Name:……**COMBN**.....

P525/1

CHEMISTRY

Paper 1

Mar./April. 2026

2 hours 45 minutes

Uganda Advanced Certificate of Education

TEST TERM TWO-2026

CHEMISTRY

Paper 1

2 hours 45 minutes

INSTRUCTIONS:

*This paper consists **two** sections **A** and **B***

*Section A has **two compulsory** items.*

***All** responses to section A must be written in the spaces provided.*

*Section **B** has **two** parts; **I** and **II**. Respond to **only one** item from each part.*

Responses to section B should be written on answer sheets provided.

Illustrate your answers, with well balanced equations where applicable.

Where necessary, use the following;

Molar gas constant, $R=8.31\ JK^{-1}mol^{-1}$.

Molar volume of a gas at s.t.p is 22.4 litres.

Standard temperature = 273K.

Standard pressure = $101325Nm^{-2}$

For Scorers' Use Only						
1	2	3	4	5	6	**Total score**

SECTION A

Attempt all items in this section

ITEM ONE;

Scenario

A mining company has discovered a large deposit of iron ore that could significantly boost steel production. The company must ensure that the ore contains a sufficient percentage of iron to make processing economically viable.

A quality control chemist in the company laboratory was assigned to analyze the iron content of the ore using a redox titration method with potassium permanganate. The chemist prepared a 4.230 g sample and converted all the iron into iron(II) ions.

Due to limited availability of reagents in the field laboratory, the chemist performed two separate titrations using different acids to acidify the potassium permanganate solution:

- In the first trial, **dilute sulphuric acid** was used, requiring $31.60cm^3$ of 0.0510 mol dm^{-3} potassium permanganate for complete reaction.
- In the second trial, **dilute hydrochloric acid** was used, requiring $36.80cm^3$ of the same solution.

The chemist noticed that the two methods gave different results for the percentage of iron in the ore.

Task;

As a chemistry student who was assisting in the laboratory, you are required to:

(i) Explain the chemical principles that make potassium permanganate suitable for determining the percentage of iron in such a titration.

(ii) Determine the percentage of iron in the ore for each of the two trials the analyst used.

(iii) Evaluate the two results obtained for the percentage of iron and suggest improvement(s) or precaution(s) the chemist should take to ensure accurate determination of iron in future analyses.

ITEM 2

Scenario

A chemical manufacturing company produces sulphur trioxide for sulphuric acid production using the Contact process. The key reaction is:

$$SO_2(g) + O_2(g) \rightleftharpoons SO_3(g) \qquad \Delta H = -198\ kJmol^{-1}$$

During a routine batch, 2723g of sulphur dioxide and 940.8g of oxygen were placed in a 160 litre reactor at a temperature of 450°C. The reaction is allowed to reach equilibrium, and analysis shows that 52% of oxygen reacted.

The production manager knows that **decrease in temperature, decrease in pressure, and adding more sulphur dioxide** would increase sulphur trioxide production but doesn't know how the **equilibrium constant (Kc)** for this reaction under these conditions can be obtained. On the other

hand, the industrial chemist has advised him that what he knows theoretically may partly not be true and/or partly ideally not applicable in industrial setting.

You happened to hear their conversation and wish to have an input using your knowledge on chemical equilibria.

Task

(i) Calculate the equilibrium constant, **Kc** for the reaction.

(ii) Confirm or refute the production manager's claims on how Sulphur trioxide yield can be increased.

(iii) Propose, with clear explanation(s) how and why the reaction conditions are ideally optimized in industrial setting for optimum Sulphur trioxide production.

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SECTION B

Attempt only **two** items from this section, **only one** from each of the parts **I** and **II**.

PART I

ITEM 3

Scenario

Jovan and his Chemistry class are in preparation for an upcoming quiz competition on which various school have been invited to compete for prizes on the theme; "***An indepth understanding of chemistry of Period 3 elements of the Periodic Table and their oxides***".

He has been assigned by the group to provide details on how understanding the physical and chemical properties of the elements and their oxides is essential for safe handling, efficient reactions, and selecting the most suitable element for a given industrial applications.

He has focused on:

- Explaining the trend in **electronegativity and metallic character** across Period 3.
- Comparing the reactions of magnesium, silicon and chlorine with water, dilute nitric acid, and sodium hydroxide.

- Explaining the trend in **melting points of the oxides** of Period 3 elements.
- Explain the **industrial uses** of **sodium and chlorine** including their advantages and limitations.

He has found some data from a textbook and an extract of it is shown below;

Element	Na	Mg	Al	Si	Cl
Formula of oxide	Na_2O	MgO	Al_2O_3	SiO_2	Cl_2O_7
Melting point of oxide(℃)	1275	2827	2007	1607	-91

Task;

Prepare a detailed message for Jovan he can use to enrich his group's preparation for the quiz.

ITEM 4

Scenario

A **materials engineering company** is developing **high-temperature coatings and semiconductors** using **Group 14 elements**. The elements under consideration are **carbon (C), silicon (Si), germanium (Ge), and tin (Sn)**.

The company provides the following data:

Element	**Melting Point (°C)**	**Common Oxidation States**
C	3550	+4
Si	1410	+4
Ge	938	+2, +4
Sn	232	+2, +4

The engineering team wants a **detailed analysis** to understand:

How each element reacts with air and water.

The **variation in bonding and structure** of the elements and how it affects the **trend in melting points** down Group 14.
The **variation in oxidation states** down the group and its effect on chemical properties.
Which of the elements is **most suitable** for high-temperature protective coatings and one for semiconductor applications.
The **potential dangers** of handling these elements in industrial processes and appropriate **mitigation strategies**.
You have been asked to **analyze the data, explain the trends, and provide recommendations** for material selection and safe usage.
Task;
Write a message to address this.

PART II

ITEM 5

A chemical company is developing organic halogenated compounds for use in the synthesis of industrially important molecules. Understanding the **structure, functional groups, and reactivity** of such compounds is critical for designing efficient synthesis pathways and for predicting environmental and industrial impacts.
A saturated bromocompound, **X**, with general formula; $C_nH_{2n-1}Br$, was isolated and given to university students for analysis.
Mass spectroscopy revealed that the compound had a molecular mass of $162.9gmol^{-1}$. Further laboratory tests showed that heating X with **sodium hydroxide** produced a new compound **Y**, which when heated with concentrated **orthophosphoric acid** yielded **cyclohexene**.
The students want to ;

- identify and name a number of isomers of X,

- describe its reaction with sodium hydroxide and the conversion of Y to cyclohexene using organic reaction mechanisms,
- propose a multi-step synthetic pathway to obtain cyclohexane-1,2-diol, a precursor in antiviral drugs from X and,
- propose environmentally safe ways to handle X while understanding its industrial relevance.
- Discuss any industrial application of X.

You visited the laboratory on during your study trip and came back with this information in your summary book.

Task;

Make a write up that the students can use as reference to answer their challenges.

ITEM 6

Scenario

A chemical company is producing **oxygenated organic solvents** for use in coatings, pharmaceuticals, and chemical synthesis. One of the target products is **butanone**, which is valued for its effectiveness as a **fast-evaporating solvent** in paints and adhesives.

Available raw materials in the plant include **1-iodobutane, but-2-ene and propyne**. The chemists are required to design efficient processes to convert these substances into useful products while understanding the reaction mechanisms involved.

During a study tour organized by the S5 class teacher at the factory, most students were curious to;

- know exactly how 1-iodobutane is converted to butanone

- understand the type of reaction, products, conditions and mechanisms for reactions that occur during some manufacturing steps that involve separate reactions of propyne and but-2-ene with acidified water.
- have an explanation on industrial uses of 1-iodobutane and butan-2-ol.
- have guidance proposals on sustainable and innovative solutions for reducing environmental harm from the use and disposal of industrial waste containing 1-iodobutane and butanone.

You were found at the company and had enough answers to have their curiosity quenched.

Task;

Make a written explanation to the S5 students.

THE PERIODIC TABLE

1	2											3	4	5	6	7	8
1.0 H 1																1.0 H 1	4.0 He 2
6.9 Li 3	9.0 Be 4											10.8 B 5	12.0 C 6	14.0 N 7	16.0 O 8	19.0 F 9	20.2 Ne 10
23.0 Na 11	24.3 Mg 12											27.0 Al 13	28.1 Si 14	31.0 P 15	32.1 S 16	35.4 Cl 17	40.0 Ar 18
39.1 K 19	40.1 Ca 20	45.0 Sc 21	47.9 Ti 22	50.9 V 23	52.0 Cr 24	54.9 Mn 25	55.8 Fe 26	58.9 Co 27	58.7 Ni 28	63.5 Cu 29	65.7 Zn 30	69.7 Ga 31	72.6 Ge 32	74.9 As 33	79.0 Se 34	79.9 Br 35	83.8 Kr 36
85.5 Rb 37	87.6 Sr 38	88.9 Y 39	91.2 Zr 40	92.9 Nb 41	95.9 Mo 42	98.9 Tc 43	101 Ru 44	103 Rh 45	106 Pd 46	108 Ag 47	112 Cd 48	115 In 49	119 Sn 50	122 Sb 51	128 Te 52	127 I 53	131 Xe 54
133 Cs 55	137 Ba 56	139 La 57	178 Hf 72	181 Ta 73	184 W 74	186 Re 75	190 Os 76	192 Ir 77	195 Pt 78	197 Au 79	201 Hg 80	204 TI 81	207 Pb 82	209 Bi 83	209 Po 84	210 At 85	222 Rn 86
223 Fr 87	226 Ra 88	227 Ac 89															

		139 La 57	140 Ce 58	141 Pr 59	144 Nd 60	147 Pm 61	150 Sm 62	152 Eu 63	157 Gd 64	159 Tb 65	162 Dy 66	165 Ho 67	167 Er 68	169 Tm 69	173 Yb 70	175 Lu 71
		227 Ac 89	232 Th 90	231 Pa 91	238 U 92	237 Np 93	244 Pu 94	243 Am 95	247 Cm 96	247 Bk 97	251 Cf 98	254 Es 99	257 Fm 100	256 Md 101	254 No 102	260 Lw 103

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