Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME

CENTER NUMBER

CANDIDATE NUMBER

6129196077

CHEMISTRY (US) **0439/23**

Paper 2 **May/June 2015**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Center 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.

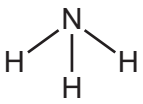
At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **16** printed pages.

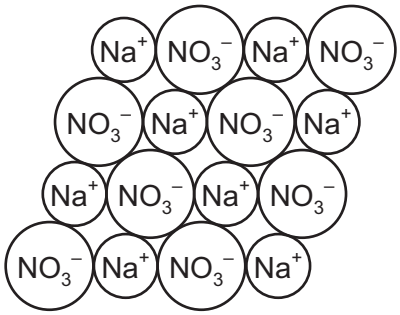
CAMBRIDGE International Examinations

1 The structures of five substances are shown below.

A

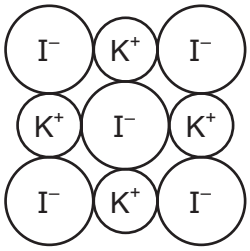


B

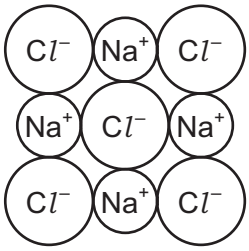


C

D



E



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** or **E**,

(i) is an element, ... [1]

(ii) turns damp red litmus paper blue, ... [1]

(iii) is a salt which contains atoms of three different elements, ... [1]

(iv) is a compound, whose aqueous solution gives a white precipitate on addition of aqueous silver nitrate, ... [1]

(v) is an ionic compound, whose aqueous solution gives off ammonia when warmed with aluminum powder and aqueous sodium hydroxide? ..... [1]

(b) (i) Give the name of compound **B**.

..... [1]

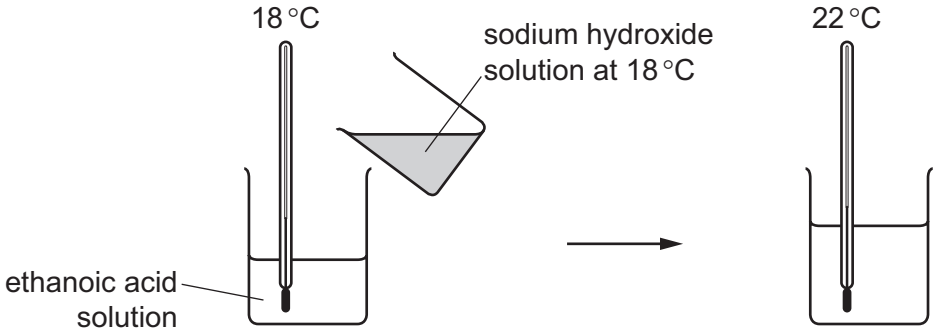
(ii) Complete the following sentences about compounds **A** and **E** using words from the list below.

atoms **gas** **giant** **ions** **liquid** **molecular** **polymer** **solid**

Compound **A** is a ..... at room temperature. It does not conduct electricity because it has a simple ..... structure. Compound **E** does not conduct electricity when it is ..... because its ..... cannot move. [4]

[Total: 10]

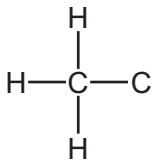
2 A student adds an aqueous solution of sodium hydroxide to an aqueous solution of e... d.
She measures the temperature before and after the addition of sodium hydroxide.



(a) (i) Explain how this experiment shows that the reaction is exothermic.

..... [1]

(ii) Complete the formula of ethanoic acid showing all atoms and bonds.



[1]

(iii) The product of the reaction is a salt called sodium ethanoate.

Describe how you would prepare pure, dry crystals of sodium ethanoate from a solution of sodium ethanoate in water.

.....

.....

.....

..... [3]

(b) Ethanoic acid belongs to the carboxylic acid homologous series.

Which **two** of the following statements describes the members of the same homologous series?
Tick **two** boxes.

They have the same physical properties. ☐

They have different functional groups. ☐

They have similar chemical properties. ☐

They are all inorganic chemicals. ☐

They have the same functional group. ☐

[2]

(c) Ethanoic acid has similar properties to hydrochloric acid.

What would be observed when a small piece of magnesium is added to aqueous e
acid?

.....

..... [2]

[Total: 9]

3 Copper(II) sulfate is heated strongly. The products are copper(II) oxide and sulfur trioxide.

$$CuSO_4 \xrightarrow{heat} CuO + SO_3$$

(a) (i) What type of reaction is this?
Tick **one** box.

addition	☐
neutralization	☐
oxidation	☐
thermal decomposition	☐

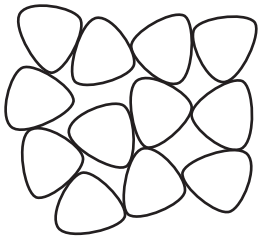
[1]

(ii) Sulfur trioxide is an acidic gas.

What precautions must be taken when heating copper(II) sulfate in the laboratory?

..... [1]

(iii) The diagram below shows the arrangement of sulfur trioxide molecules at 30 °C.



key

SO_3 molecules

What is the state of sulfur trioxide at 30 °C?
Use the information in the diagram to explain your answer.

.....

.....

..... [3]

(b) Sulfur trioxide dissolves in water to form sulfuric acid.

(i) Complete the symbol equation for this reaction.

$$SO_3 + H_2O \rightarrow .....$$

[1]

(ii) Sulfuric acid is strongly acidic.

Which **one** of the following pH values is strongly acidic?
Put a ring around the correct answer.

pH 1 pH 6 pH 7 pH 9 pH 13

[1]

(c) Copper(II) oxide is a solid.
An aqueous solution of copper(II) sulfate can be made by heating excess copper(II) oxide with dilute sulfuric acid.

Draw a labeled diagram of the apparatus you would use to separate the excess copper(II) oxide from the solution.

[2]

(d) Anhydrous copper(II) sulfate can be used to test for water.

$$CuSO_4(s) + 5H_2O(l) \rightleftharpoons CuSO_4.5H_2O(s)$$

(i) What is the meaning of the symbol $\rightleftharpoons$?

..... [1]

(ii) Give the color change when water is added to anhydrous copper(II) sulfate.

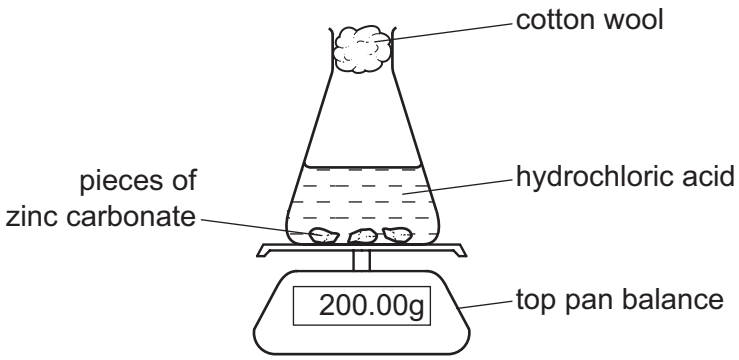
from ..... to ..... [2]

[Total: 12]

4 A student investigated the reaction of zinc carbonate with hydrochloric acid.

$$ZnCO_3(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + CO_2(g) + H_2O(l)$$

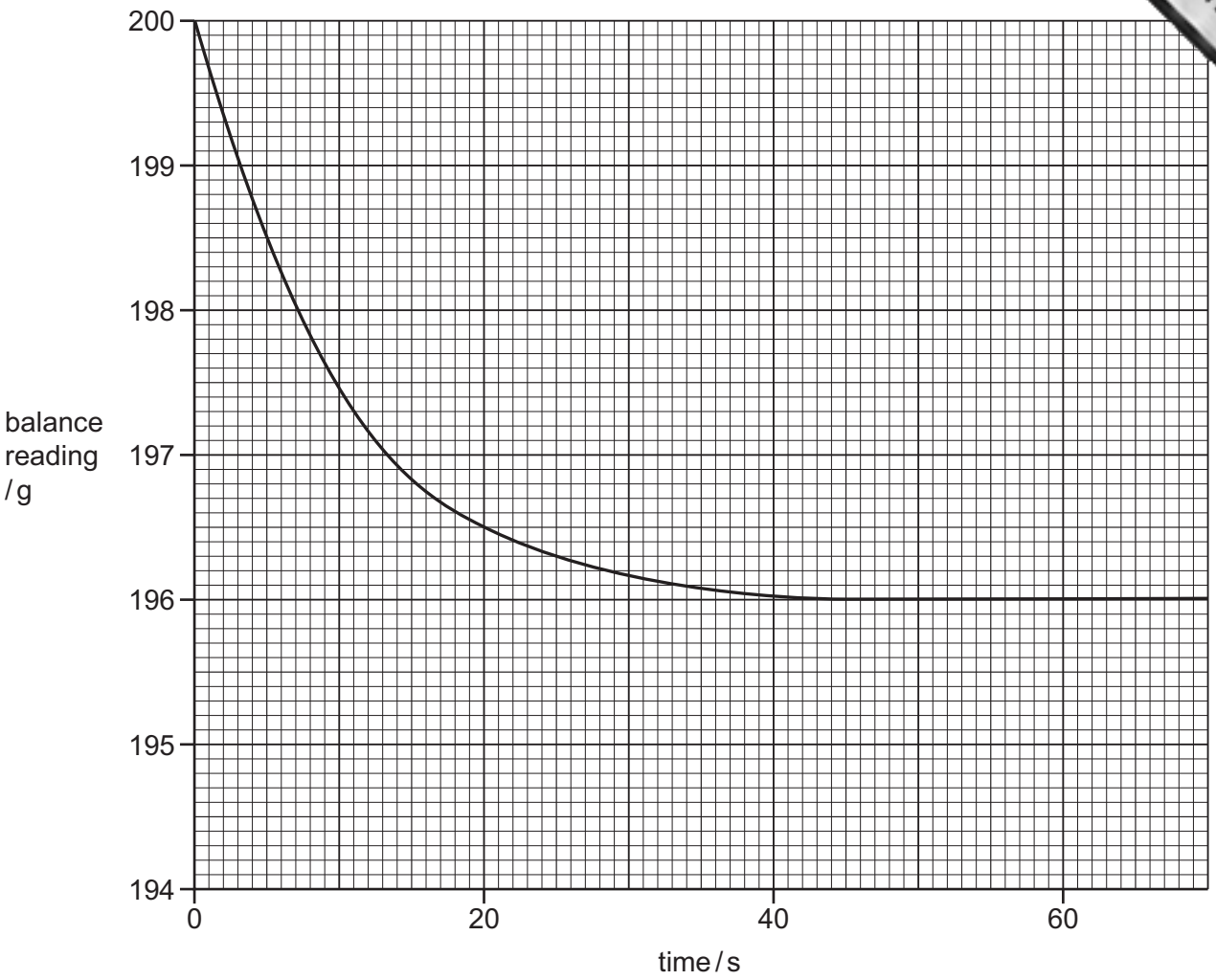
She measured the decrease in mass of the reaction mixture with time.



(a) Explain why the mass of the reaction mixture decreased with time.

..... [1]

(b) The student carried out the reaction at 20 °C using small pieces of zinc carbonat… h below shows the results.



(i) Describe how the mass of the reaction mixture changes with time.

.....

..... [2]

(ii) How long did it take for the reaction to stop?

..... s [1]

(iii) Calculate the decrease in mass of the reaction mixture in the first 20 seconds of the reaction.

..... g [1]

(iv) On the grid above, draw a line to show how the mass of the reaction mixture changes when the experiment is carried out at 30 °C and all other conditions remain the same. [2]

(v) How does the rate of this reaction change when larger pieces of zinc carbona[illegible]?

.....

(c) The zinc chloride formed in this reaction is a salt.

(i) Give the name of another compound of zinc which, when reacted with hydrochloric acid, makes zinc chloride.

..... [1]

(ii) Molten zinc chloride can be electrolyzed using graphite electrodes.

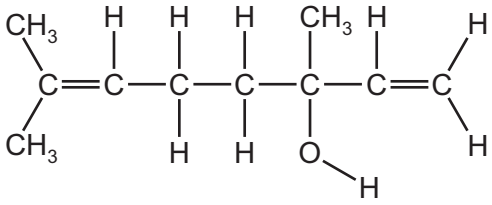
Give the name of the products formed at

the anode, ...

the cathode. .....
[2]

[Total: 11]

5 Linalool is a compound found in the seeds of the coriander plant.
The formula of linalool is shown below.



(a) (i) On the formula above, put a ring around an alcohol functional group. [1]

(ii) How many different elements are there in one molecule of linalool?

..... [1]

(iii) How many carbon atoms are there in one molecule of linalool?

..... [1]

(iv) Linalool is an unsaturated compound.

What feature in the formula of linalool shows that it is an unsaturated compound?

..... [1]

(b) Linalool can be extracted from coriander seeds.
The following statements are about the procedure for extracting linalool from coriander seeds.

A Distill the solution.

B Add a solvent to the ground up seeds.

C Grind the coriander seeds.

D Filter off the solid from the solution.

E Stir the mixture, then it leave for 24 hours.

(i) Put the statements **A**, **B**, **C**, **D** and **E** in the correct order.
The first one has been done for you.

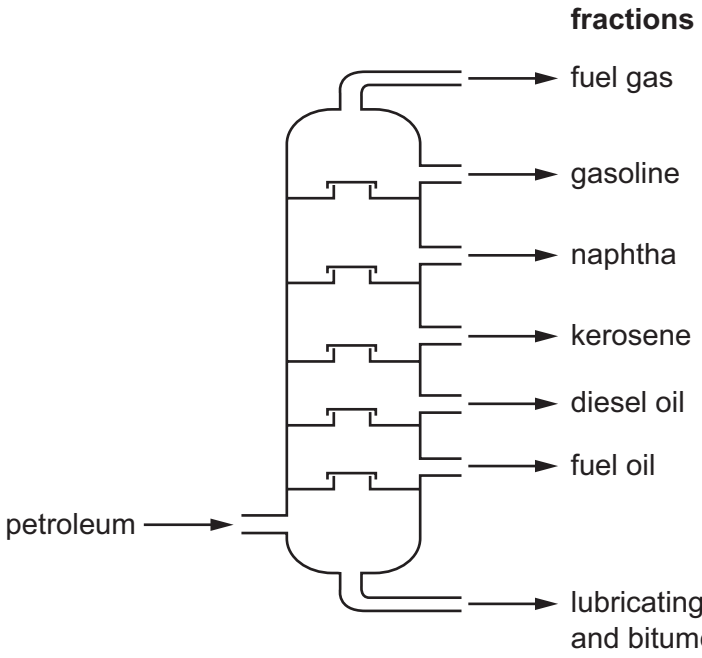
C				

[2]

(ii) On what physical property does distillation depend?

..... [1]

(c) Petroleum is a mixture of hydrocarbons which can be separated into useful [illegible] by fractional distillation.
The diagram below shows a fractional distillation column.



(i) On the diagram above, put

- a letter X to show where the temperature in the column is lowest, [1]
- a letter H to show where the fraction containing molecules with the highest relative molecular mass exits the column. [1]

(ii) Give **one** use of the naphtha fraction.

..... [1]

(d) Methane is a hydrocarbon present in natural gas.

(i) Give **one** other source of methane.

..... [1]

(ii) Give **one** reason why scientists are concerned about the increasing amount of methane in the atmosphere.

..... [1]

(iii) To which homologous series does methane belong?

..... [1]

[Total: 13]

6 The table below shows the properties of some nonmetallic elements, **A**, **B**, **C** and **D**.

element	state at room temperature	color	melting point / °C	electrical conductivity
A	solid	black	3317	good
B	solid	gray	1410	poor
C	gas	green	–101	does not conduct
D	solid	yellow	119	does not conduct

(a) (i) Which **two** elements are giant covalent structures?
Give a reason for your answer.

.....

..... [2]

(ii) Which element is carbon in the form of graphite?
Give a reason for your answer.

.....

..... [2]

(iii) Which element is chlorine?

..... [1]

(b) When aqueous chlorine is added to aqueous potassium bromide, the solution turns orange. An aqueous solution of bromine and potassium chloride is formed.

Describe and explain what happens when aqueous bromine is added to separate solutions of aqueous potassium chloride and aqueous potassium iodide.

.....

.....

.....

.....

.....

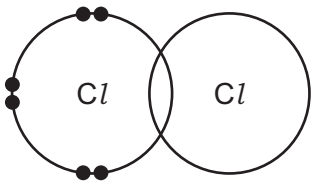
..... [4]

(c) Chlorine is used in water treatment.

Explain why.

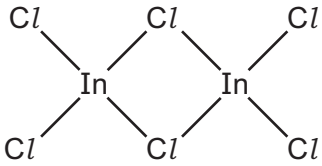
..... [1]

(d) Complete the diagram below to show the arrangement of electrons in a molecule of chlorine.



[2]

(e) Chlorine reacts with indium, In, to form a chloride with the formula shown below.



(i) Give the molecular formula for this chloride.

..... [1]

(ii) How many protons does indium have in its nucleus?
Use the Periodic Table to help you.

..... [1]

[Total: 14]

7 Many flowers produce volatile oils. These oils are responsible for the sweet scent of many flowers.

(a) What does the term *volatile* mean?

..... [1]

(b) A teacher placed some highly-scented flowers at the front of the class.
At first, the students at the back of the class could not smell the scent. After two minutes they could smell the scent.

Use the kinetic particle theory to explain these observations.

.....

.....

.....

.....

..... [3]

(c) Many plant oils are unsaturated hydrocarbons.
Alkenes are also unsaturated hydrocarbons.
The table shows some properties of four alkenes.

alkene	molecular formula	relative molecular mass	melting point / °C	boiling point / °C
ethene	C_2H_4	28	–161	–103
propene	C_3H_6	42	–185	–47
butene	C_4H_8	56		–6
pentene	C_5H_{10}	70	–165	+30

(i) How does the boiling point of these alkenes change as the number of carbon atoms in the alkene increases?

..... [1]

(ii) Why is it difficult to predict the melting point of butene?

..... [1]

(iii) The relative molecular mass of each alkene differs from the next by 14.

Which group of atoms is responsible for this difference.
Tick **one** box.

CH_4	☐
CH_3	☐
CH_2	☐
CH	☐

[1]

(iv) Complete the word equation for the complete combustion of ethene.

ethene + ... → carbon dioxide + ...

[2]

(d) A radioactive isotope of carbon called carbon-14 can be used to date old pieces of cloth.

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

.....

..... [1]

(ii) Carbon-14 contains 8 neutrons and 6 protons.

The symbol for carbon-14 can be written $^{14}_{6}C$.

Write the symbol for carbon-12 in a similar way.

[1]

[Total: 11]

DATA SHEET
The Periodic Table of the Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 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 Aluminum 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 = 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.).