Centre Number	Candidate Number	Candidate Name

NAMIBIA SENIOR SECONDARY CERTIFICATE

CHEMISTRY ORDINARY LEVEL

6117/2

PAPER 2 Structured Questions

1 hour 30 minutes

Marks 80

2022

Additional Materials: Non-programmable calculator
Ruler

INSTRUCTIONS AND INFORMATION TO CANDIDATES

- Candidates answer on the Question Paper in the spaces provided.
- Write your Centre Number, Candidate Number and Name in the spaces provided on top of this page.
- Write in dark blue or black pen.
- You may use a soft pencil for any diagrams, graphs or rough working.
- Do not use correction fluid.
- Do not write in the margin *For Examiner's Use*.
- Answer **all** questions.
- The number of marks is given in brackets [ ] at the end of each question or part question.
- You will lose marks if you do not show your working or if you do not use appropriate units.
- The Periodic Table is printed on page 15.

For Examiner's Use	
1	
2	
3	
4	
5	
6	
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8	
Total	

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Checker	

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

Republic of Namibia

MINISTRY OF EDUCATION, ARTS AND CULTURE

1 Period 2 of the periodic table is shown in Table 1.1 below.

Table 1.1.

lithium	beryllium	boron	carbon	nitrogen	oxygen	fluorine	neon

(a) Choose from the elements given in Table 1.1 to answer the following questions.

Each element may be used once, more than once or not at all.

State which element

(i) forms an ion with a charge of 2^+,

..... [1]

(ii) forms a soluble hydroxide with water that cannot be precipitated,

..... [1]

(iii) forms a coloured gas at room temperature and pressure,

..... [1]

(iv) forms an oxide which is also a product of fermentation,

..... [1]

(v) consists of diatomic molecules with the relative formula mass, M_r, of 32.

..... [1]

(b) A nitrogen atom forms an ion, which has a formula $^{14}_{7}N^{3-}$.

Complete Table 1.2 about the nitrogen ion.

Table 1.2

subatomic particles	number of subatomic particles
p (protons)	7
e^- (electrons)	i) …….
n (neutrons)	ii) …….

[2]

(c) Describe the formation of lithium and oxide ions when lithium reacts with oxygen.

.....

.....

.....

..... [2]

For Examiner's Use

(d) Explain why molten lithium oxide conducts electricity.

.....

.....

.....

..... [2]

(e) Write the chemical formula for beryllium chloride

..... [1]

[12]

2 When aqueous copper(II) sulfate is electrolysed, reactions occur at the inert carbon electrodes, cathode and anode.
The apparatus is shown in Fig. 2.1.

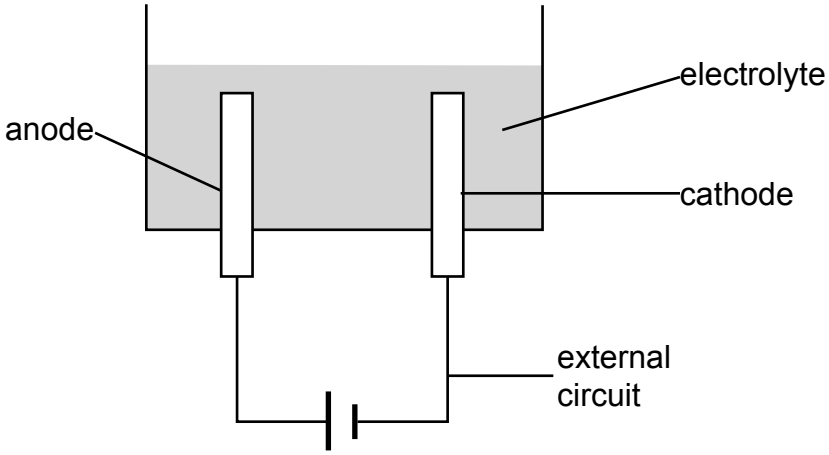

Fig 2.1

(a) Describe what is meant by the term *electrolyte*.

.....

..... [1]

(b) Give **one** ion in the electrolyte which is attracted to the anode.

..... [1]

(c) Write a balanced half-equation for the reaction that occurs at the anode.

..... [2]

(d) State the product formed at the cathode and explain why it was formed.

.....

.....

.....

..... [2]

(e) Sodium cannot be produced by electrolysis of aqueous sodium chloride using inert electrodes.
Suggest how sodium can be produced from sodium chloride by electrolysis.

.....

..... [1]

(f) Name **one** use of copper.

.....

..... [1]

[8]

For Examiner's Use

3 Lead sulfate is an insoluble salt.

(a) Zinc sulfate reacted with compound **X** to produce lead sulfate.

Name compound **X**.

..... [1]

(b) Give the name of the type of a chemical reaction that is used to prepare insoluble salts.

.....

..... [1]

(c) A flowchart shows the steps involved in the preparation of a pure, dry sample of lead sulfate from the mixture.

Complete the flowchart by filling in **step 2** and **3**.

Step 1	mix zinc sulfate and compound **X**
Step 2	**(i)** .....
Step 3	**(ii)** .....
Step 4	dry the insoluble salt (lead sulfate)

[2]

(d) Neutralisation is the method of preparing soluble salts.

(i) Complete the **word equation** for the neutralisation reaction used to prepare sodium chloride.

sodium carbonate + ……..... → sodium chloride +

carbon dioxide + ……..... [2]

(ii) Describe the chemical test for carbon dioxide.

test: .....

result: .....

..... [2]

[8]

For Examiner's Use

4 In an experiment, 600 cm^3 of 1.5 mol/dm^3 of sulfuric acid, a strong acid, reacted with excess magnesium hydroxide to form a soluble salt, magnesium sulfate and water.

(a) In terms of dissociation of ions, explain the meaning of strong acid.

.....

..... [1]

(b) Name the process of manufacturing sulfuric acid.

..... [1]

(c) Balance the chemical equation for the reaction.

$$Mg(OH)_2 \quad + \quad H_2SO_4 \rightarrow MgSO_4 \quad + \quad H_2O$$ [1]

(d) Calculate

(i) the number of moles in 600 cm^3 of 1.5 mol/dm^3 of dilute sulfuric acid,

moles = ... [2]

(ii) the relative formula mass of magnesium sulfate,

M_r ..... [1]

(iii) the mass of magnesium sulfate produced in the reaction,

mass = ... [2]

(iv) the number of water molecules produced in the reaction.

water molecules =..... [2]

For Examiner's Use

(e) Ascorbic acid, known as Vitamin C, is a weak acid. Analysis of 100 g of ascorbic acid shows that it contains 40.92 g carbon, 4.58 g hydrogen and 54.50 g oxygen.

(i) Calculate the empirical formula of ascorbic acid.

Empirical formula ..... [3]

(ii) The relative formula mass of ascorbic acid is 176.
Calculate the molecular formula of ascorbic acid.

Molecular formula ..... [2]

[15]

For Examiner's Use

5 Zinc reacts with dilute nitric acid.

$$Zn + 2HNO_3 \rightarrow Zn(NO_3)_2 + H_2$$

(a) State the observation made during the reaction.

..... [1]

(b) The experiment was used to investigate the rate of reaction of zinc when reacted with dilute nitric acid. All other conditions remained the same. The size of the pieces of zinc were:

A - zinc powder

B - granules

C - lumps

Complete Table 5.1 by filling in the sizes of the pieces corresponding to the rate of reaction.

Table 5.1

Size of the piece of zinc	**(i)**……	**(ii)**…….....	**(iii)**……..……
Rate of reaction cm^3/min	10	24	3

[2]

(c) The experiment was repeated with dilute nitric acid at higher temperature. In terms of collision theory, describe the effects of higher temperature on the rate of reaction.

.....

.....

.....

..... [2]

(d) In terms of change in ionic charge, explain why nitric acid is reduced.

.....

.....

..... [1]

(e) Fig. 5.1 shows the energy level diagram for the reaction.

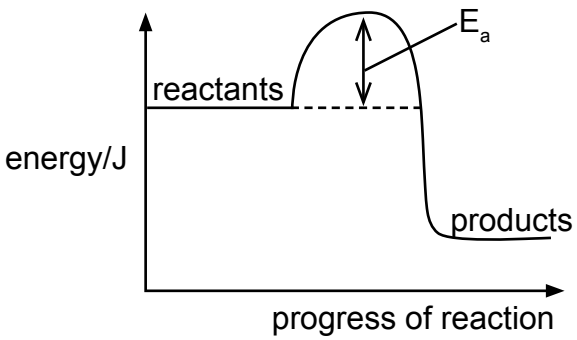

Fig. 5.1

(i) State with a reason, how the energy level diagram shows whether the reaction is endothermic or exothermic.

.....

.....

.....

..... [2]

(ii) State the change that occurs on the energy level diagram when a catalyst is added to the reaction.

.....

..... [1]

(f) Name the ore of zinc used to produce pure zinc.

..... [1]

[10]

6 In an experiment, different mixtures of metals and metal oxides were heated. Table 6.1 shows the results.

Table 6.1

mixture	reacts/no reaction	products if any
copper(II) oxide + iron	reacts	iron oxide(II) and copper
iron(III) oxide + zinc	reacts	……..+ …….
calcium oxide + copper	no reaction	no products

(a) Identify the **two** products formed when iron(III) oxide reacts with zinc.

.....

..... [2]

(b) Arrange the metals calcium, copper, iron and zinc in the order of reactivity.

most reactive	
least reactive	

[2]

(c) Explain why there is a reaction between copper(II) oxide and iron.

.....

.....

.....

..... [2]

(d) Aluminum is high in the reactivity series but does not react with water or acids. Give the explanation that accounts for this apparent unreactivity of aluminium.

.....

.....

.....

..... [2]

For Examiner's Use

(e) The presence of calcium sulfate and magnesium sulfate in water causes the hardness of water.

(i) State the type of hardness caused by the presence of these two compounds.

..... [1]

(ii) Describe one way of removing the type of hardness in **(i)**.

.....

..... [1]

[10]

7 Esters, fats and polyesters all contains the ester-linkage.
Fat is a natural macromolecule found as the main constituent of food.

(a) Give the other two main constituents of food.

.....

..... [2]

(b) Ethyl ethanoate is an ester formed by the reaction of ethanoic acid and alcohol **Z**.

(i) Name alcohol **Z**.

..... [1]

(ii) Draw the molecular structure of ethanoic acid.

[2]

(iii) The structural formula of ethyl ethanoate is shown in Fig. 7.1.
Circle the ester linkage in the structure.

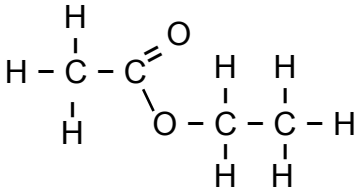

Fig. 7.1

[1]

(iv) Give **one** use of esters.

..... [1]

(c) A polyester is represented by the structure shown in Fig. 7.2.

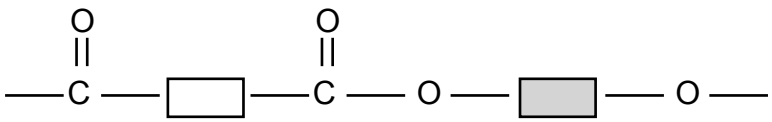

Fig. 7.2

(i) State the type of polymerisation that produced the polyester shown in Fig. 7.2.

..... [1]

(ii) Name the **two** monomers used to produce the polyester shown in Fig. 7.2.

1 .....

2 ..... [2]

[10]

For Examiner's Use

8 Fig. 8.1 shows some of the stages of the purification of water from the sewage.

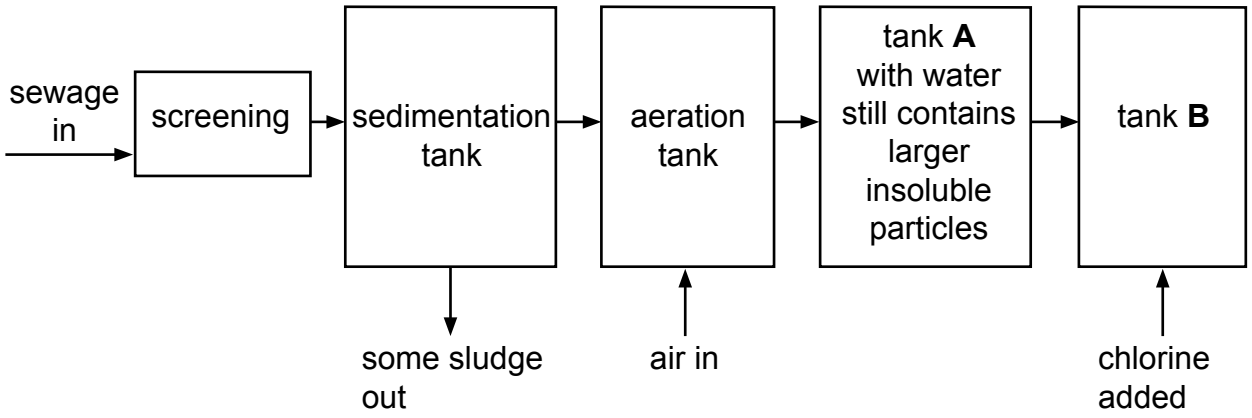

Fig. 8.1

(a) State the percentage composition of nitrogen in the dry air.

.....

..... [1]

(b) After sedimentation, the air is mixed with water in the aeration tank. Outline how water is purified in the aeration tank.

.....

.....

.....

..... [2]

(c) Give the method used to remove larger insoluble particles in tank **A**.

..... [1]

(d) State the role of chlorine gas in the purification of water from the sewage.

.....

..... [1]

(e) All the sludge is collected into tanks called digesters, then digested by mixing it with bacteria that destroy the harmful substances and at the same time produces methane gas.

State the negative effect of excess emission of methane gas to the environment.

.....

.....

.....

..... [2]

[7]

DATA SHEET
The Periodic Table of the Elements

Group I	Group II						Group III	Group IV	Group V	Group VI	Group VII	Group 0
					1 **H** Hydrogen 1							4 **He** Helium 2
7 **Li** Lithium 3	9 **Be** Beryllium 4						11 **B** Boron 5	12 **C** Carbon 6	14 N Nitrogen 7	16 **O** Oxygen 8	19 **F** Fluorine 9	20 **Ne** Neon 10
23 **Na** Sodium 11	24 **Mg** Magnesium 12						27 **Al** Aluminium 13	28 **Si** Silicon 14	31 **P** Phosphorus 15	32 **S** Sulfur 16	35,5 **Cl** Chlorine 17	40 **Ar** Argon 18
39 **K** Potassium 19	40 **Ca** Calcium 20	45 **Sc** Scandium 21	48 **Ti** Titanium 22	51 **V** Vanadium 23	52 **Cr** Chromium 24	55 **Mn** Manganese 25	56 **Fe** Iron 26	59 **Co** Cobalt 27	59 **Ni** Nickel 28	64 **Cu** Copper 29	65 **Zn** Zinc 30	70 **Ga** Gallium 31	73 **Ge** Germanium 32	75 **As** Arsenic 33	79 **Se** Selenium 34	80 **Br** Bromine 35	84 **Kr** Krypton 36
85 **Rb** Rubidium 37	88 **Sr** Strontium 38	89 **Y** Yttrium 39	91 **Zr** Zirconium 40	93 **Nb** Niobium 41	96 **Mo** Molybdenum 42	**Tc** Technetium 43	101 **Ru** Ruthenium 44	103 **Rh** Rhodium 45	106 **Pd** Palladium 46	108 **Ag** Silver 47	112 **Cd** Cadmium 48	115 **In** Indium 49	119 **Sn** Tin 50	122 **Sb** Antimony 51	128 **Te** Tellurium 52	127 ***I*** Iodine 53	131 **Xe** Xenon 54
133 **Cs** Caesium 55	137 **Ba** Barium 56	139 **La** Lanthanum 57 *	178 **Hf** Hafnium 72	181 **Ta** Tantalum 73	184 **W** Tungsten 74	186 **Re** Rhenium 75	190 **Os** Osmium 76	192 **Ir** Iridium 77	195 **Pt** Platinum 78	197 **Au** Gold 79	201 **Hg** Mercury 80	204 **Tl** Thallium 81	207 **Pb** Lead 82	209 **Bi** Bismuth 83	**Po** Polonium 84	**At** Astatine 85	**Rn** Radon 86
Fr Francium 87	226 **Ra** Radium 88	227 **Ac** Actinium 89 †															

140 **Ce** Cerium 58	141 **Pr** Praseodymium 59	144 **Nd** Neodymium 60	**Pm** Promethium 61	150 **Sm** Samarium 62	152 **Eu** Europium 63	157 **Gd** Gadolinium 64	159 **Tb** Terbium 65	162 **Dy** Dysprosium 66	165 **Ho** Holmium 67	167 **Er** Erbium 68	169 **Tm** Thulium 69	173 **Yb** Ytterbium 70	175 **Lu** Lutetium 71
232 **Th** Thorium 90	**Pa** Protactinium 91	238 **U** Uranium 92	**Np** Neptunium 93	**Pu** Plutonium 94	**Am** Americium 95	**Cm** Curium 96	**Bk** Berkelium 97	**Cf** Californium 98	**Es** Einsteinium 99	**Fm** Fermium 100	**Md** Mendelevium 101	**No** Nobelium 102	**Lr** Lawrencium 103

***58 - 71 Lanthanoid series**
†90 - 103 Actinoid series

Key

a
X
b

a = relative atomic mass
X = atomic symbol
b = proton (atomic) number

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

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