NATIONAL OPEN UNIVERSITY OF NIGERIA
UNIVERSITY VILLAGE, PLOT 91 CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESS WAY, JABI - ABUJA.
FACULTY OF SCIENCES
DEPARTMENT OF PURE AND APPLIED SCIENCE
FIRST SEMESTER EXAMINATION 2021[1234]

COURSE CODE: **CHM406**
COURSE TITLE: **Nuclear and radiochemistry**
TIME: **2 Hours**
INSTRUCTION: **Answer question one and any three questions.**

QUESTION ONE

1a Explain the following terms

i. Radioactivity
ii. Critical mass
iii. Half life
iv. Isotopes (2.5marks each)

1.b i. Explain how neutron to proton ratio accounts for stability of a nucleus (5 marks)
ii. List 5 differences between nuclear and chemical reactions (5marks)
iii. Identify and write briefly on the following particles α, β (5 marks)

QUESTION TWO

2a. List five areas of endeavor where radio-isotopes can be useful (5marks)

b. A pieces of wood obtained in Calabar South was found to have a C-14 activity (per gram of carbon) only 0.636 times that of wood cut today. What is the age of the wood? [$t_{1/2}$ of C-14 = 5730 years] (5 marks)

c. Briefly define the terms:

i. Nuclear isomerism
ii. Chain reactions (5 marks)

QUESTION THREE

3a. Briefly explain the following

i. Elastic scattering

ii. Inelastic scattering (6 marks)

b. Discuss the following

i. Medical uses of radio isotopes

ii. How radioactive labelled nucleides are useful in scientific research (4 marks)

c. Calculate the mass defect in $\frac{12}{6}C$

$[\frac{12}{6}C = 12.00380amu$, Ip = 1.007277amu, In = 1.008665amu]

(5 marks)

QUESTION FOUR

4a. An electron $^{40}_{20}Q$ undergoes three neutron emissions

i. Show the process using chemical equations

ii. How does this affect the mass number of Q

iii. How does the process affect the atomic number of Q

iv. Write the electronic configuration of the daughter atom formed

v. Name the daughter atom and its position on the Periodic Table (7 marks)

b. List and explain two factors that determine the stability of an atomic nucleic (4 marks)

c. Define with three examples trans-uranium elements (4 marks)

QUESTION FIVE

5a. Using nuclear notation, represent the following equations

i. $^{239}_{92}U + ^{1}_{0}n$ -------- $^{239}_{92}U + \gamma$

ii. $^{16}_{8}O + ^{4}_{2}He$ --------- $^{20}_{10}Ne + \gamma$

iii. $^{32}_{16}S + ^{1}_{0}n$ ---------- $^{32}_{15}P + ^{1}_{1}H$

iv. $^{14}_{7}N + ^{4}_{2}He$ -----$^{17}_{8}O + ^{1}_{1}H$

v. $^{27}_{13}Al + ^{4}_{2}He$ ------- $^{30}_{14}Si + ^{1}_{1}H$ (5 marks)

b. $^{14}_{7}N + ^{1}_{1}H$ ---------- $^{11}_{6}C + ^{y}_{x}K$

i. Find the values of x and y (6 marks)

ii. What particle does k represent? (2 marks)

c. Write an equation to relate half life (t½) to decay constant (K) (2 marks)

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