KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2016/2017 ACADEMIC YEAR

THIRD YEAR SECOND SEMESTER
SPECIAL/SUPPLEMENTARY EXAMINATIONS

FOR THE DEGREE OF B.ED (SCIENCE)

COURSE CODE: SCH 312

COURSE TITLE: RADIATION AND NUCLEAR CHEMISTRY

DURATION: 2 HOURS

DATE: 19TH SEPTEMBER2017 **TIME:** 2:30PM – 5:30PM

INSTRUCTIONS TO CANDIDATES

- Answer **QUESTION ONE** (Compulsory) and any other two (2) 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

1. a) Explain some of the following nuclear terminologies (**4 marks**).

i. Isotope

ii. Isober

iii. A nuclide X can be written as ${}_{17}{}^{35}X$, define and identify the Atomic mass and Mass number of X (**4 Marks**)

b) Define the following terms and give examples in each case (**4 marks**)

i) Radiation

ii) Ionizing radiations

iii) Non- ionizing radiations

Explain the inter-relationship between nuclear binding energy and nuclear stability (**4 marks**).

c) Compute the number of alpha decays under gone by 1g of thorium 232 in one year. If the decay constant $\lambda = 1.58 \times 10^{-18}$ per second. (**4 marks**).

d) Unstable nuclear can undergo the following radioactivity to become more stable, briefly explain when the following occurs (**5 marks**).

i. Electron capture

ii. Neutron emission

iii. Alpha emission

iv. Gamma radiations

g) Complete the following nuclear equations and indicate the type of radioactivity involved (**5mark**).

a. — ${}_{90}{}^{234}Th + {}_{2}{}^{4}He$

b. ${}_{19}{}^{131}I \longrightarrow$ — + ${}_{-1}{}^{0}e$

c. ${}_{19}{}^{40}K \longrightarrow$ — + ${}_{18}{}^{40}Ar$

d. $2({}_{6}{}^{12}C) \longrightarrow$ — + ${}_{0}{}^{1}n$

e. $2({}_{2}{}^{3}He) \longrightarrow$ — + $2({}_{1}{}^{1}H)$

QUESTION TWO 20 MARKS

b) a) Calculate the binding energy in Mev per atom, and the binding energy per nucleon of the following nuclides using the data in the table (**9 Mark**)

Elementary particle	Mass (u)	Mass Kg
Proton	1.0072764669	$1.6726216 \times 10^{-27}$
Neutrons	1.0086649158	$1.6749272 \times 10^{-27}$

Atoms	Mass (u)
i) $^{10}_{4}Be$	10.0135337
ii) $^{35}_{17}Cl$	34.96885271
iii) $^{49}_{22}Ti$	48.947871

c) Define radioactivity and differentiate between nuclear fusion and nuclear fission. **(3marks)**

d) Discuss some of the practical application of nuclear chemistry in (**8 marks**)

i. Environment

ii. Industry

iii. Medicine

iv. Agriculture

e) State three general properties of stabile nuclide. **(3 marks)**

QUESTION THREE 20 MARKS

3 What is meant by **(3 marks)**

i. Binding energy

ii. Binding energy per nucleon

iii. Separation energy of an atomic nucleus.

b) Atomic mass of $_1{}^3H$ and $_2{}^3H$ and 3.01605 amu and 3.016030 amu respectively calculate their BE and explain what is responsible for difference in the two BE. **(3 Marks)**

c) Show that the following fusion reaction is possible

$^2_1H + {}^2_1H {}^4_2He \longrightarrow$

The energy released per fusion event is 24 Mev where the binding energy per nucleon value of ^2_1H and ^4_2He are 0.55 Mev/ nucleon and 7.1 Mev/ Nucleon respectively.

d). Derive the decay law.(**3 marks)**

e). 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)**

i) Tritium (^3H) decays by beta emission to ^3He with half- life of 12.26 years . A sample of atritiated compound has an initial activity of 0.833 Bq calculate the number N of tritium nuclei in the sample initially, the decay constant λ and the activity after 2.50 years.(**5 marks)**

QUESTION FOUR 20 MARKS

4) a) Compute the number of alpha decays under gone by 1 g of thorium 232 in 1 year . if the decay constant $\lambda = 1.58 \times 10^{-18}$ per second **(3 marks)**

b) 0.01 mg of Pu 234 units has a decay constant of 1.4×10^{7} particle/minute what is its half-life?. **(3 marks)**

c) How much time will be taken by Pu to decay to 1 % of its initial activity **(4 Marks)**

d) Unstable nuclide can undergo the following radioactivity to gain stability

i) fussion

ii) fission

define the terms fusion and fission and in each case give an example **(4 Marks)**

e).

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 **(4 marks)**

ii). Determine the half life of the isotope of gold **(2 Marks)**