Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME	

CENTRE NUMBER						CANDIDATE NUMBER					

CHEMISTRY **0620/32**

Paper 3 Theory (Core) **October/November 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.

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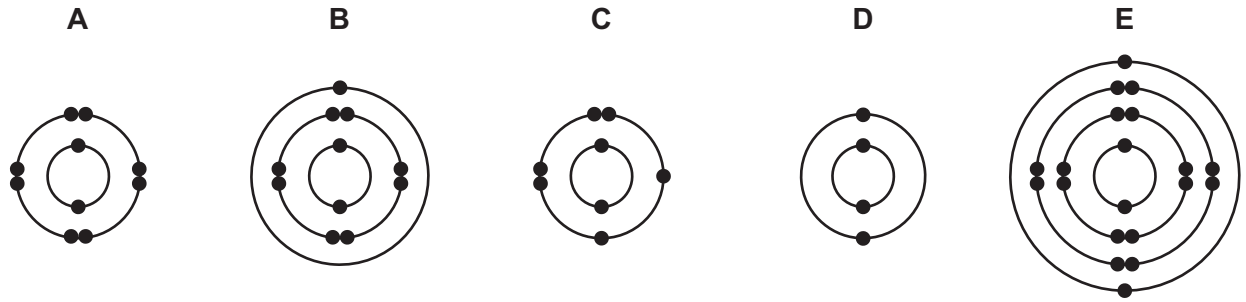
CAMBRIDGE International Examinations

1 **(a)** The electronic structures of five atoms, **A**, **B**, **C**, **D** and **E**, are shown.



Answer the following questions about these structures.
Each structure may be used once, more than once or not at all.
State which structure, **A**, **B**, **C**, **D** or **E**, represents:

(i) an atom in Group VIII of the Periodic Table ..... [1]

(ii) an atom of a reactive non-metal ..... [1]

(iii) an atom with a proton number of 11 ..... [1]

(iv) an atom with only **three** shells of electrons ..... [1]

(v) an atom which forms a stable ion with a single positive charge. ..... [1]

(b) Complete the table to show the number of electrons, neutrons and protons in the nitrogen atom and chromium ion shown.

	number of electrons	number of neutrons	number of protons
$^{15}_{7}N$	7		
$^{52}_{24}Cr^{2+}$		28	

[3]

[Total: 8]

2 **(a)** The table shows the concentrations of the ions present in a solution obtained from cells in the body.

ion present	formula of ion	concentration in mg / 1000 cm^3
sodium	Na^+	273
potassium	K^+	540
calcium	Ca^{2+}	3
magnesium	Mg^{2+}	20
chloride	Cl^-	140
hydrogencarbonate	HCO_3^-	730
phosphate	PO_4^{3-}	1

Answer these questions using only information from the table.

(i) Which negative ion is present in the highest concentration?

..... [1]

(ii) Calculate the mass of potassium ions present in 250 cm^3 of this solution.

mass of potassium ions = ... mg [1]

(iii) Calculate the **total** mass of positive ions present in 1000 cm^3 of this solution.

total mass of positive ions = ... mg [1]

(iv) Give the name of the compound formed from Na^+ and HCO_3^- ions.

..... [1]

(b) Describe what is observed in these **two** reactions.

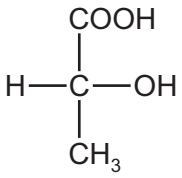
- An excess of aqueous sodium hydroxide is added to a solution containing Ca^{2+} ions.

.....

- An excess of aqueous ammonia is added to a solution containing Ca^{2+} ions.

.....
[2]

(c) Lactic acid can build up in muscle cells during exercise.
The structure of lactic acid is shown.



(i) On the structure, draw a circle around the carboxylic acid functional group. [1]

(ii) Deduce the molecular formula of lactic acid showing the number of carbon, hydrogen and oxygen atoms.

..... [1]

(d) Lactic acid can form a polymer.

Complete the sentence about polymers using words from the list.

atomic **large** **molecular** **monomers** **polymers** **small**

During polymerisation ..... molecules called ..... join together to form long-chain molecules with a very high relative ..... mass.

[3]

[Total: 11]

3 **(a)** The table gives information about the solubility of copper and selenium in an organic solvent and in water. The organic solvent boils at 30 °C.

element	solubility in organic solvent	solubility in water
copper	insoluble	insoluble
selenium	soluble	insoluble

(i) Use the information in the table to suggest how you could obtain pure, dry samples of copper and selenium from a mixture of copper powder and selenium powder.

.....

.....

.....

.....

.....

..... [4]

(ii) Ethanol is an organic solvent.

Draw the structure of ethanol. Show all of the atoms and all of the bonds.

[2]

(iii) Selenium reacts with fluorine to form selenium(VI) fluoride.

Balance the chemical equation for this reaction.

$$Se + ...F_2 \rightarrow SeF_6$$

[1]

(b) The chemical equation for the reaction of copper with hot concentrated sulfuric acid is shown.

$$Cu + 2H_2SO_4 \rightarrow CuSO_4 + SO_2 + 2H_2O$$

(i) Complete the word equation for this reaction.

copper	+	sulfuric acid	→	....	+	....	+	.....

[2]

(ii) One of the compounds in this equation is a pollutant gas which contributes to acid rain.

Identify the pollutant gas and state a common source of it.

pollutant gas .....

source .....
[2]

(c) Solid hydrated copper(II) sulfate decomposes to anhydrous copper(II) sulfate when it is continuously heated.

Is this an endothermic or an exothermic reaction?
Explain your answer.

.....

..... [1]

[Total: 12]

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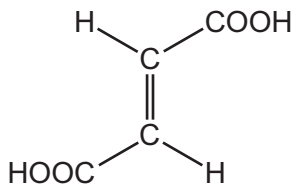
4 This question is about acids.

(a) The structure of fumaric acid is shown.



Fumaric acid is an unsaturated compound.

(i) What feature of the structure of fumaric acid shows that it is unsaturated?

..... [1]

(ii) Describe a test for an unsaturated compound.

test .....

result .....
[2]

(b) Hydroiodic acid can be used for the reduction of some carboxylic acids.

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

..... [1]

(ii) Hydroiodic acid is oxidised by oxygen.

Balance the chemical equation for this reaction.

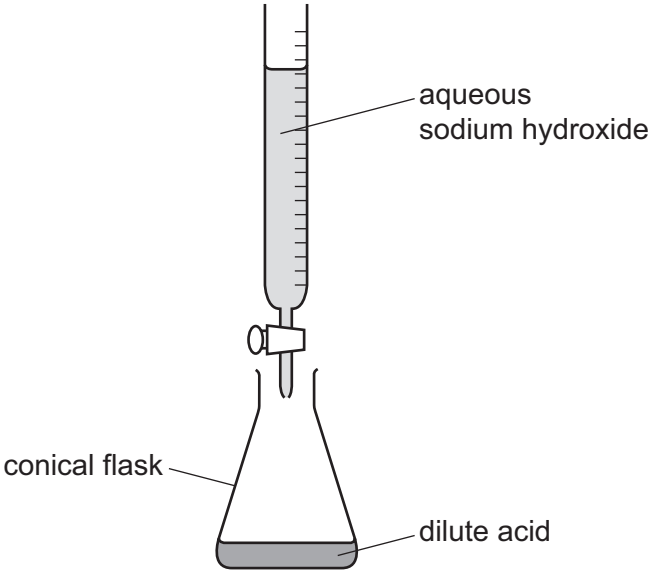
$$.....HI + O_2 \rightarrow 2H_2O + ...I_2$$

[2]

(iii) What percentage of clean, dry air is oxygen?

..... [1]

(c) The concentration of a dilute acid can be found by reacting it with aqueous sodium hydroxide using the apparatus shown.



(i) What piece of apparatus should be used to add exactly 25.0 cm^3 of dilute acid to the conical flask?

..... [1]

(ii) A few drops of litmus solution are added to the conical flask.

Explain why litmus solution is added to the conical flask.

.....

..... [1]

(iii) Aqueous sodium hydroxide is then added to the dilute acid until it is in excess.

Describe the change in the colour of the litmus solution in the conical flask.

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

[Total: 11]

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5 Bromine is a volatile liquid. Potassium bromide is a compound made from bromine.

(a) Use the kinetic particle model to describe the arrangement **and** motion of the particles in bromine when it is:

- a liquid

.....

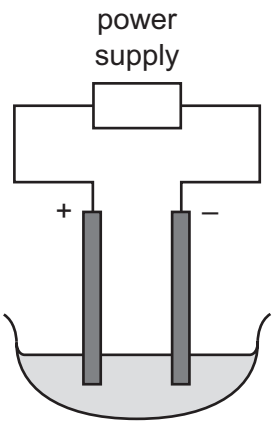
.....

- a gas

.....

.....
[4]

(b) Molten potassium bromide can be electrolysed using the apparatus shown.



(i) On the diagram, label:
- the anode
- the electrolyte

[2]

(ii) Predict the products of this electrolysis at:

the positive electrode .....

the negative electrode. .....
[2]

(iii) Give **one** observation that is made at the positive electrode.

..... [1]

(iv) Suggest why the electrodes are made of graphite and **not** of magnesium.

.....

..... [1]

(c) Aqueous potassium bromide reacts with aqueous chlorine.

(i) Complete the word equation for this reaction.

potassium bromide	+	chlorine	→	....	+	.....

[2]

(ii) Using ideas about the reactivity of the halogens, explain why aqueous potassium bromide does **not** react with aqueous iodine.

.....

..... [1]

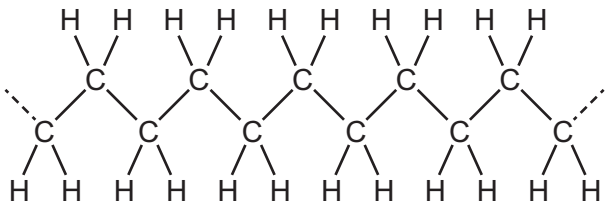
(iii) Describe what you would observe when aqueous silver nitrate is added to aqueous potassium bromide.

..... [2]

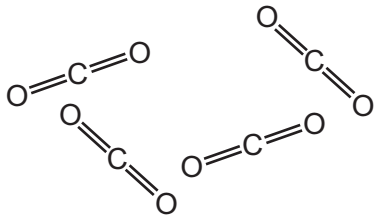
[Total: 15]

6 **(a)** The diagrams show the structures of four substances, **R**, **S**, **T** and **U**.

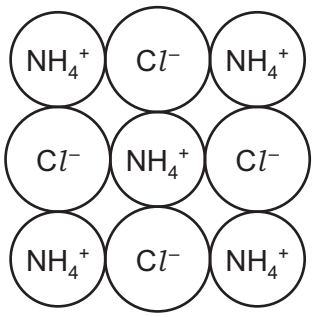
R



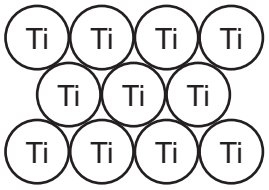
S



T



U



State which **one** of these substances, **R**, **S**, **T** or **U**:

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

(ii) contains ionic bonds ..... [1]

(iii) is a gas at room temperature ..... [1]

(iv) is a polymer. ..... [1]

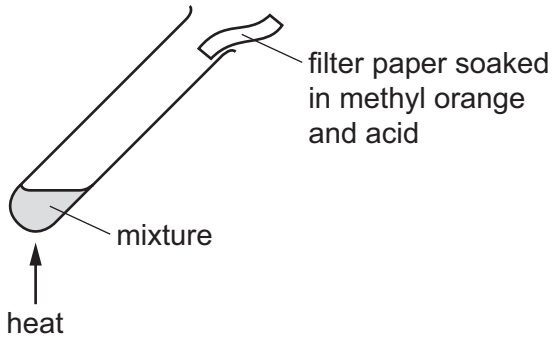
(b) Ammonium chloride is present in some fertilisers.

Which **two** of the following compounds are also present in many fertilisers?
Tick **two** boxes.

- hydrogen sulfide ☐
- calcium phosphate ☐
- copper(II) fluoride ☐
- nickel(II) oxide ☐
- potassium nitrate ☐

[2]

(c) A mixture of ammonium chloride and aqueous sodium hydroxide is heated as shown.



The filter paper changes colour from red to yellow.

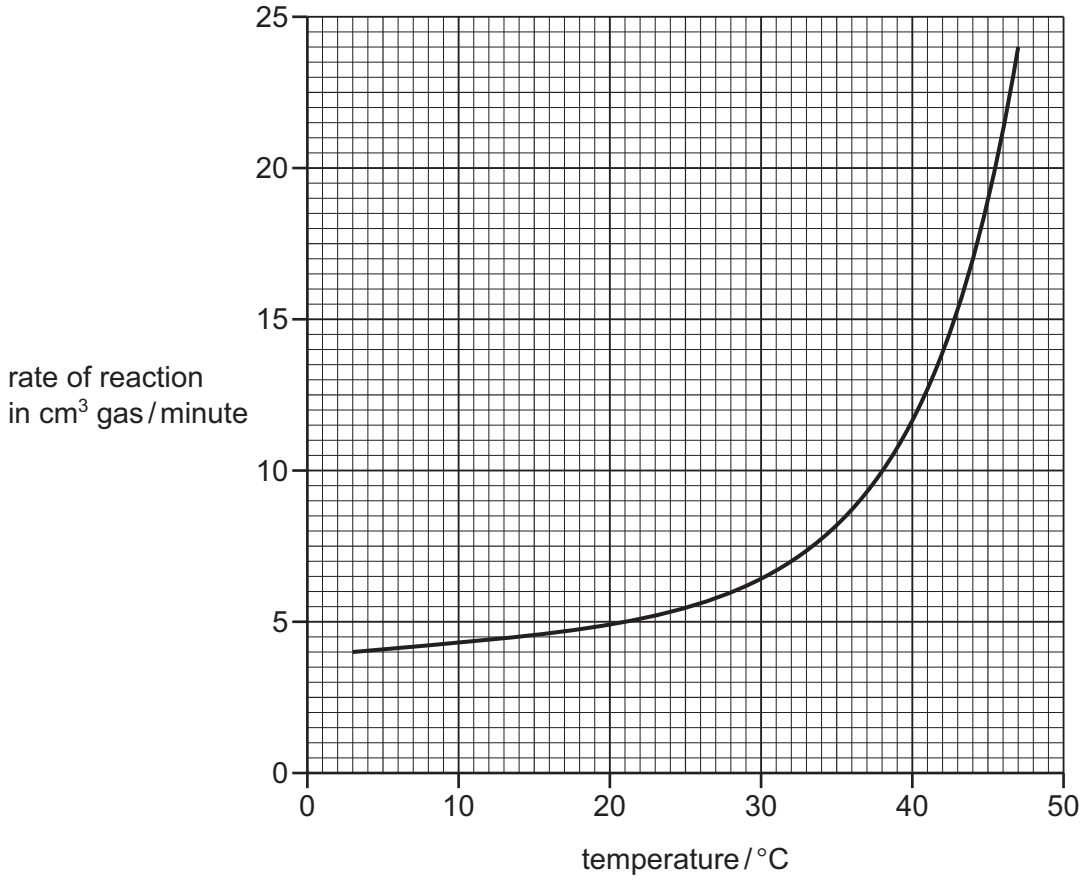
Explain why.

.....

..... [2]

[Total: 8]

7 **(a)** The graph shows the effect of temperature on the rate of reaction of dilute hydrochloric acid with zinc powder.



(i) Determine the rate of reaction at 40 °C.

rate of reaction = ... cm^3 gas / minute [1]

(ii) The experiments were repeated using small lumps of zinc instead of zinc powder.
All other conditions were kept the same.

On the grid, draw a graph to show how the rate of reaction changes with temperature when small lumps of zinc are used instead of zinc powder. [2]

(b) What effects do these factors have on the rate of a chemical reaction?

(i) decreasing the concentration of a reactant

..... [1]

(ii) adding a catalyst

..... [1]

(c) Zinc and iron are both metals.

Give **two** physical properties which are characteristic of metals.

1 .....

2 .....
[2]

(d) Stainless steel is an alloy of iron.

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

..... [1]

(ii) Give **one** common use of stainless steel.

..... [1]

[Total: 9]

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8 The table shows the properties of some Group I elements.

element	density in g / cm^3	melting point in °C	relative hardness
sodium	0.97	98	4.9
potassium	0.86	63	2.6
rubidium	1.53		1.6
caesium		29	1.0

(a) **(i)** Describe the trend in the relative hardness of the Group I elements.

..... [1]

(ii) Predict the melting point of rubidium.

..... [1]

(iii) Explain why it is difficult to predict the density of caesium.

.....

..... [1]

(b) When potassium reacts with water, it floats and melts into a ball. A flame is observed.

(i) What colour does potassium give to the flame?

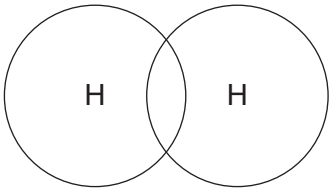
..... [1]

(ii) Use the information in the table to suggest why potassium floats on water.

..... [1]

(iii) Hydrogen is produced when potassium reacts with water.

Complete the dot-and-cross diagram to show the electron arrangement in a molecule of hydrogen.



[1]

[Total: 6]

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The Periodic Table of Elements

Key

atomic number
atomic symbol
name
relative atomic mass

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 –		

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.).

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