Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

CHEMISTRY **0620/32**

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

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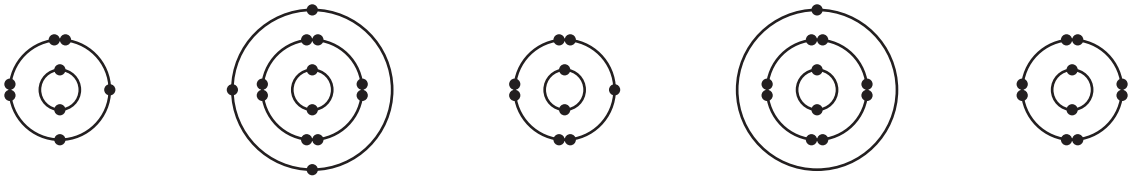
CAMBRIDGE International Examinations

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

View solution



A **B** **C** **D** **E**

Answer the following questions about these atoms.
Each atom may be used once, more than once or not at all.

Which atom, **A**, **B**, **C**, **D** or **E**,

(i) has a total of 8 electrons, ... [1]

(ii) is in Group III of the Periodic Table, ... [1]

(iii) has 13 protons, ... [1]

(iv) is a noble gas, ... [1]

(v) forms a stable ion with a single negative charge? ..... [1]

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

View solution

	number of electrons	number of neutrons	number of protons
$^{34}_{16}S$	16		
$^{18}_{8}O^{2-}$		10	

[3]

[Total: 8]

2 **(a)** The table shows the ions present in a 1000 cm^3 sample of rainwater.

View solution

ion present	formula of ion	mass present in mg / 1000 cm^3
calcium	Ca^{2+}	1
hydrogencarbonate	HCO_3^-	3
magnesium	Mg^{2+}	1
potassium	K^+	2
sodium	Na^+	9
silicate	SiO_3^{2-}	1
	Cl^-	17

Answer these questions using the information from the table.

(i) State the name of the ion Cl^-.

..... [1]

(ii) Which positive ion is present in the highest concentration?

View solution

..... [1]

(iii) Calculate the mass of potassium ions present in 200 cm^3 of this sample.

View solution

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

(iv) Calculate the mass of solid formed when all the water is evaporated from the 1000 cm^3 sample.

View solution

mass of solid formed = ... mg [1]

(v) Name the compound containing Na^+ ions and HCO_3^- ions.

..... [1]

View solution

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(b) Describe a test for potassium ions.

test .....

result .....

View solution [2]

(c) The formulae of some nitrates are given.

View solution

aluminium nitrate, $Al(NO_3)_3$

magnesium nitrate, $Mg(NO_3)_2$

sodium nitrate, $NaNO_3$

Deduce the formula for potassium nitrate.

..... [1]

(d) Molten potassium bromide can be electrolysed using inert electrodes.

View solution

Predict the products of this electrolysis at

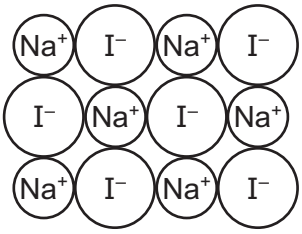
the negative electrode (cathode), ...

the positive electrode (anode). .....

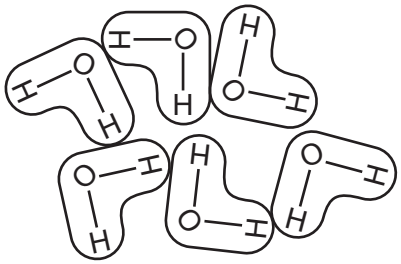
[2]

[Total: 10]

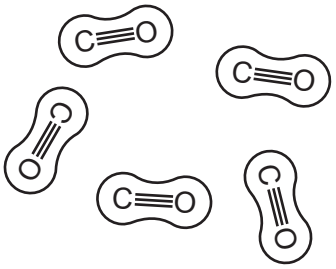
3 The diagram shows part of the structures of three substances, **X**, **Y** and **Z**, at room temperature and pressure.



X



Y



Z

View solution

(a) Describe substances **X**, **Y** and **Z** in terms of

- their bonding,
- the arrangement of their particles,
- the motion of their particles.

.....

.....

.....

.....

.....

.....

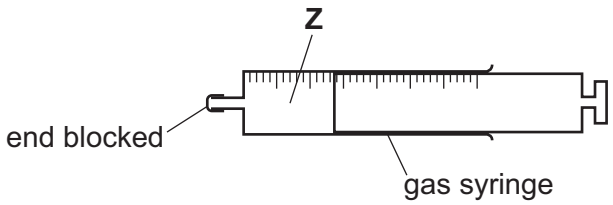
.....

.....

..... [5]

(b) A closed gas syringe contains substance **Z**.

View solution



Describe what happens to the volume of substance **Z** in the syringe when the temperature is increased. The pressure remains constant. Explain your answer in terms of particles.

.....

..... [2]

(c) Describe the colour change when substance **Y** is added to anhydrous copper(II) sulfate.

View solution

..... [2]

(d) Give a reason why substance **Y** is a compound.

..... [1]

[Total: 10]

View solution

4 Aluminium and zinc are both metals.
Aluminium is extracted from its purified ore by electrolysis.

(a) (i) State the name of an ore of aluminium.

View solution

..... [1]

(ii) Explain why aluminium is extracted from its purified ore by electrolysis and **not** by heating with carbon.

.....

..... [1]

(b) Aluminium reacts with hydrochloric acid to form aluminium chloride and a gas which 'pops' with a lighted splint.

(i) Identify this gas.

View solution

..... [1]

(ii) Suggest a practical method for investigating the rate of this reaction involving collection of the gas.
You may include a labelled diagram in your answer.

View solution

.....

.....

.....

..... [3]

(c) State **one** use of aluminium. Give a reason why it is used for this purpose.

View solution

use .....

reason .....
[2]

(d) Give **two** advantages of recycling aluminium.

1 .....

2 .....

View solution [2]

(e) Zinc is extracted from zinc oxide by heating zinc oxide with carbon monoxide.

View solution

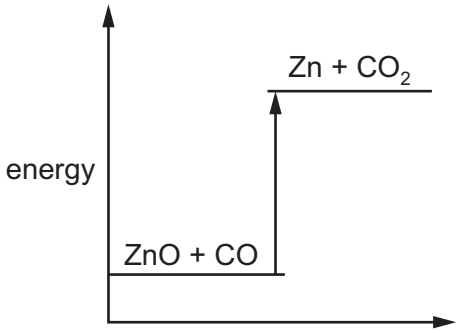
$$ZnO + CO \rightarrow Zn + CO_2$$

(i) How does this equation show that zinc oxide is reduced?

..... [1]

(ii) The energy level diagram for this reaction is shown.

View solution



Explain how this diagram shows that the reaction is endothermic.

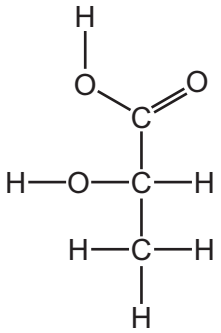
.....

..... [1]

[Total: 12]

Question 5 starts on the next page.

5 The structure of lactic acid is shown.



View solution

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

(ii) State the name of **one** other functional group found in lactic acid.

View solution

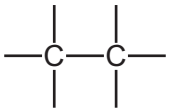
..... [1]

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

..... [1]

(c) Complete the structure of ethanol. Show all of the atoms and all of the bonds.

View solution



[2]

(d) The table shows the properties of some alcohols.

View solution

alcohol	melting point / °C	boiling point / °C	volatility
methanol	–98	65	decreases ↓
ethanol	–114		
propanol	–126	98	
butanol	–89	117	

(i) What is the meaning of the term *volatility*?

..... [1]

(ii) Which alcohol in the table has the highest melting point?

..... [1]

(iii) Predict the boiling point of ethanol.

..... [1]

(iv) What is the state of propanol at 120 °C? Explain your answer.

.....

..... [2]

(e) (i) Complete this chemical equation for the incomplete combustion of methanol.

View solution

$$CH_3OH + \text{.....} \rightarrow CO + \text{.....}H_2O$$

[2]

(ii) Calculate the relative molecular mass of methanol, CH_3OH.
Show all your working.
Use your Periodic Table to help you.

View solution

relative molecular mass = ... [2]

[Total: 14]

6 **(a)** The table shows the properties of some types of steel.

View solution

type of steel	density in g / cm^3	resistance to corrosion	relative strength	relative hardness
L	7.80	poor	4.8	200
M	7.82	very good	5.1	210
N	7.85	good	4.6	210

Which type of steel, **L**, **M** or **N**, would be best to reinforce concrete?
Give **two** reasons for your answer.

type of steel .....

reason 1 .....

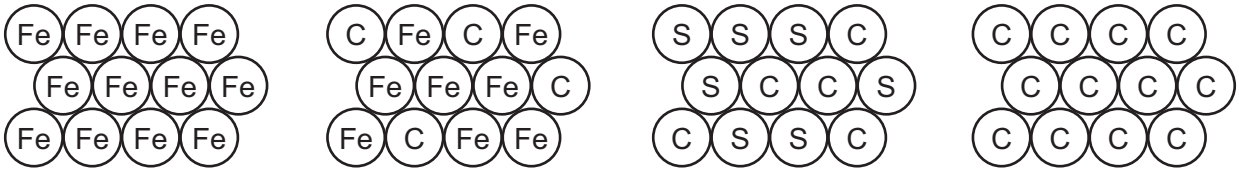
reason 2 .....

[2]

(b) Steel is an alloy.

View solution

Which diagram, **P**, **Q**, **R** or **S**, represents an alloy?



P **Q** **R** **S**

..... [1]

(c) Iron is a transition element.

View solution

State **three** properties of transition elements which are **not** shown by Group I elements.

1 .....

2 .....

3 .....

[3]

(d) Iron reacts with hydrochloric acid to form iron(II) chloride and hydrogen.

View solution

Complete the chemical equation for this reaction.

$$Fe + ...HCl \rightarrow FeCl_2 + ...$$

[2]

(e) Some information about the reaction of four metals with oxygen is given.

View solution

copper: surface turns black slowly when heated strongly
iron: thin wire burns when heated strongly
gold: remains a gold colour when heated strongly
potassium: bursts into flame when heated gently

List these metals in order of their reactivity. Put the least reactive metal first.

least reactive ⟶ **most** reactive

[2]

(f) The table compares the time taken for reaction of iron with methanoic acid, phosphoric acid and propanoic acid, each at three different concentrations. The time taken for the iron to decrease in mass by 1.0 g was measured. All other conditions were kept the same.

View solution

acid	time taken for reaction / hours		
	concentration of acid 0.01 mol / dm^3	concentration of acid 0.02 mol / dm^3	concentration of acid 0.04 mol / dm^3
methanoic acid	98	47	20
phosphoric acid	9	5	2
propanoic acid	220	102	45

(i) How does the concentration of acid affect the rate of reaction?

.....

..... [1]

(ii) Which acid reacts most rapidly with the iron?

View solution

..... [1]

(iii) Predict how long it would take for the iron to decrease in mass by 1.0 g using propanoic acid of concentration 0.03 mol / dm^3.

View solution

time taken = ... hours [1]

(iv) Suggest which **one** of these pH values is the pH of concentrated aqueous phosphoric acid. Draw a circle around the correct answer.

View solution

pH 2 pH 7 pH 9 pH 13

[1]

[Total: 14]

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7 Sulfur is an element in Group VI of the Periodic Table.

(a) What is the meaning of the term *element*?

View solution

.....

..... [1]

(b) Give **one** source and **one** use of sulfur.

View solution

source .....

use .....

[2]

(c) When sulfur vapour touches a cold surface it changes directly to a solid.

View solution

What is the name given to this change of state?

..... [1]

(d) Sulfur dioxide and oxides of nitrogen are both atmospheric pollutants.

View solution

- Give the sources of these gases.
- Describe the effects of these pollutants on the environment.
- Describe the effects of these pollutants on health.

.....

.....

.....

.....

.....

.....

..... [5]

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(e) Sulfur and zinc are both insoluble in water.
Sulfur does **not** react with hydrochloric acid but zinc reacts to form a soluble salt and a gas which escapes into the air.

Suggest how you could prepare a pure dry sample of sulfur from a mixture of sulfur powder and zinc powder.

.....

.....

.....

.....

.....

..... [3]

[Total: 12]

View solution

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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.).