



**Cambridge International Examinations**  
Cambridge International General Certificate of Secondary Education

CANDIDATE  
NAME

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CENTRE  
NUMBER

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CANDIDATE  
NUMBER

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**CHEMISTRY**

**0620/22**

Paper 2

**February/March 2015**

**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 use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, 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.

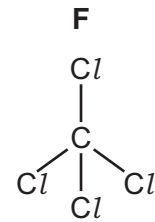
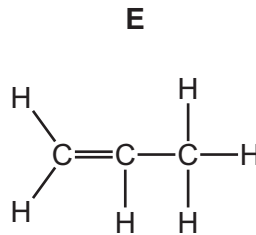
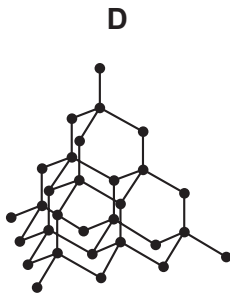
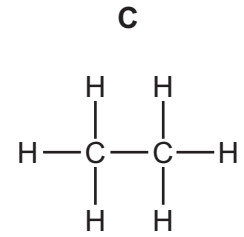
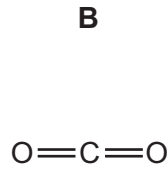
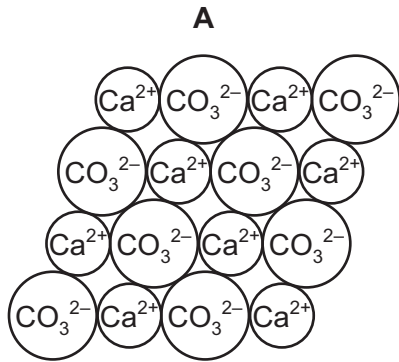
At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [ ] at the end of each question or part question.

The syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 1/Level 2 Certificate.

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

1 The diagram shows the structures of some substances containing carbon.



Answer the following questions about these substances.  
Each substance may be used once, more than once or not at all.

(a) Which substance, **A**, **B**, **C**, **D**, **E** or **F**

- (i) is a saturated hydrocarbon, .....
- (ii) has an ionic structure, .....
- (iii) is a product of respiration, .....
- (iv) is in the same homologous series as methane, .....
- (v) is used for cutting? .....

[5]

(b) Substance **D** is an element.

Explain why substance **D** is an element.

..... [1]

[Total: 6]

2 Some properties of the halogens are shown in the table.

halogen	boiling point /°C	state at room temperature and pressure
fluorine	-188	
chlorine	-35	gas
bromine	+59	liquid
iodine	+184	solid
astatine		solid

(a) Use the information in the table to deduce

(i) the boiling point of astatine,

..... [1]

(ii) the state of fluorine at room temperature and pressure.

..... [1]

(b) When chlorine reacts with aqueous potassium iodide, the solution turns brown.

(i) Write a word equation for this reaction.

..... [2]

(ii) Explain why iodine does not react with aqueous potassium chloride.

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

(c) When sodium reacts with iodine, energy is released.

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

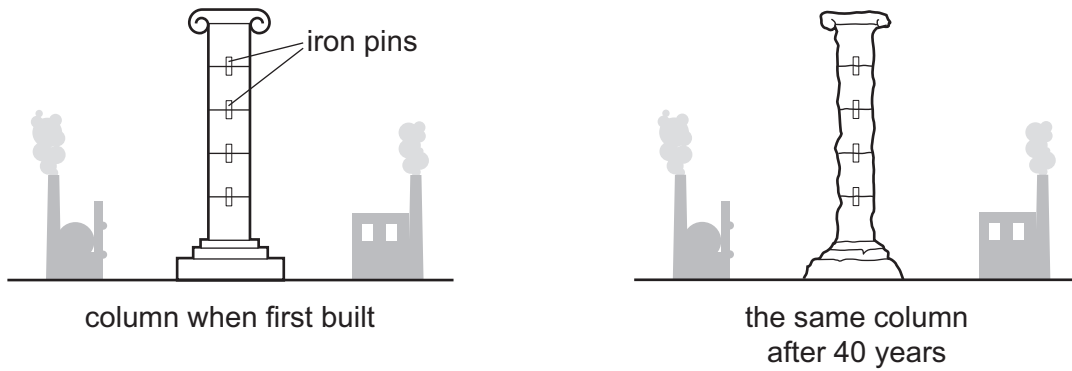
..... [1]

(ii) Explain what happens in terms of electron transfer when a sodium atom reacts with an iodine atom.

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

[Total: 8]

3 The diagram shows a limestone column in an industrial town. Limestone is largely calcium carbonate.



(a) Describe and explain the changes to the column over 40 years.  
In your answer refer to

- the change to the limestone,
- the name of a pollutant causing this change,
- the chemistry involved in this change.

.....

.....

.....

.....

.....

.....

.....

..... [4]

(b) The sections of the column are joined with iron pins which rust when exposed to the atmosphere.  
Describe **two** methods of rust prevention and explain how they prevent rusting.

.....

.....

.....

..... [3]

(c) Iron is a transition element.

Give **two** properties of transition elements that make them different from non-transition metals such as magnesium.

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

(d) An isotope of iron has 58 nucleons.

Complete the table to show

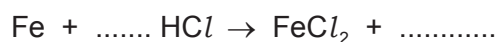
- the number of electrons and neutrons in this isotope of iron,
- the relative charges on each particle.

particle	number of each particle present	relative charge on the particle
electron		
neutron		no charge
proton	26	

[4]

(e) Iron reacts with hydrochloric acid to form iron(II) chloride and a gas which 'pops' with a lighted splint.

Complete the symbol equation for this reaction.



[2]

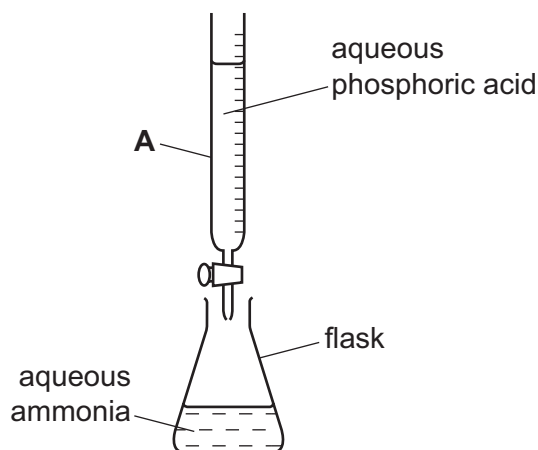
[Total: 15]

4 Ammonium phosphate,  $(\text{NH}_4)_3\text{PO}_4$ , is a fertiliser.

(a) Which **two** elements in ammonium phosphate are important for plant growth?

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

(b) Aqueous ammonium phosphate can be made in the laboratory by reacting aqueous ammonia with aqueous phosphoric acid.



(i) State the name of the piece of apparatus labelled **A**.

..... [1]

(ii) Suggest the pH value of aqueous phosphoric acid.

..... [1]

(iii) Describe how the pH of the mixture in the flask changes as the acid is added.

..... [1]

(iv) Which **one** of the following best describes the reaction of aqueous ammonia with aqueous phosphoric acid?

Put a ring around the correct answer.

**combustion**

**decomposition**

**neutralisation**

**reduction**

[1]

(c) When sodium hydroxide is added to ammonium phosphate, ammonia is released.

Complete the symbol equation for this reaction.



[2]

[Total: 7]

5 The table shows the concentration of some ions present in a sample of seawater.

name of ion	formula of ion	concentration in g/dm <sup>3</sup>
bromide	Br <sup>-</sup>	0.06
calcium	Ca <sup>2+</sup>	0.30
chloride	Cl <sup>-</sup>	20.00
	I <sup>-</sup>	0.04
magnesium	Mg <sup>2+</sup>	1.00
potassium	K <sup>+</sup>	0.50
sodium	Na <sup>+</sup>	11.00
sulfate	SO <sub>4</sub> <sup>2-</sup>	0.80

(a) (i) Which positive ion in the table has the lowest concentration?

..... [1]

(ii) Give the name of the ion with the formula I<sup>-</sup>.

..... [1]

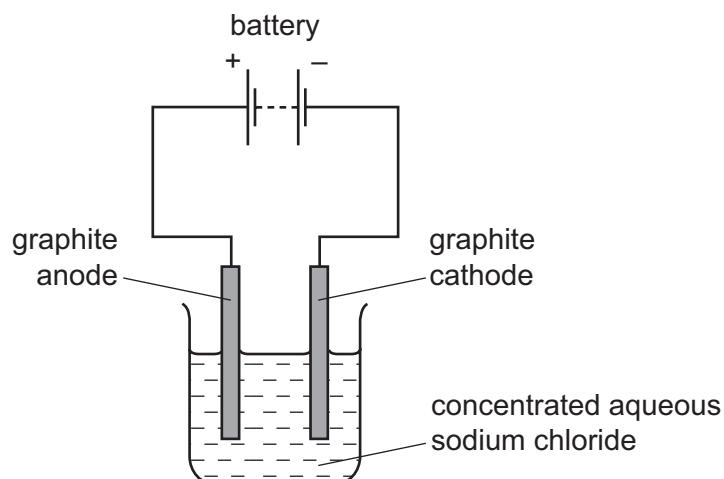
(iii) Which **two** ions in the table are formed from elements in Group II of the Periodic Table?

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

(iv) Give the names of **two** ions in the table which move towards the anode (positive electrode) when a sample of this seawater is electrolysed.

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

- (b) Sodium chloride can be extracted from seawater.  
Concentrated aqueous sodium chloride is electrolysed using the apparatus shown.



- (i) Suggest why the anode and cathode are made of graphite.

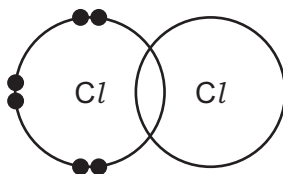
..... [1]

- (ii) Give the name of the product formed at the cathode (negative electrode).

..... [1]

- (iii) Chlorine is formed at the anode.

Complete the electronic structure of a chlorine molecule. Show only the outer shell electrons.



[2]

- (c) Molten magnesium bromide is electrolysed.

Predict the products at the anode (positive electrode) and cathode (negative electrode).

anode .....

cathode .....

[2]

[Total: 11]



6 Zinc oxide is used for making baby soap and cream for treating sunburn.

(a) Suggest why the zinc oxide used for these purposes needs to be pure.

..... [1]

(b) Zinc oxide can be reduced by carbon. Carbon monoxide is one of the products.

(i) What is the meaning of the term *reduction*?

..... [1]

(ii) Write a word equation for the reaction of zinc oxide with carbon.

..... [1]

(iii) Explain why, in the laboratory, the reaction should be carried out in a fume cupboard.

..... [1]

(c) The table shows how easy it is to reduce various metal oxides by heating with carbon.

metal oxide	ease of reduction with carbon
lead oxide	easily reduced at 300 °C
magnesium oxide	not reduced at 900 °C
nickel oxide	easily reduced at 500 °C
zinc oxide	fairly easily reduced at 900 °C

Use the information in the table to put the metals in order of their reactivity.

least reactive  $\longrightarrow$  most reactive

--	--	--	--

[2]

(d) Zinc oxide reacts with sulfuric acid.

Complete the word equation for this reaction.

zinc oxide + sulfuric acid  $\rightarrow$  zinc sulfate + .....

[1]

(e) Pure dry crystals of zinc sulfate can be made by the reaction of dilute sulfuric acid with excess zinc.

(i) How is excess zinc removed from the reaction mixture?

..... [1]

(ii) Describe how you would obtain pure dry crystals of zinc sulfate from an aqueous solution of zinc sulfate.

.....

.....

.....

..... [3]

(iii) Zinc sulfate can be made from the reaction of sulfuric acid with zinc oxide or zinc.

Give the name of another compound that reacts with sulfuric acid to produce zinc sulfate.

..... [1]

(f) A student reacts zinc with excess sulfuric acid.  
She obtains 16.1 g of zinc sulfate from 6.5 g of zinc.

(i) Calculate the mass of zinc sulfate she would obtain from 26.0 g of zinc.

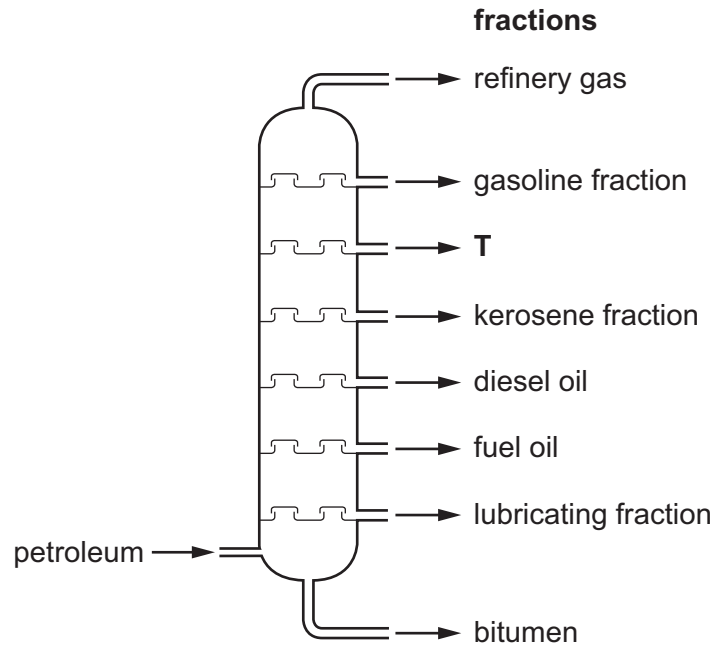
[1]

(ii) Calculate the relative formula mass of zinc sulfate,  $\text{ZnSO}_4$ .

[2]

[Total: 15]

7 Petroleum is separated into useful fractions by fractional distillation.



(a) (i) Put an **X** on the diagram to show where the temperature in the column is the highest. [1]

(ii) Give the name of the fraction labelled **T**.

..... [1]

(iii) The lubricating fraction is used to make lubricants.

Give **one** other use of this fraction.

..... [1]

(b) Each fraction contains alkanes.

Which **two** of the following statements are correct?

Tick **two** boxes.

Alkanes burn to form carbon dioxide and hydrogen.

Ethene is an alkane with two carbon atoms.

Alkanes polymerise to form poly(alkanes).

Alkanes are generally unreactive apart from burning.

Methane is an alkane present in natural gas.

[2]

(c) Hydrogen can be made by cracking.

(i) What is meant by the term *cracking*?

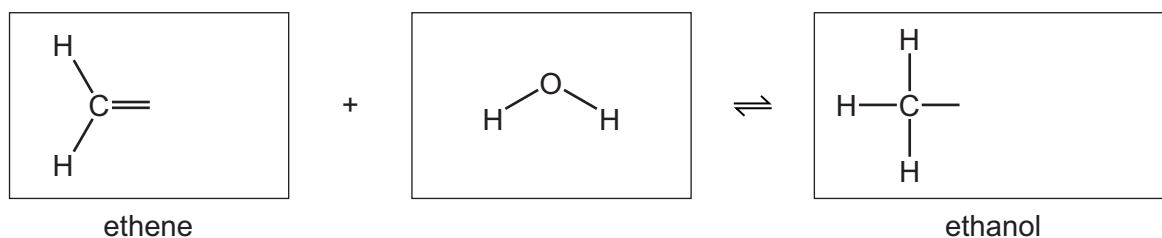
.....  
 ..... [2]

(ii) Complete the equation for the cracking of propane.



(d) Ethanol is formed by the catalytic addition of steam to ethene.

(i) Complete the structures of ethene and ethanol in the equation below, showing all atoms and bonds.



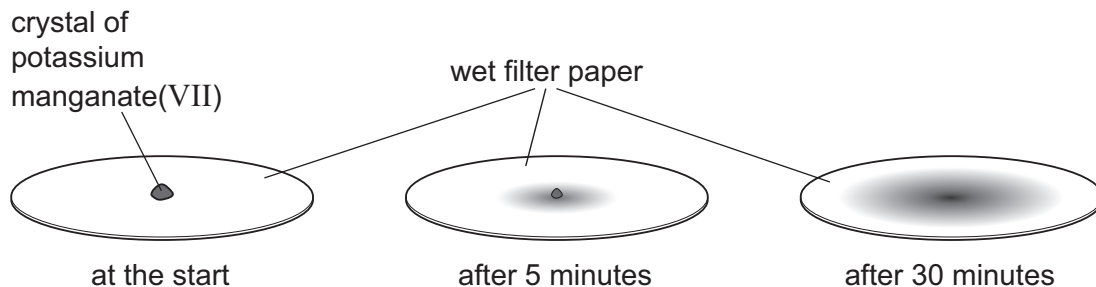
[2]

(ii) What does the symbol ⇌ mean?

..... [1]

[Total: 11]

- 8 A student placed a crystal of purple potassium manganate(VII) on a filter paper which had been soaked in water.  
 After 5 minutes, a purple colour had spread out from the crystal.  
 After 30 minutes, the purple colour had spread further out.



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

.....  
 .....  
 .....  
 .....  
 ..... [3]

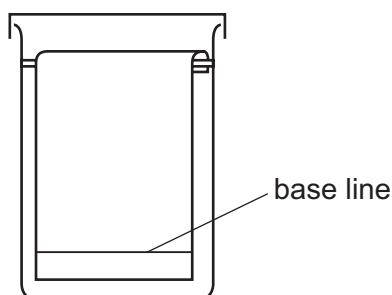
- (b) Describe the closeness and motion of the particles in a crystal of potassium manganate(VII).

closeness .....

motion .....

[2]

- (c) Mixtures of dyes can be separated by paper chromatography using the apparatus shown below.



On the diagram above

- draw a line to show the solvent level at the beginning of the experiment,
- put a cross to show where the spot of dye mixture is placed at the beginning of the experiment.

[2]

[Total: 7]





**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	
7 <b>Li</b> Lithium 3	9 <b>Be</b> Beryllium 4											20 <b>Ne</b> Neon 10	
23 <b>Na</b> Sodium 11	24 <b>Mg</b> Magnesium 12	5 <b>B</b> Boron 5	12 <b>C</b> Carbon 6	14 <b>N</b> Nitrogen 7	16 <b>O</b> Oxygen 8	19 <b>F</b> Fluorine 9	40 <b>Ar</b> Argon 18						
39 <b>K</b> Potassium 19	40 <b>Ca</b> Calcium 20	27 <b>Al</b> Aluminium 13	28 <b>Si</b> Silicon 14	31 <b>P</b> Phosphorus 15	32 <b>S</b> Sulfur 16	35.5 <b>Cl</b> Chlorine 17	84 <b>Kr</b> Krypton 36						
85 <b>Rb</b> Rubidium 37	88 <b>Sr</b> Strontium 38	65 <b>Zn</b> Zinc 30	64 <b>Cu</b> Copper 29	59 <b>Ni</b> Nickel 28	59 <b>Co</b> Cobalt 27	75 <b>As</b> Arsenic 33	79 <b>Se</b> Selenium 34	127 <b>I</b> Iodine 53	131 <b>Xe</b> Xenon 54				
133 <b>Cs</b> Caesium 55	137 <b>Ba</b> Barium 56	112 <b>Cd</b> Cadmium 48	108 <b>Ag</b> Silver 47	106 <b>Pd</b> Palladium 46	103 <b>Rh</b> Rhodium 45	122 <b>Sb</b> Antimony 51	128 <b>Te</b> Tellurium 52	209 <b>Bi</b> Bismuth 83	207 <b>Pb</b> Lead 82	204 <b>Tl</b> Thallium 81	201 <b>Hg</b> Mercury 80	209 <b>At</b> Astatine 85	210 <b>Rn</b> Radon 86
87 <b>Fr</b> Francium 87	226 <b>Ra</b> Radium 88	227 <b>Ac</b> Actinium 89											

140 <b>Ce</b> Cerium 58	141 <b>Pr</b> Praseodymium 59	144 <b>Nd</b> Neodymium 60	150 <b>Sm</b> Samarium 62	152 <b>Eu</b> Europium 63	157 <b>Gd</b> Gadolinium 64	162 <b>Dy</b> Dysprosium 66	165 <b>Ho</b> Holmium 67	169 <b>Tm</b> Thulium 69	173 <b>Yb</b> Ytterbium 70	175 <b>Lu</b> Lutetium 71
232 <b>Th</b> Thorium 90	238 <b>U</b> Uranium 92	238 <b>Pa</b> Protactinium 91	150 <b>Sm</b> Samarium 62	150 <b>Sm</b> Samarium 62	150 <b>Sm</b> Samarium 62	150 <b>Sm</b> Samarium 62	150 <b>Sm</b> Samarium 62	150 <b>Sm</b> Samarium 62	150 <b>Sm</b> Samarium 62	150 <b>Sm</b> Samarium 62
98 <b>Cf</b> Californium 98	99 <b>Es</b> Einsteinium 99	100 <b>Fm</b> Fermium 100	97 <b>Bk</b> Berkelium 97	96 <b>Cm</b> Curium 96	95 <b>Am</b> Americium 95	94 <b>Pu</b> Plutonium 94	93 <b>Np</b> Neptunium 93	92 <b>U</b> Uranium 92	91 <b>Pa</b> Protactinium 91	90 <b>Th</b> Thorium 90

\*58-71 Lanthanoid series  
†90-103 Actinoid series

a	<b>X</b>	
b		

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

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