



Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--

* 9 1 2 6 6 5 3 2 7 1 *



CHEMISTRY

0620/32

Paper 3 Theory (Core)

October/November 2017

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 on all the work you hand in.

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.

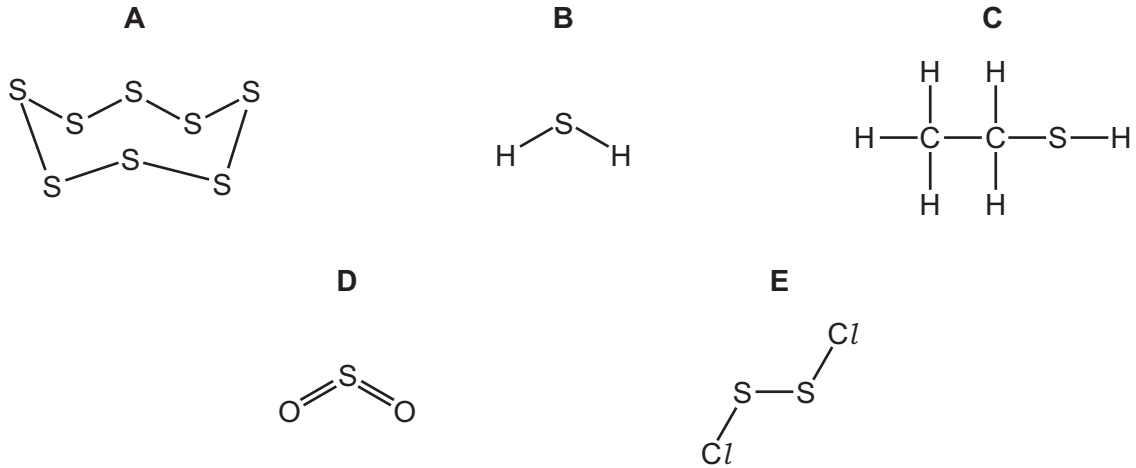
At the end of the examination, fasten all your work securely together.

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 **15** printed pages and **1** blank page.

1 The diagram shows the structures of five substances, **A**, **B**, **C**, **D** and **E**.



Answer the following questions using only the structures in the diagram. Each structure may be used once, more than once or not at all.

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

- (i) is an element, [1]
- (ii) has a structure similar to ethanol, [1]
- (iii) is a compound which contributes to acid rain, [1]
- (iv) has double covalent bonds, [1]
- (v) contains halogen atoms? [1]

(b) Structure **A** is a non-metal.

State **three** typical differences between metals and non-metals.

- 1
- 2
- 3 [3]

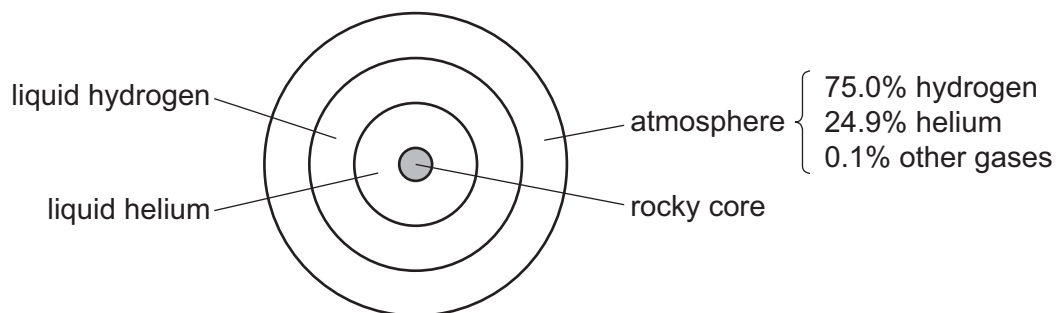
(c) Structure **B** is hydrogen sulfide. Hydrogen sulfide is a compound.

What is meant by the term *compound*?

-
- [1]

[Total: 9]

2 The diagram shows the composition of the planet Saturn.



(a) Describe how Saturn's atmosphere differs from the Earth's atmosphere.
Give **three** differences.

- 1
-
- 2
-
- 3
-

[3]

(b) Some properties of hydrogen and helium are given in the table.

element	density of the liquid in g/cm ³	melting point in °C	boiling point in °C
hydrogen	0.07	-259	-253
helium	0.15	-272	-269

(i) Use the information to suggest why the layer of liquid hydrogen in Saturn floats on top of the liquid helium.

..... [1]

(ii) What is the physical state of hydrogen at -250 °C?
Explain your answer.

.....

..... [2]

(c) The atmosphere of Saturn contains small amounts of ammonia.

(i) Describe a test for ammonia.

test

result

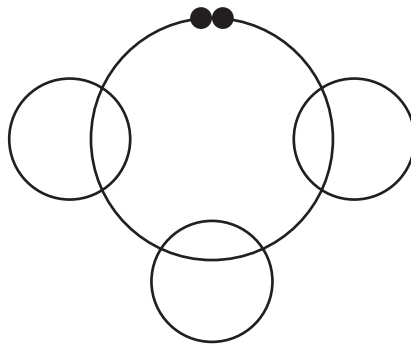
[2]

(ii) Ammonia is a covalent compound.

Complete the diagram to show

- the arrangement of electrons in a molecule of ammonia,
- the symbols of the atoms present.

Show outer electrons only.



[2]

(d) Saturn's atmosphere also contains small amounts of ammonium hydrosulfide.

Calculate the relative molecular mass of ammonium hydrosulfide, NH_4SH .
Use your Periodic Table to help you.

relative molecular mass = [2]

(e) Saturn's atmosphere also contains small amounts of methane.

Small amounts of methane are present in the Earth's atmosphere.
Methane is a greenhouse gas.

(i) Name another greenhouse gas present in the Earth's atmosphere.

..... [1]

(ii) Scientists are concerned about the increase in the amount of greenhouse gases in the Earth's atmosphere.

Explain why.

..... [1]

[Total: 14]

3 The following compounds are present in a liquid used for cleaning metal.

ethanoic acid
ethanol
glycerol
sodium chloride
water

(a) (i) Draw the structure of the functional group present in ethanoic acid.

[1]

(ii) Which **one** of the following pH values is acidic?
Put a circle around the correct answer.

pH4 pH7 pH9 pH13

[1]

(iii) Ethanoic acid reacts with sodium hydroxide.

What type of reaction is this?
Put a circle around the correct answer.

neutralisation **oxidation** **polymerisation** **reduction**

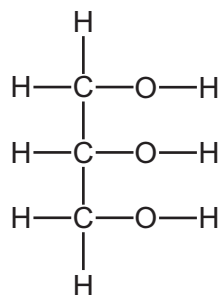
[1]

(iv) The reaction of ethanoic acid with sodium hydroxide is exothermic.

What is meant by the term *exothermic*?

..... [1]

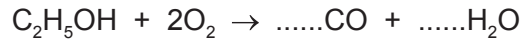
(b) The structure of glycerol is shown.



Deduce the molecular formula of glycerol showing the number of carbon, hydrogen and oxygen atoms.

..... [1]

(c) Balance the chemical equation for the incomplete combustion of ethanol.



[2]

(d) (i) Describe a method of obtaining pure samples of **both** sodium chloride and water from aqueous sodium chloride. Explain why this method works.

.....

.....

.....

.....

..... [3]

(ii) Which physical property could you measure to find out if a sample of water is pure?

..... [1]

(iii) Sodium chloride contains chloride ions.

Describe a test for chloride ions.

test

result

[2]

[Total: 13]

4 The table shows the properties of four substances.

substance	boiling point	electrical conductivity of solid	electrical conductivity when molten	solubility in water
calcium iodide	very high	does not conduct	conducts	
phosphorus	low	does not conduct	does not conduct	insoluble
sodium chloride	very high	does not conduct	conducts	soluble
zinc	high		conducts	insoluble

(a) Complete the table to show the solubility in water of calcium iodide and the electrical conductivity of solid zinc. [2]

(b) Give **one** piece of evidence from the table that shows that phosphorus is a simple covalent substance.

..... [1]

(c) What information in the table shows that sodium chloride is an ionic compound?

.....
 [2]

(d) Molten calcium iodide can be electrolysed.

Predict the products of this electrolysis at

the positive electrode (anode),

the negative electrode (cathode).

[2]

(e) An atom of phosphorus has 31 nucleons.

Deduce the number of protons and neutrons present in **one** atom of phosphorus.
 Use your Periodic Table to help you.

number of protons

number of neutrons

[2]

(f) Phosphorus burns in an excess of air to form phosphorus(V) oxide.

Is phosphorus(V) oxide an acidic oxide or a basic oxide?
Explain your answer.

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

(g) Arsenic is in the same group of the Periodic Table as phosphorus.
Arsenic sublimes at 613 °C.

What is meant by the term *sublimation*?

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

[Total: 11]

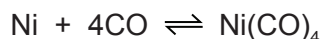
- 5 Nickel can be obtained from nickel(II) oxide by heating it with a mixture of carbon monoxide and hydrogen.



- (a) How does this equation show that the nickel(II) oxide is reduced?

..... [1]

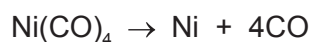
- (b) Nickel can be purified by reacting impure nickel with carbon monoxide. A compound called tetracarbonylnickel, $\text{Ni}(\text{CO})_4$, is formed.



What is the meaning of the symbol \rightleftharpoons ?

..... [1]

- (c) The tetracarbonylnickel is heated to obtain pure nickel.



- (i) Suggest why the nickel obtained can be separated easily from the carbon monoxide.

..... [1]

- (ii) State **one** adverse effect of carbon monoxide on health.

..... [1]

- (d) Nickel is a transition element.
Potassium is a Group I element.

- (i) Describe **two** differences in the physical properties of nickel and potassium.

1

.....

2

.....

[2]

- (ii) Describe **one** difference in the properties of nickel(II) chloride and potassium chloride.

..... [1]

- (e) The properties and relative reactivity with water of some Group I elements are shown in the table.

element	density in g/cm ³	boiling point in °C	relative reactivity with water
sodium		883	forms bubbles rapidly but does not burst into flames
potassium	0.86	760	forms bubbles very rapidly and bursts into flames
rubidium	1.53		
caesium	1.88	669	reacts explosively

- (i) Complete the table

- to predict the boiling point of rubidium,
- for the relative reactivity of rubidium with water.

[2]

- (ii) Describe the general trend in the density of the Group I elements.

..... [1]

[Total: 10]

6 Ethanol can be manufactured from ethene or by the fermentation of glucose.

(a) Describe these **two** methods of manufacturing ethanol.

In your answer, include

- the names of any additional substances needed,
- the reaction conditions.

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [5]

(b) Ethene is an unsaturated hydrocarbon.

(i) Describe how you could distinguish between an unsaturated hydrocarbon and a saturated hydrocarbon using aqueous bromine.

.....

.....

..... [2]

(ii) Ethene molecules can form polymers.

Which phrase describes a polymer?

Tick **one** box.

a giant structure containing one type of atom

a large molecule formed by cracking monomers

a large molecule formed by the addition of many ions

a large molecule formed from many monomers

[1]

(iii) *Terylene* is a polymer.

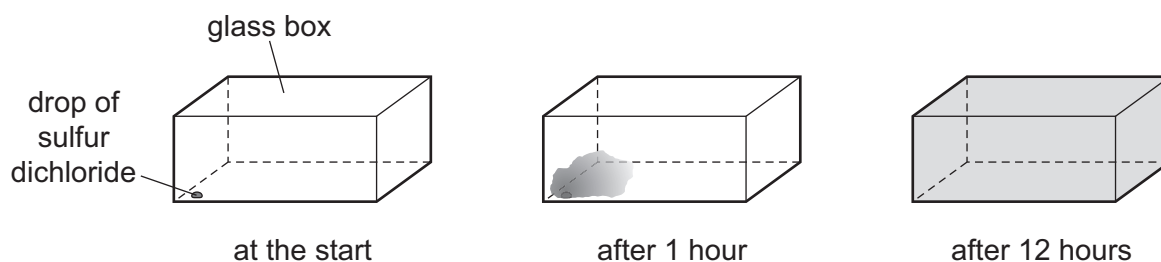
Give **one** use of *Terylene*.

..... [1]

[Total: 9]

7 Sulfur dichloride, SCl_2 , is a red liquid which vaporises easily at room temperature and pressure.

- (a) A drop of sulfur dichloride was placed in the corner of a glass box. The glass box was closed and left for 12 hours. After 12 hours a red vapour had spread to fill the whole box.



Explain these observations using the kinetic particle model.

.....

.....

.....

.....

.....

..... [3]

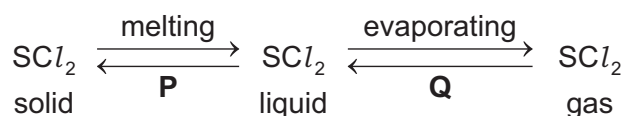
- (b) Sulfur dichloride can be made by passing chlorine through liquid disulfur dichloride, S_2Cl_2 .

Complete the chemical equation for this reaction.



[2]

- (c) Some changes of state of sulfur dichloride are shown.



Name the changes of state represented by **P** and **Q**.

P

Q

[2]

[Total: 7]

8 Calcium carbonate (limestone) decomposes when heated.

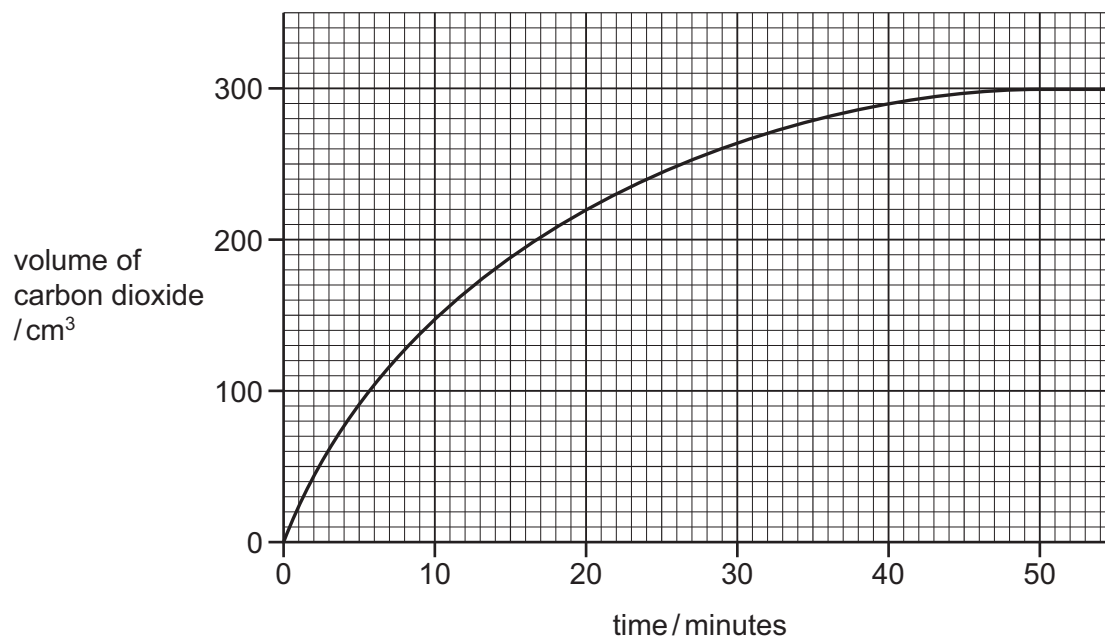


(a) When 20.0g of calcium carbonate are decomposed, 11.2g of calcium oxide (lime), CaO, are formed.

Calculate the mass of calcium oxide formed when 160.0g of calcium carbonate are decomposed.

..... g [1]

(b) The graph shows the volume of carbon dioxide produced when some small pieces of calcium carbonate are heated and decompose.



(i) Deduce the volume of carbon dioxide produced during the first 20 minutes of the decomposition.

..... [1]

(ii) At what time was the reaction complete?

..... [1]

(iii) What would be the effect, if any, on the rate of reaction if the same mass of powdered calcium carbonate were used?

..... [1]

(c) The table shows how limestone is used.

use of limestone	percentage of limestone used for this purpose
agriculture	
cement manufacture	37
chemical industries	14
iron and steel manufacture	11
road building	20
other uses	2
total	100

(i) What percentage of limestone is used in agriculture?

..... [1]

(ii) Limestone and lime are used in agriculture.

Why is lime used in agriculture?

.....
 [2]

[Total: 7]

BLANK PAGE

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge International Examinations Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cie.org.uk after the live examination series.

Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.

The Periodic Table of Elements

		Group											
I	II	III	IV	V	VI	VII	VIII						
		1 H hydrogen 1											
3 Li lithium 7	4 Be beryllium 9	Key atomic number atomic symbol name relative atomic mass											
11 Na sodium 23	12 Mg magnesium 24	5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20	13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	30 Zn zinc 65	29 Cu copper 64	28 Ni nickel 59	27 Co cobalt 59	26 Fe iron 56	25 Mn manganese 55	24 Cr chromium 52	23 V vanadium 51	22 Ti titanium 48	21 Sc scandium 45	36 Kr krypton 84	
37 Rb rubidium 85	38 Sr strontium 88	48 Cd cadmium 112	47 Ag silver 108	46 Pd palladium 106	45 Rh rhodium 103	44 Ru ruthenium 101	43 Tc technetium —	42 Mo molybdenum 96	41 Nb niobium 93	40 Zr zirconium 91	39 Y yttrium 89	54 Xe xenon 131	
55 Cs caesium 133	56 Ba barium 137	80 Hg mercury 201	79 Au gold 197	78 Pt platinum 195	77 Ir iridium 192	76 Os osmium 190	75 Re rhenium 186	74 W tungsten 184	73 Ta tantalum 181	72 Hf hafnium 178	57–71 lanthanoids	86 Rn radon —	
87 Fr francium —	88 Ra radium —	112 Cn copernicium —	111 Rg roentgenium —	110 Ds darmstadtium —	109 Mt meitnerium —	108 Hs hassium —	107 Bh bohrium —	106 Sg seaborgium —	105 Db dubnium —	104 Rf rutherfordium —	89–103 actinoids	—	

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium —	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium —	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium —	94 Pu plutonium —	95 Am americium —	96 Cm curium —	97 Bk berkelium —	98 Cf californium —	99 Es einsteinium —	100 Fm fermium —	101 Md mendelevium —	102 No nobelium —	103 Lr lawrencium —

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).