KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2019/2020 ACADEMIC YEAR

THIRD YEAR SECOND SEMESTER
SPECIAL/SUPLIMENTARY EXAMINATIONS

FOR THE DEGREE OF B.ED (Sc)

COURSE CODE: **SCH 312**

COURSE TITLE: **NUCLEAR AND RADIATION CHEMISTRY**

DURATION: 2 HOURS

DATE: 10/2/21 **TIME: –** 8–10 Am

INSTRUCTIONS TO CANDIDATES

- Answer **all** Questions.
- Indicate **answered questions** on the front cover.
- Start every question on a new page and make sure question's number is written on each page.

This paper consists of **3** printed pages. Please Turn Over

Question one (30 marks)

a) Define and give examples of each of the following terminologies (**5marks**)

b) Differentiate between the isotopic mass and atomic mass (**2 marks**)

c) i)Briefly describe the discovery of radioactivity (**5 marks**)

d) State and explain two natural sources of radioactive radiations (**4 marks**)

e) Explain how the n:p ratio and total number of nucleons are used to determine stability of the nuclear.

i) n:p ratio **(3 marks):**

ii) Number of nucleons **(3 marks)**

f) i) Define radiations. (**2 marks**)

ii) Give two types of radiations. (**2 marks**)

g) Based on the even-odd rule, predict which one you would expect to be radioactive in each of the following pairs: **(4 marks)**

a) O-16 or O-17

b) Cl-35 or Cl-36 .

c) Ne-20 or Ne-17

d) Ca-40 or Ca-45 .

Question Two (20 marks)

a) Explain Geiger Muller counter as a method of detection and measurement of radioactivity. (**10 marks**)

b) Show that $t\frac{1}{2} = \frac{o.693}{\lambda}$ (**5 marks**)

c) 0.01 mg of Pu- 239 units has decay constant of 1.4×10^7 particles/ minute. What is its half-life (**5 marks**)

Question Three (20 marks)

a) Define the following terminologies. (**6 marks**)

i) Radioactivity

ii) Nuclear fission

iii) Nuclear fusion

b)i From decay law show that

$N=N_oe^{-\lambda t}$ (**5 marks**)

Where λ = constant, t= time

ii All natural radioactive elements belong to one of the three series Uranium , Thorium and Actinium series. For each series state its commencement and termination **(3 marks)**

c) Tritium (3H) decays by beta emission to (3He) with a half- life of 12.26 years. A sample of a tritiated compound has an initial activity of 0.833Bq. Calculate the decay constant K and activity after 2.50 years. (**4 marks**)

Question Four (20 marks)

a) Define the following terms

i) Mass defect **(2 marks)**

ii) Binding energy **(2 marks)**

b) The radionuclide 210Po decay by alpha emission to daughter nuclide. The atomic mass of 210Po is 209.982 amu and that of a daughter is 205.9745 amu and He = 4.00260amu

a) Identify the daughter **(1 mark)**
c) Calculate the total energy release per disintegration in erg/mol. (**2 marks**)
d) Discuss some of the practical application of nuclear chemistry in

i. Analytical applications and give an example**(3marks)**
ii. Industrial exploration of oil leaks **(3marks)**
iii. Radio Carbon dating **(3marks)**
iv. Agriculture and give an example **(4 marks)**

Question Five (20 marks)

a). A sample of 2 g $_{83}^{209}Bi$ with a half-life 2.7×10^{7} years decays into stable isotope of thallium by emitting alpha particle. What would be the activity of the sample after 2 years? (**3 marks**)
b) An irradiated sample of gold gave the following results

Time/min	0	1	8	10	25	50	75	100
Counter/min	300	296	285	270	228	175	133	103

i). Draw the graph of counter per minute against time in minutes (**5marks**)
ii). Determine the half-life of the isotope of gold (**3 Marks**)
iii) At what time will the activity of the sample be 210c/m **(2marks)**
c) Explain the two main mechanisms of how alpha particles interact with matter

i) Excitation **(2 marks)**
ii) Ionization **(2 marks)**

b) The amount of C-14 in a piece of wood is found to be one-sixth of its amount in afresh piece of wood. Calculate the age of old piece of wood (half-life =5730years) (**3 Marks**)