NAME…….. …… COMBINATION……..

P525/1

CHEMISTRY

Paper 1

April 2026

$2^{3}/_{4}$ hours

ST. ELIZABETH SECONDARY SCHOOL NKOOWE

Uganda Advanced Certificate of Education

S.5 END OF TERM ONE 2026

CHEMISTRY

Paper 1

(Theory)

2 HOURS 45 MINUTES

INSTRUCTIONS TO CANDIDATES:

Respond to all five items

Responses should be written in the spaces provided

All items carry equal scores

You are advised to read all the items carefully and respond logically according to the task question

Where necessary; use the following: ***Cl=35.5, O=16, C=12, Be=9, H=1, Molar gas constant=8.314KJ/mol, Molar gas volume=22400cm^3/22.4dm^3***

Item 1

During a rapid response investigation near Kitezi land fill, the water surveillance Unit has discovered heavy metal contaminants in boreholes supplying a large number of households which are proving to be the major source of cancer to many residents

A fragment of a metallic lead from a nearly illegal battery recycling site was analyzed using a mass spectrometer. The detector registered four isotopic signals with currents of 0.16mA (**mass 204),2.72mA (mass 206),2.50mA (mass 207) and 5.92mA (mass 208**). The investigation team was briefed that these readings can help to determine the relative atomic mass of lead

Further analysis of the contaminated water revealed that the dissolved poisonous salt contained 62.2% lead,8.45% nitrogen and the rest being oxygen and the molar mass of the salt was reported as **331.22g/mol**

In extreme contamination cases,**0.45moles of nitrogen gas(N_2)** was released during the side reactions at **28^{o}C** and **98000Pa** and in other cases nitrogen dioxide was formed. To protect public health, the ministry has assigned your team to analyze the data and provide a complete stoichiometric and methodological evaluation of the situation.

Task:

As a chemist, help the company to;

a) Determine the relative atomic mass of lead (RAM)

b) Determine the molecular formula of the poisonous salt in water

c) Know the volume of nitrogen gas evolved using the ideal gas law

d) Predict the mass of nitrogen formed at s.t.p

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e) Explain the environmental impacts of the gaseous products and their mitigations

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Item 2

A farmer is interested in growing tomatoes and maize. Given the crops grow well in soils rich in Sulphur and nitrate nutrients respectively, he is forced to look for the best fertilizers so as to boost the yields and performance of his crops. At the agricultural shop, the officer has provided him with a variety of fertilizers containing Sulphur and nitrate nutrients as follows. During the preliminary tests, he burnt one of the fertilizers, Magnesium nitrate hexa hydrate **$Mg(NO_3)_2.6H_2O$** in absence of air and decomposed to form a brown gas of nitrogen dioxide according to the equation

$2Mg(NO_3)_2(s) \longrightarrow 2MgO(s)+4NO_2(g)+O_2(g)$

The farmer also wanted to know the volume of the brown gas produced from **1kg** of the fertilizer and assess the environmental impacts of the emissions to environment to avoid diverse effects in the long run.

The farmer however lacks key knowledge and has contacted you for help

Task

Help the farmer to;

a) Select **the best fertilizer for** the tomatoes by determining the percentage composition by mass of Sulphur in the following fertilizers

i) Ammonium sulphate

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ii) Calcium sulphite

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iii) Potassium per sulphate

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iv) Magnesium sulphate

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Best fertilizer_____

b) Determine the mass of nitrate nutrient that would be delivered to the maize if the farmer bought 5kg of the fertilizer

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c) Predict the total volume of gas produced from burning the fertilizer at s.t.p

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d) Know the possible environmental impacts of such fertilizers and mitigations

Item 3

Industrial chemists working in Bijlee plastic company that makes pipes for fittings are investigating the nature of two unknown organic **compounds K and L** recently shipped from another company. Elemental analysis of K shows that it contains 87.8% Carbon and the rest being hydrogen with the vapor density of 41 on the label. When L was burnt in excess air,14.4g of water and 13.44dm^3 of carbon dioxide were obtained at s.t.p(L has vapor density of 22)

Determining the identity, structure and active functional groups present is crucial before processing is done

Task ;

a) Determine the empirical formulae and molecular formulae of L and K

i) Empirical formula of K

ii) Molecular formula of K

iii) Empirical formular of L

iv) Molecular formula of L

b) By writing down **all po**ssible isomers and their IUPAC names, determine the identity of L and K and state their functional groups

i) Isomers for K

ii) Isomers for L

Item 4

A pharmaceutical production facility has received two Zirconium-containing samples **(Sample A, RAM=91.09 and sample B, RAM=90.6) i**ntended for the preparation of Zirconium-89. This isotope is required for labeling monoclonal antibodies used in **positron**

emission tomography where accurate localization depends on a sufficiently long-lived positron emitting tracer. The production team must evaluate which sample provides a higher proportion of the required isotope for use in the synthesis of radiolabeled antibodies. The company also received the following organic compounds for use in specific operations

Label	**composition**
O	**$CH_3CH_2CH_2CH_2OH$**
P	**C_4H_8**
Q	**$CH_3CH_2CH_2CH_2CH_2Br$**

Mass spectrometry has also provided the isotopic composition of the two samples. The radioactive isotope needed is **Zirconium-89** but its abundance is not known

Isotope (mass number)	**Abundance (%) in both samples**
90	**Unknown**
89	**Unknown**
92	**17.1**
94	**17.4**
96	**2.8**

Task

a) Describe how the percentage abundances provided were obtained using a mass spectrometer

b) Determine the percentage of Zr-89 in the two samples and provide a recommendation of which sample should be used for labelling antibodies

c) Identify the homologous series, **all t**he structures and IUPAC names of possible isomers and functional groups of the isomers of compounds O, P and Q before being used in the process of production

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 Te 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 68	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

END

NICE HOLIDAYS