NELSON MANDELA SECONDARY SCHOOL – MASAKA

END OF TERM I1 EXAMINATIONS 2025

S.5 Chemistry Theory

P525/1

3hrs

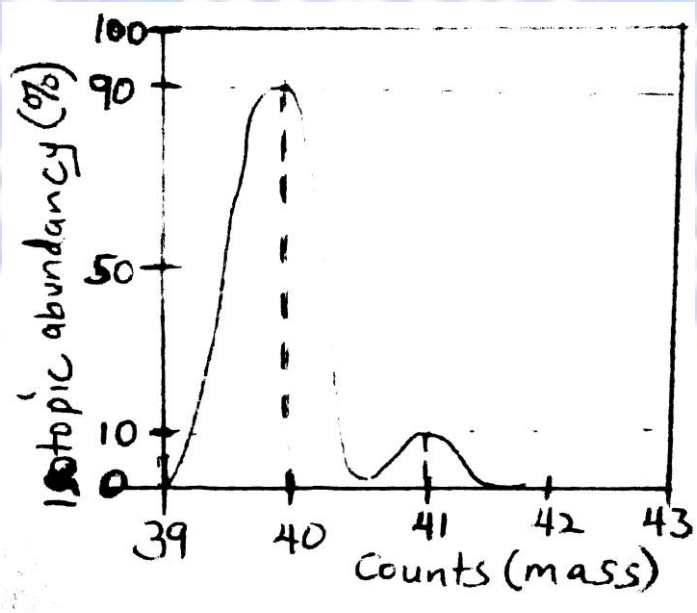
Instructions

Respond to all the two examination items.

Item1 (40scores)

The minister of energy of the republic of Uganda is intending to start up a nuclear plant in contract with a Japanese scientist who has his nuclear substance R he always keeps in a lead bag whose package paper has a label, "$\mathbf{t_{1/2} = 62days}$". The scientist is so challenged with his age that he has even forgotten the true substance he is keeping in the bag. It was decided that the substance must first go through mass spectrometry for the initial examination.

The signal showed on the screen as below



The scientist seemed so confused that the results made him a suspect two elements R_1 and R_2, However, he said that there are very high chances that it is R_1 because R_2 is not a solid at room temperature.

For more test confidence, the scientist bombarded substance R with two Beta radiations which turned it into gas R_2. After nodding his head, He decayed the newly formed gas R_2 with an alpha radiation which turned the gas back to R, the original substance but with a slight change in the atomic mass. The scientist finally confirmed element R as R_1.

Then he drew a plan to start with a sample of 12g of R in a radioactive decay where after a reasonable number of days, the plant stopped when there were only 5g left. He struggled to recall the day he started subjecting the substance to decay so as to determine the real time for which it had decayed to that mass but he totally failed! The scientist is now stack on what to tell the minister because he had to purchase the amount that would be enough to run the plant for a year of 365 days.

Task

a) What does the information "$\mathbf{t_{1/2} = 62days}$" written on the label mean? 04scores
b) Using the results from the mass spectrometry, determine the relative atomic mass of R and hence the two suspected elements R1 and R_2. 08scores
c) Scientifically,
i) Illustrate how R turned into the gas R_2 03scores
ii) Show how the newly formed gas R_2 turned back to R, which the scientist confirmed as R_1 03scores
iii) Calculate the slight change in the atomic mass; and state the reason for the name given to the particles of original R and R_2. 03score
d) Help the scientist to determine the time it took for the 12g of R_1 to decay to the 5g; hence determine the mass of R needed to run the plant for the 365 days of the year if 5g is the minimum mass at which the plant can stay running. 10scores.
e) What is the benefit and effect of this project? 09scores

Item 2 (60scores)

Lwezawula is a chemical analyst in JoJo chemical industries limited. He was tasked to make an analysis on four elements W, X, Y, and Z. Each element was properly sealed but unnamed.

The labels of these elements contained a lot of information in terms of number of ionization energies. It was shown that the maximum number of ionization energies for each element is 11, 12, 13 and 14 respectively. Lwezawula said that this information is enough for him to

make thorough analysis on the properties of the elements. The three tables below summarize his analysis.

Table 1

Element	w	x	y	z
Value of first ionization energy in $KJMol^{-1}$	496	738	577	786
Maximum number of ionization energies	11	12	13	14

Table 2

Ionization energy in $KJMol^{-1}$	1st	2nd	3rd	4th
W	496	4562	6910	9543
X	738	1451	7733	10541
Y	577	1817	2745	11577

Table 3

Element	W	X	Y
Melting point (^oC)	98	649	660

Task

a) i) What does the maximum number of ionization energies signify? 3scores
ii) Use the information of Lwezawula's analysis to write the electronic configuration of each element W, X, Y and Z. 8scores

b) i) Present the values of first ionization energies against atomic numbers on a suitable bar chart. 10scores
ii) Explain the general trend in the first ionization energy from W to Z. 04scores

iv) Explain why element X has an abnormally higher ionization energy than Y which is centrally to the general trend. 04scores

v) Using the ionization energy data and electronic configuration, identify the period to which each element W, X, Y and Z belong in the periodic table. Explain you're your identities. 12scores

c) Considering the first four ionization energies in table 2, identify the group in the periodic table to which each element W, X, Y and Z belongs. Explain. 09scores

d) Explain the trend in the melting points of the element from W to Y as observed in table 3. 10scores

END