Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

9126653271

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.

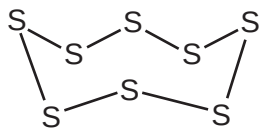
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This document consists of **15** printed pages and **1** blank page.

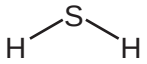
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1 The diagram shows the structures of five substances, **A**, **B**, **C**, **D** and **E**.

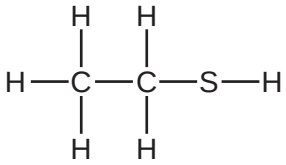
A



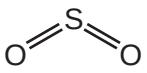
B



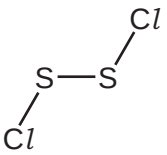
C



D



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*?

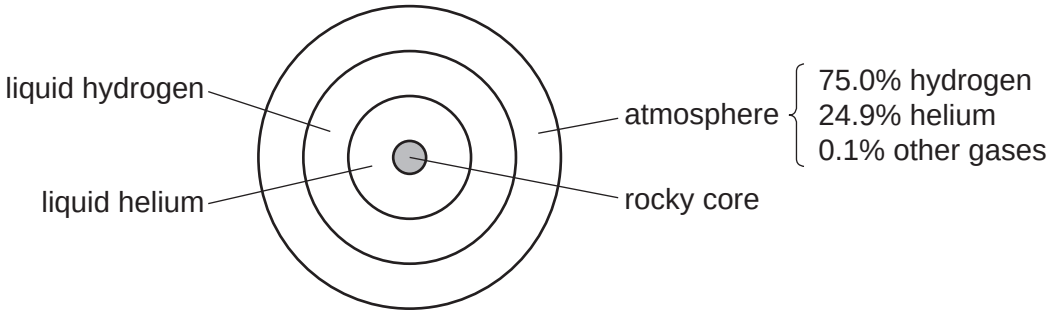
.....

..... [1]

[Total: 9]

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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.

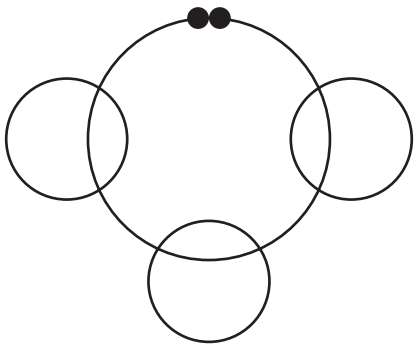
test .....

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]

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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.

pH 4 pH 7 pH 9 pH 13

[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**

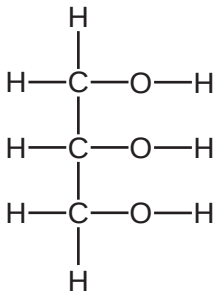
[1]

(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]

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[Turn over

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

$$C_2H_5OH + 2O_2 \rightarrow .....CO + ...H_2O$$

[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]

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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]

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[Turn over

(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]

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

$$2NiO + CO + H_2 \rightarrow 2Ni + CO_2 + H_2O$$

(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, $Ni(CO)_4$, is formed.

$$Ni + 4CO \rightleftharpoons Ni(CO)_4$$

What is the meaning of the symbol $\rightleftharpoons$?

..... [1]

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

$$Ni(CO)_4 \rightarrow Ni + 4CO$$

(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]

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[Turn over

(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]

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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.

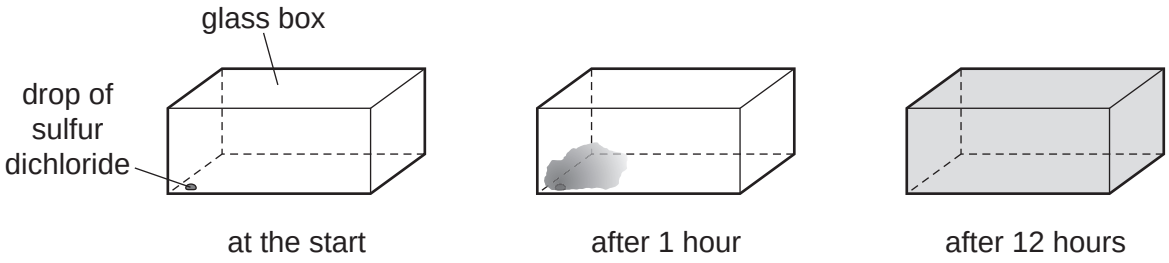
Give **one** use of *Terylene*.

..... [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.

$$S_2Cl_2 + \text{.....} \rightarrow \text{.....}SCl_2$$

[2]

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

$$\underset{\text{solid}}{SCl_2} \underset{\textbf{P}}{\overset{\text{melting}}{\rightleftharpoons}} \underset{\text{liquid}}{SCl_2} \underset{\textbf{Q}}{\overset{\text{evaporating}}{\rightleftharpoons}} \underset{\text{gas}}{SCl_2}$$

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

P .....

Q .....

[2]

[Total: 7]

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8 Calcium carbonate (limestone) decomposes when heated.

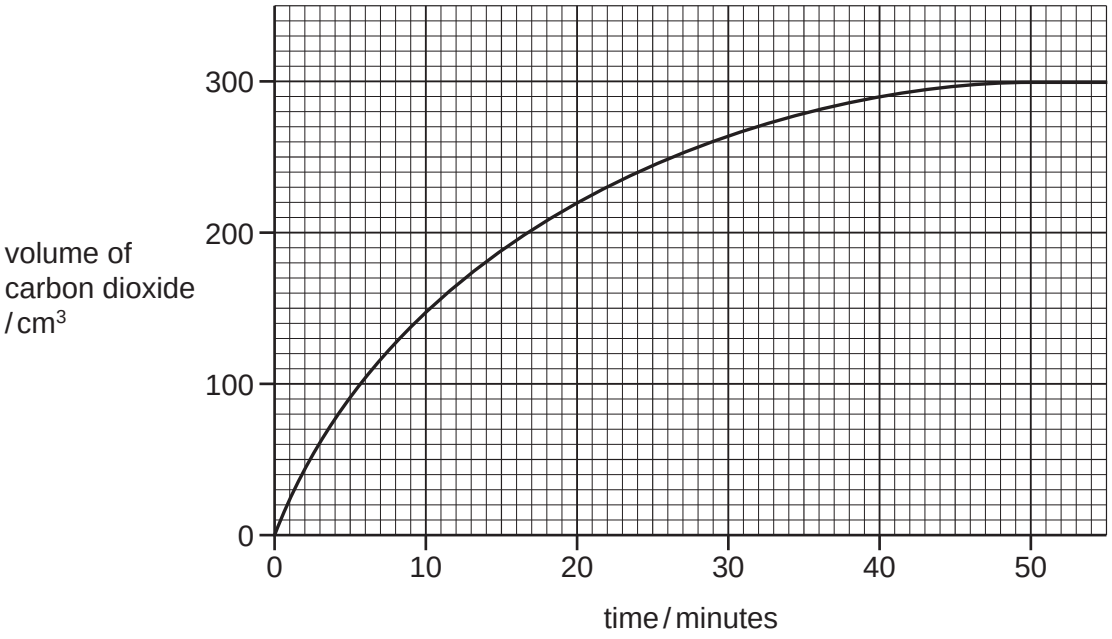
$$CaCO_3 \rightarrow CaO + CO_2$$

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

Calculate the mass of calcium oxide formed when 160.0 g 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]

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[Turn over

(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]

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The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	VIII
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											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	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium –	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key

atomic number
atomic symbol
name
relative atomic mass

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 dm^3 at room temperature and pressure (r.t.p.).