Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

3868593465

CHEMISTRY **0620/32**

Paper 3 Theory (Core) **May/June 2018**

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 **16** printed pages.

1 The names of nine gases are given.

ammonia
carbon monoxide
chlorine
ethane
ethene
helium
hydrogen
neon
oxygen

(a) Answer the following questions about these gases.
Each gas may be used once, more than once or not at all.
State which gas:

(i) bleaches damp litmus paper

..... [1]

(ii) dissolves in water to form an alkali

..... [1]

(iii) is a monatomic gas with ten protons in its nucleus

..... [1]

(iv) is formed when hydrocarbons undergo incomplete combustion

..... [1]

(v) is an unsaturated hydrocarbon.

..... [1]

(b) Diatomic hydrogen molecules contain covalent bonds.

State what is meant by the terms:

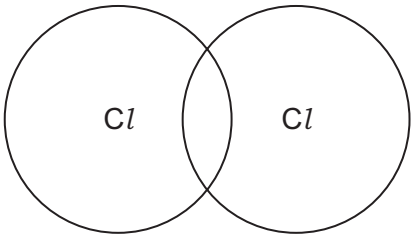
(i) *diatomic* .....

..... [1]

(ii) *covalent bonds* .....

..... [1]

(c) Complete the dot-and-cross diagram to show the electron arrangement in a molecule of chlorine. Show outer shell electrons only.



[2]

[Total: 9]

2 The table shows the percentage by volume of each of the gases present in the exhaust gases from a petrol engine with a catalytic converter.

name	percentage by volume
carbon monoxide	0.20
carbon dioxide	15.00
hydrocarbons	0.02
hydrogen	0.01
nitrogen	
oxides of nitrogen	0.02
water vapour	12.75
	total 100.00

(a) (i) Calculate the percentage by volume of nitrogen in the exhaust gases.

.....% [1]

(ii) Which gas shown in the table is present in the lowest percentage by volume?

..... [1]

(b) (i) Give **one** adverse effect of oxides of nitrogen on health.

..... [1]

(ii) Balance the chemical equation for the reaction of nitrogen dioxide with sodium hydroxide.

$$.....NO_2 + ...NaOH \rightarrow NaNO_3 + NaNO_2 + H_2O$$ [2]

(iii) State the name of the salt with the formula $NaNO_3$.

..... [1]

(c) Petrol contains saturated hydrocarbons.

State what is meant by the terms:

(i) *saturated* .....

..... [1]

(ii) *hydrocarbon* .....

..... [2]

(d) The table shows the composition of a sample of dry natural gas.

name of gas	percentage by volume
methane	95.0
ethane	3.2
propane	0.2
butane	0.1
carbon dioxide	0.5
nitrogen	1.0
	total 100.0

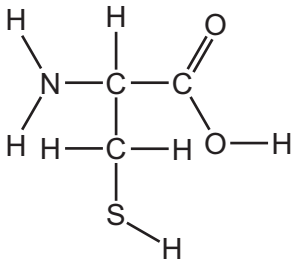
Calculate the percentage by volume of hydrocarbons in the sample of dry natural gas.

.....% [1]

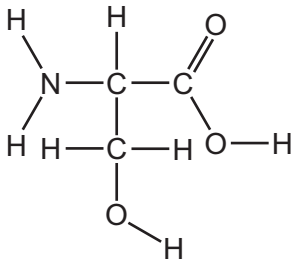
[Total: 10]

[Turn over

3 **(a)** The structures of two compounds, **A** and **B**, are shown.



compound **A**



compound **B**

(i) How many different types of atoms are present in compound **A**?

..... [1]

(ii) On structure **B** draw a circle around the alcohol functional group. [1]

(iii) Compounds **A** and **B** are formed in the body by enzyme-catalysed reactions.

What is the purpose of a catalyst?

..... [1]

(iv) Enzymes are polymers of compounds called amino acids.

What is meant by the term *polymer*?

.....

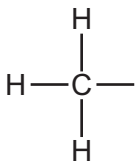
..... [1]

(b) Ethanoic acid is a carboxylic acid.

(i) Give **one** property of ethanoic acid.

..... [1]

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



[1]

(c) Ethanoic acid can be made by the oxidation of ethanol.

(i) The melting point of ethanol is –114 °C.
The boiling point of ethanol is 78 °C.

What is the physical state of ethanol at –120 °C?
Explain your answer.

.....

..... [2]

(ii) Complete the sentences about the manufacture of ethanol using words from the list.

a catalyst **addition** **an enzyme** **cracking**

ethane **ethene** **high** **low**

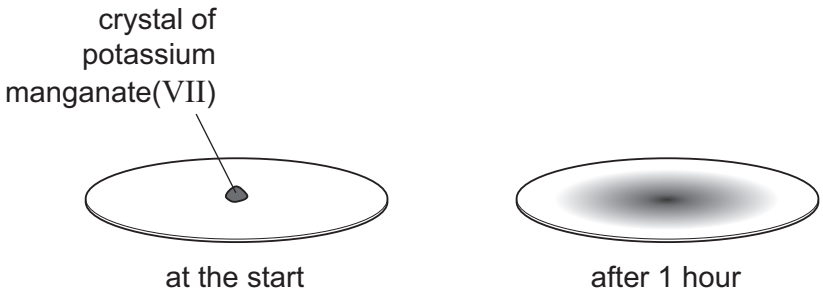
Ethanol can be manufactured by the ..... of steam to ..... .

The reaction takes place at a ..... temperature in the presence of ..... . [4]

[Total: 12]

4 This question is about manganese and its compounds.

(a) Potassium manganate(VII) is soluble in water.
A purple crystal of potassium manganate(VII) was placed in the middle of a piece of damp filter paper.
After 1 hour, the purple colour had spread over most of the filter paper.



Explain these observations using the kinetic particle model.

.....

.....

.....

.....

..... [3]

(b) Potassium manganate(VII) is produced from manganese(IV) oxide by an oxidation reaction.

What is meant by the term *oxidation*?

.....

..... [1]

(c) Potassium manganate(VII) decomposes when heated. The products are oxygen and manganese(IV) oxide.

(i) Describe a test for oxygen.

test .....

result .....
[2]

(ii) Manganese(IV) oxide reacts with concentrated hydrochloric acid.

Balance the chemical equation for this reaction.

$$MnO_2 + ...HCl \rightarrow MnCl_2 + Cl_2 + ...H_2O$$

[2]

(d) The table compares the reactivity of four metals with hydrochloric acid of the same concentration.

metal	reactivity with hydrochloric acid
lead	No bubbles seen. Metal does **not** disappear.
magnesium	Rapid formation of bubbles. Metal disappears rapidly.
manganese	Steady formation of bubbles. Metal disappears slowly.
tin	Bubbles formed slowly. Metal disappears very slowly.

Use this information to put the metals in order of their reactivity. Put the least reactive metal first.

least reactive ⟶ most reactive

[2]

(e) Manganese is a transition element. Sodium is an element in Group I of the Periodic Table.

Describe **three** ways in which the properties of manganese differ from those of sodium.

1 .....

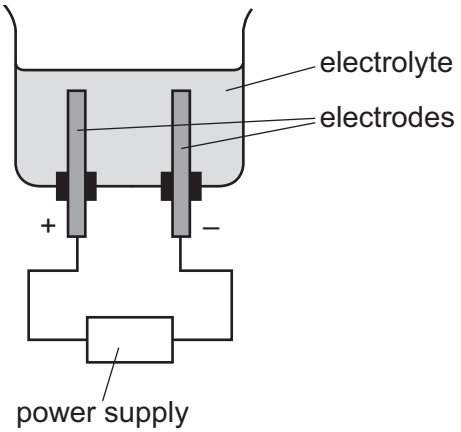
2 .....

3 .....

[3]

[Total: 13]

5 **(a)** Electrolysis of concentrated aqueous sodium chloride can be done using the apparatus shown.



(i) During electrolysis, a gas is produced at each electrode.

Complete the diagram to show how the gases can be collected. [1]

(ii) The positive electrode is called the anode.

State the name of the negative electrode.

..... [1]

(iii) Predict the main products of the electrolysis of concentrated aqueous sodium chloride at:

the negative electrode .....

the positive electrode. .....
[2]

(iv) Give the name of a suitable element to use as the electrodes in this electrolysis.

..... [1]

(b) Sodium hydroxide is manufactured by the electrolysis of sodium chloride.

(i) After electrolysis, 1000 cm^3 of solution contains 750 g of sodium hydroxide.

What mass of sodium hydroxide is present in 200 cm^3 of this solution?

..... [1]

(ii) What effect would impurities have on the melting point of sodium hydroxide?

..... [1]

(c) Describe how you could prepare a sample of solid sodium chloride from a solution of sodium chloride.

..... [1]

[Total: 8]

[Turn over

6 This question is about isotopes.

(a) An atom of an isotope of nitrogen is represented by the symbol shown.

$$^{15}_{7}N$$

Describe the structure of an atom of this isotope of nitrogen.
In your answer, include:

- the position of the protons, neutrons and electrons in the atom
- the number of protons, neutrons and electrons present in the atom.

.....

.....

.....

.....

.....

.....

..... [5]

(b) What is meant by the term *isotopes*?

.....

.....

..... [2]

(c) Give **one** industrial use of radioactive isotopes.

..... [1]

[Total: 8]

7 **(a)** The properties of some Group VII elements are shown in the table.

element	melting point in °C	boiling point in °C	density at room temperature in g / cm^3	colour
chlorine	–101	–35	0.0032	green
bromine	–7	59	3.1	red-brown
iodine	114	184		grey-black
astatine		337	6.4	

(i) Complete the table to suggest:
- the density of iodine
- the melting point of astatine
- the colour of astatine.

[3]

(ii) Suggest why the density of chlorine at room temperature is much lower than the density of bromine and astatine at room temperature.

.....

..... [1]

(iii) Describe the trend in the boiling points of the halogens.

..... [1]

(b) Aqueous bromine reacts with aqueous potassium iodide.

Complete the word equation for this reaction.

bromine	+	potassium iodide	→	.....	+	.....

[2]

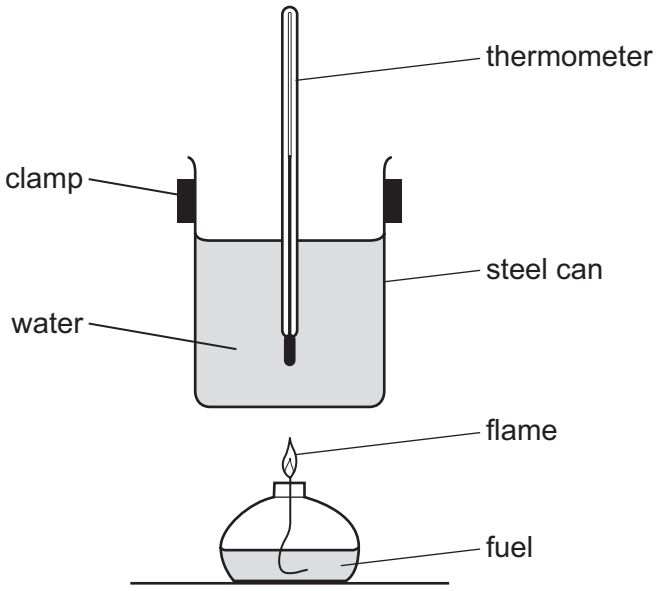
(c) A compound has the formula $C_2F_4Cl_2$.

Calculate the relative molecular mass of $C_2F_4Cl_2$.
Show all your working.
Use your Periodic Table to help you.

relative molecular mass = ... [2]

[Total: 9]

8 The energy released by burning four different fuels is compared using the apparatus shown. A known mass of each fuel is burned and the temperature rise of the water is measured.



(a) Suggest **two** factors that should be kept constant in this experiment.

1 .....

2 .....
[2]

(b) The table shows the temperature changes when four different fuels, **A**, **B**, **C** and **D**, are burned.

fuel	mass of fuel burned / g	initial temperature of the water / °C	final temperature of the water / °C
A	2	20	30
B	1	18	24
C	4	21	37
D	2	20	28

Which fuel gave the greatest temperature rise per gram?

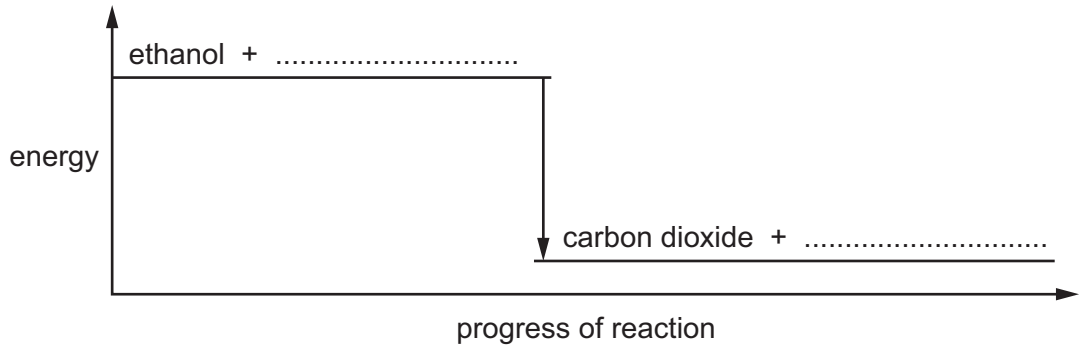
..... [1]

(c) Ethanol is a fuel.

Give **one** other use of ethanol.

..... [1]

(d) The energy level diagram for the complete combustion of ethanol is shown.



(i) Complete the diagram by filling in the missing reactant and the missing product. [2]

(ii) Is the complete combustion of ethanol exothermic or endothermic?
Use the information in the diagram to explain your answer.

.....

..... [1]

(e) A steel can is used in the experiment.

(i) Stainless steel is an alloy of iron.

What is meant by the term *alloy*?

.....

..... [1]

(ii) Describe the arrangement and type of motion of the particles in solid iron.

arrangement .....

type of motion .....
[2]

(iii) Suggest why stainless steel is used instead of pure iron for making cutlery.

.....

..... [1]

[Total: 11]

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.).