

(ii) State **one** use of

hydrogen, ...

water. ..... [2]

[Total: 12]

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2 Alkalis are soluble bases.

(a) Which **one** of the following is alkaline?
Put a ring around the correct answer.

distilled water **hydrochloric acid**

sodium chloride solution **sodium hydroxide solution**

[1]

(b) Suggest a pH value for a solution which is alkaline.

..... [1]

(c) Describe how you would find the pH of a solution.

.....

.....

..... [2]

(d) When excess fertilisers are put on the soil, the soil may become acidic.

(i) Why is it important to farmers that the soil does not become too acidic?

..... [1]

(ii) Calcium carbonate is used to decrease the acidity of the soil. Explain how calcium carbonate decreases soil acidity.

.....

..... [2]

[Total: 7]

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3 The table below shows some properties of the halogens.

halogen	melting point / °C	boiling point / °C	colour
chlorine	–101	–35	
bromine	–7	+59	
iodine	+114	+184	greyish-black

(a) (i) Complete the spaces in the table to show the colours of chlorine and bromine. [2]

(ii) Room temperature is about 20 °C.
Use the information in the table to explain why

chlorine is a gas at room temperature, ...

.....

bromine is a liquid at room temperature. .....

..... [2]

(iii) Astatine is the halogen below iodine in the Periodic Table.
Suggest a value for the melting point of astatine.

..... [1]

(b) Chlorine reacts with an aqueous solution of potassium iodide.

(i) Complete the balanced equation for this reaction.

$$Cl_2 + ...KI \rightarrow 2KCl + ...$$

[2]

(ii) State the names of the products of this reaction.

..... [2]

(iii) To which period in the Periodic Table does chlorine belong?

..... [1]

(c) Complete the following sentences about the test for iodide ions using words from the list below.

hydrochloric **nitric** **potassium** **precipitate**

silver **solution** **white** **yellow**

A small volume of solution containing aqueous iodide ions is put into a test-tube. Dilute ..... acid is added followed by a few drops of ..... nitrate solution. A ..... coloured ..... is formed if iodide ions are present. [4]

[Total: 14]

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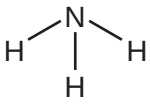
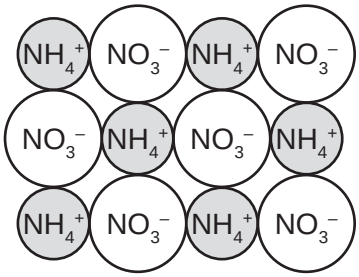
4 The diagram below shows the structure of some substances containing nitrogen.

A

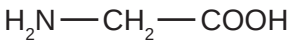
B



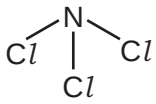
C



D



E



(a) (i) Which one of these substances, **A**, **B**, **C**, **D** or **E**, is an alkaline gas? ☐

(ii) Which one of these substances is an ionic salt? ☐

(iii) Which one of these substances contains a carboxylic acid functional group? ☐

[3]

(b) Oxides of nitrogen such as nitrogen dioxide, NO_2, are atmospheric pollutants.
Give **one** source of nitrogen oxides in the air.

..... [1]

(c) State **one** harmful effect of nitrogen dioxide.

..... [1]

(d) Calculate the relative formula mass of nitrogen dioxide, NO_2.

[1]

(e) In the presence of a catalyst, nitrogen dioxide reacts with carbon monoxide.

$$2NO_2 + 4CO \rightarrow N_2 + 4CO_2$$

(i) Which substance gets oxidised during this reaction? Explain your answer.

.....

..... [2]

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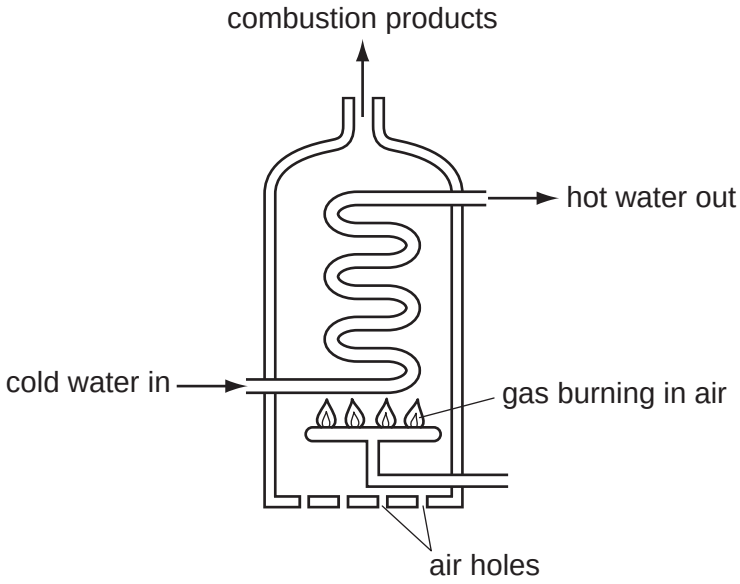
(ii) What is the meaning of the term *catalyst*?

..... [1]

(iii) Carbon monoxide is formed when some of the air holes in a water heater get blocked. The diagram shows a water heater.



Explain why carbon monoxide is formed when some of the air holes in a water heater get blocked.

.....

..... [2]

(iv) Explain why carbon monoxide is dangerous.

..... [1]

[Total: 12]

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5 Iron is a shiny metallic solid. Iron is a transition element.

(a) State **three** other physical properties of a transition element.

.....

.....

..... [3]

(b) Iron reacts with sulfuric acid.

$$Fe + H_2SO_4 \rightarrow FeSO_4 + H_2$$

(i) Write a word equation for this reaction.

..... [2]

(ii) Describe, with the aid of a diagram, how you could measure the speed of this reaction.
In your answer describe:

- the apparatus you would use
- the measurements you would take.

.....

.....

.....

..... [4]

(c) When iron reacts with sulfur, energy is released.

(i) What is the name given to a reaction which releases energy?

..... [1]

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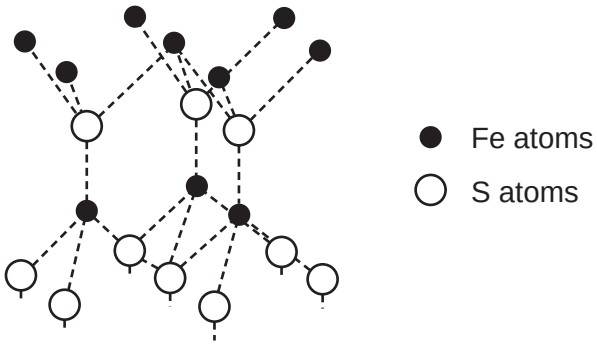
(ii) The compound formed in this reaction is iron(II) sulfide.
What do you understand by the term *compound*?

.....

..... [1]

(iii) The diagram below shows the structure of iron(II) sulfide.



What is the simplest formula for iron(II) sulfide?

..... [1]

[Total: 12]

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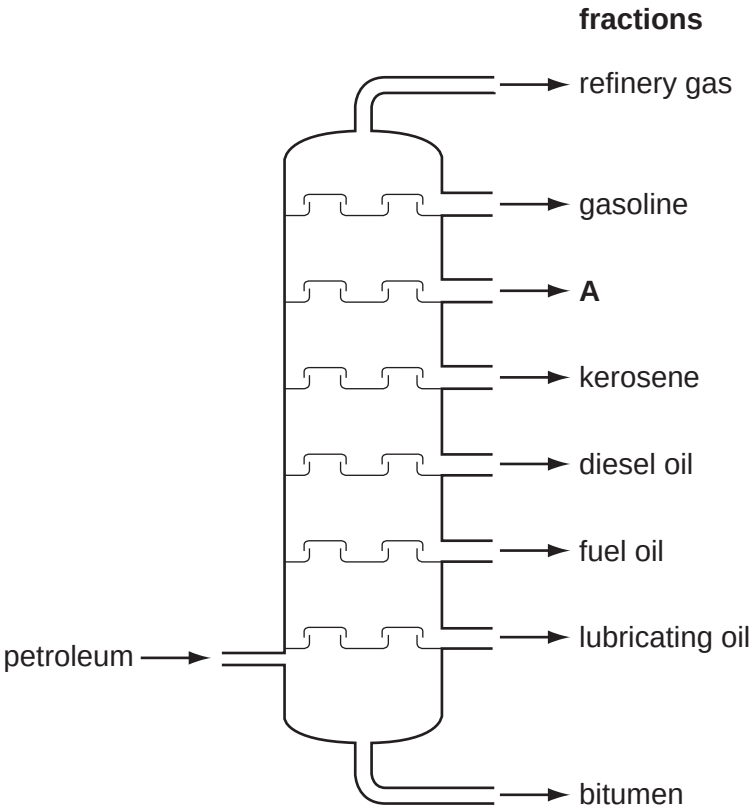
6 The diagram shows a fractionating column used to separate different hydrocarbon fractions in an oil refinery.



(a) On the diagram, draw an X to show the place in the column where the temperature is the highest. [1]

(b) State the name of the fraction labelled **A**.

..... [1]

(c) State a use for

the kerosene fraction, ...

the diesel oil fraction. ..... [2]

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(d) Complete the following sentences about fractional distillation using words from the list below.

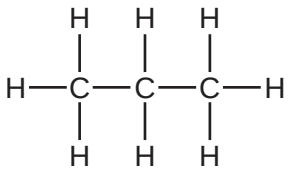
boiling **condenses** **cooled** **heated** **higher**

lower **melting** **mixture** **pressure** **vaporises**

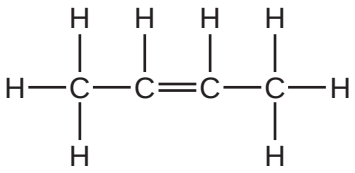
Petroleum is a ..... of hydrocarbons. This mixture is ..... and the hydrocarbons vaporise. The temperature in the fractionating column is ..... at the top than at the bottom. As the vapours move up the column, each hydrocarbon fraction ..... when the temperature in the column falls below the ..... point of the hydrocarbon fraction. [5]

(e) The structures of four hydrocarbons, **A**, **B**, **C** and **D**, are shown below.

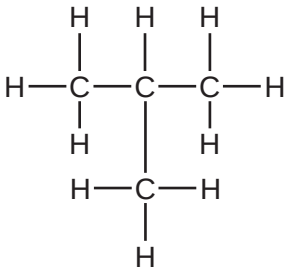
A



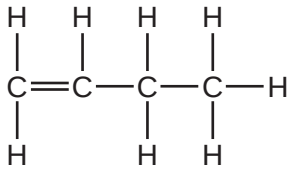
B



C



D



(i) Which **two** of these structures **A**, **B**, **C** or **D** have the same relative molecular mass?

..... and ..... [1]

(ii) Which **two** of these structures **A**, **B**, **C** or **D** will decolourise aqueous bromine?

..... and ..... [2]

[Total: 12]

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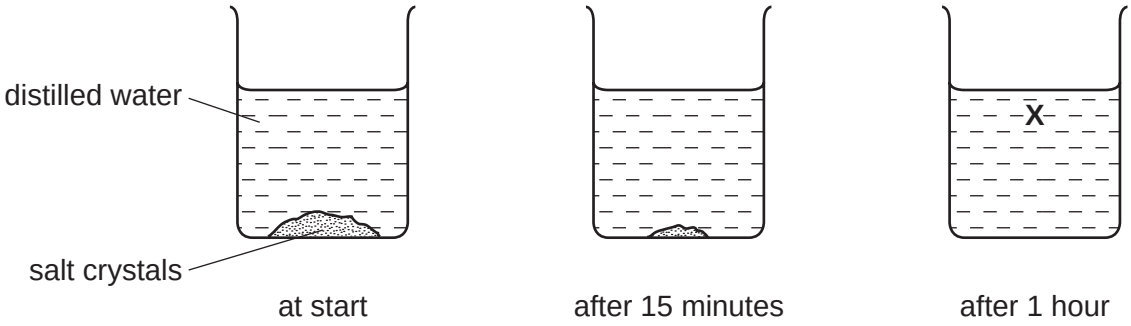
7 A student placed some crystals of salt at the bottom of a beaker of distilled water. She left the contents of the beaker to stand for one hour.
The diagram below shows her observations.



After one hour, all the salt had disappeared but the solution at point **X** tasted salty.

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

.....

.....

.....

.....

..... [4]

(b) Salt is sodium chloride, NaC*l*.

(i) Which one of the following statements about bond formation in sodium chloride is true?
Tick **one** box.

A sodium atom shares one electron with a chlorine atom. ☐

A sodium atom loses its outermost electron and a chlorine atom gains an electron. ☐

A sodium atom shares two electrons with a chlorine atom. ☐

A sodium atom gains an electron and a chlorine atom loses its outermost electrons. ☐

[1]

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(ii) Explain why solid sodium chloride does not conduct electricity but molten sodium chloride does conduct.

.....

.....

..... [2]

(iii) State the name of the product formed at each electrode when a concentrated aqueous solution of sodium chloride is electrolysed using graphite electrodes.

at the positive electrode .....

at the negative electrode ..... [2]

(iv) What is the name of the negative electrode?
Put a ring around the correct answer.

anion **anode** **cation** **cathode** **electrolyte**

[1]

(v) Suggest why graphite is a suitable material for an electrode.

..... [1]

[Total: 11]

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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
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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