Cambridge O Level

Cambridge International Examinations
Cambridge Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

1481331435

CHEMISTRY **5070/22**

Paper 2 Theory **May/June 2018**

1 hour 30 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.

Section A
Answer **all** questions.
Write your answers in the spaces provided in the Question Paper.

Section B
Answer any **three** questions.
Write your answers in the spaces provided in the Question Paper.

Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.
A copy of the Periodic Table is printed on page 20.

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 **18** printed pages and **2** blank pages.

CAMBRIDGE International Examinations

[Turn over

Section A

Answer **all** the questions in this section in the spaces provided.

The total mark for this section is 45.

1 Choose from the gases to answer the questions.

ammonia
carbon dioxide
chlorine
butane
hydrogen
nitrogen
oxygen
propane
sulfur dioxide

Each gas can be used once, more than once or not at all.

Which gas:

(a) burns in air to give only water

..... [1]

(b) is used to kill bacteria in the purification of water for domestic use

..... [1]

(c) has a molecule containing only 11 atoms

..... [1]

(d) occupies 78% by volume of dry air

..... [1]

(e) is released when calcium hydroxide is added to soil that contains the fertiliser ammonium nitrate?

..... [1]

[Total: 5]

2 The transition elements occupy the central block of the Periodic Table.

Iron and copper are typical transition elements.

(a) The compounds of transition elements are often coloured.

What is the colour of iron(III) hydroxide?

.....[1]

(b) A redox reaction happens when iron filings are added to aqueous copper(II) sulfate.

$$Fe(s) + Cu^{2+}(aq) \longrightarrow Cu(s) + Fe^{2+}(aq)$$

(i) Describe what is observed during this reaction.

.....

.....[2]

(ii) Use the equation to explain that oxidation takes place in this reaction.

.....

.....[1]

(iii) Use the equation to explain that reduction takes place in this reaction.

.....

.....[1]

(c) Compounds containing ions of transition elements are often used as catalysts.

Name a catalyst that is the compound of a transition element and state the reaction it catalyses.

name .....

reaction .....

.....[1]

(d) Catalysts increase the rate of reaction by providing an alternative reaction pathway with a lower activation energy.

Explain why catalysts are used in industry.

.....

.....[1]

[Total: 7]

[Turn over

3 Silver chloride, AgC*l*, is an insoluble salt and silver nitrate is a soluble salt.

(a) Silver chloride can be prepared by the reaction between aqueous silver nitrate and dilute hydrochloric acid.

(i) Describe the preparation of a pure, dry sample of silver chloride from aqueous silver nitrate and dilute hydrochloric acid.

.....

.....

.....

.....

.....[3]

(ii) Write the ionic equation, including state symbols, for this reaction.

.....[2]

(b) Silver chloride decomposes in the presence of light to make silver and chlorine.

(i) What is the name of the type of reaction that requires light?

.....[1]

(ii) Construct the equation for the decomposition of silver chloride.

.....[1]

(c) Silver nitrate can be prepared by reacting silver oxide with dilute nitric acid.

$$Ag_2O + 2HNO_3 \rightarrow 2AgNO_3 + H_2O$$

Excess silver oxide is reacted with 30.0 cm^3 of 0.150 mol/dm^3 nitric acid.

After purification the percentage yield of silver nitrate is 80.0%.

Calculate the mass of silver nitrate prepared.

Give your answer to **three** significant figures.

[M_r: $AgNO_3$, 170]

mass of silver nitrate ..... g [3]

[Total: 10]

4 Phosphorus is a non-metal in Group V of the Periodic Table.

(a) Phosphorus can be manufactured from calcium phosphate, $Ca_3(PO_4)_2$.

$$2Ca_3(PO_4)_2 + 6SiO_2 + 10C \rightarrow 6CaSiO_3 + 10CO + P_4$$

What is the maximum mass of phosphorus that can be made using 300 g of silicon dioxide, SiO_2?

mass of phosphorus ..... g [2]

(b) Phosphorus, P_4, is a simple molecular substance.

Suggest **two** physical properties of phosphorus.

1 .....

2 .....
[2]

(c) Using ideas about structure and bonding, suggest why calcium phosphate, $Ca_3(PO_4)_2$, has a high melting point.

.....

.....

.....

.....[2]

(d) Complete the table about the number of electrons, neutrons and protons in two particles.

particle	$^{30}_{15}P$	.....
number of electrons	.....	18
number of neutrons	.....	16
number of protons	.....	15

[2]

[Total: 8]

5 Naphtha is a fraction obtained from petroleum (crude oil).

(a) Explain how naphtha is obtained from petroleum (crude oil).

.....

.....

.....

.....

.....

.....[3]

(b) One compound in the naphtha fraction has the formula $C_{12}H_{26}$.

(i) From this formula, how can you deduce that this compound is an alkane?

.....

.....

.....[1]

(ii) The alkane, $C_{12}H_{26}$, can be cracked to form an alkene that has six carbon atoms per molecule.

Construct the equation for this reaction.

.....[2]

(c) Ethene, C_2H_4, can be made by cracking hydrocarbons.

Draw a 'dot-and-cross' diagram for ethene.

You only need to show the outer shell electrons.

[2]

[Turn over

(d) Chlorine reacts with both ethene and ethane.

(i) One molecule of ethene reacts with one molecule of chlorine.

Draw the structure of the product of this reaction. Show all of the atoms and all of the bonds.

[1]

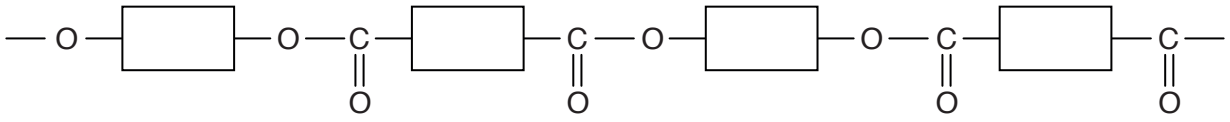
(ii) One molecule of ethane can react with two molecules of chlorine.

What is the molecular formula of the organic product of this reaction?

.....[1]

[Total: 10]

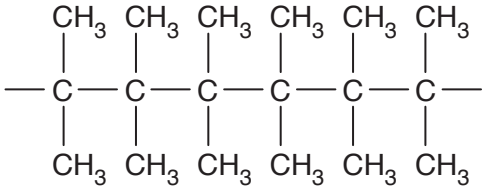
6 The diagram shows the partial structure of a polyester.



(a) Draw the partial structure of nylon.

[1]

(b) The diagram shows the partial structure of an addition polymer.



(i) What is meant by the term *addition polymerisation*?

.....

.....

.....[2]

(ii) Draw the structure of the alkene that can be used to make this addition polymer.

[1]

(iii) Describe one pollution problem associated with the disposal of this addition polymer.

.....

.....[1]

[Total: 5]

Section B

Answer **three** questions from this section in the spaces provided.

The total mark for this section is 30.

7 Sphalerite is an ore containing compounds of zinc. One of the compounds in the ore is ZnS.

(a) Calculate the mass of zinc in 30.0 tonnes of ZnS.

mass of zinc ..... tonnes [2]

(b) ZnS is heated in air. Zinc oxide and sulfur dioxide are formed.

(i) Construct the equation for this reaction.

.....[2]

(ii) Suggest one environmental problem involved with heating ZnS in air.

.....

.....[1]

(c) Zinc oxide is reacted with dilute sulfuric acid to form aqueous zinc sulfate.

Construct the equation for this reaction.

.....[1]

(d) Pure zinc is made by the electrolysis of aqueous zinc sulfate.

Zinc forms at the negative electrode. Hydroxide ions react at the positive electrode.

Construct the equations for the reactions at both electrodes.

positive electrode (anode) .....

negative electrode (cathode) .....
[2]

(e) Zinc is used to galvanise iron to prevent the iron from rusting.

Explain how galvanising prevents iron from rusting.

.....

.....

.....

.....[2]

[Total: 10]

8 A scientist investigates the thermal decomposition of calcium carbonate in a closed system.

A dynamic equilibrium mixture is established.

$$CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$$

(a) What is meant by the term *dynamic equilibrium*?

.....

.....

.....

.....[2]

(b) The pressure of the equilibrium mixture is decreased.

The temperature of the closed system is kept constant.

Predict and explain what will happen to the composition of the equilibrium mixture.

.....

.....

.....

.....

.....[2]

(c) The temperature of the equilibrium mixture is increased.

The pressure within the closed system is kept constant.

The position of equilibrium shifts to the right hand side.

What conclusion can be made about the enthalpy change of the reaction?

.....

.....[1]

(d) Calcium carbonate reacts with dilute nitric acid to form three compounds, **X**, **Y** and **Z**.

- **X** is a salt.
- **Y** is a colourless gas.
- **Z** is a colourless liquid.

(i) Name **Y** and describe a test for this gas.

name .....

test .....

observation .....

[2]

(ii) Name **Z** and describe a chemical test for this liquid.

name .....

chemical test .....

observation .....

[2]

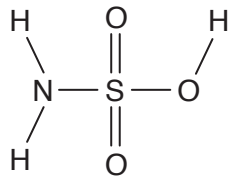
(iii) Construct the equation for the reaction between calcium carbonate and nitric acid.

.....[1]

[Total: 10]

[Turn over

9 Sulfamic acid has the structure shown.



(a) Write the molecular formula for sulfamic acid.

.....[1]

(b) Sulfamic acid is a weak acid.

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

.....

.....[1]

(ii) What is the difference between a weak acid and a strong acid?

.....

.....

.....

.....[2]

(c) What mass of sulfamic acid is required to make 250 cm^3 of a 0.150 mol/dm^3 solution?

mass ..... g [3]

(d) In a titration, 0.00250 moles of NaOH is exactly neutralised by 0.150 mol / dm^3 sulfamic acid.

One mole of sodium hydroxide reacts with one mole of sulfamic acid.

Calculate the volume, in cm^3, of sulfamic acid needed in this titration.

volume ..... cm^3 [1]

(e) One mole of aqueous sulfamic acid can produce one mole of hydrogen ions.

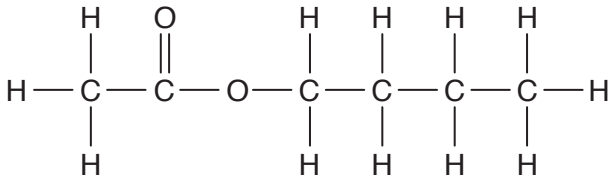
Construct the equation to show the reaction between sulfamic acid and magnesium.

.....[2]

[Total: 10]

[Turn over

10 Ester **A** has the structure shown.



(a) Name ester **A**.

.....[1]

(b) Ester **A** reacts with hot aqueous sodium hydroxide to give two compounds, **B** and **C**.

(i) Compound **B** has the percentage composition by mass:

29.3% carbon; 3.7% hydrogen; 39.0% oxygen; 28.0% sodium.

Calculate the empirical formula for this compound.

[2]

(ii) Compound **C** has a relative molecular mass of 74 and is oxidised by warm acidified potassium manganate(VII) to give butanoic acid.

Suggest a structure for **C**.

Give reasons for your answer.

.....

.....

.....

.....[2]

(c) **(i)** What is meant by the term *isomerism*?

.....

.....[1]

(ii) Draw an isomer of ester **A**.

[1]

(d) Explain why ester **A** is a saturated compound.

.....

.....[1]

(e) Ester **A** can be used as a fragrance or perfume because it diffuses easily.

(i) Explain why the rate of diffusion of the ester decreases as the temperature decreases.

.....

.....

.....[1]

(ii) Suggest **one** other use for ester **A**.

.....[1]

[Total: 10]

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The Periodic Table of Elements

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