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(University of Choice)

MASINDE MULIRO UNIVERSITY OF

SCIENCE AND TECHNOLOGY

(MMUST)

Main campus

UNIVERSITY SUPPLEMENTARY EXAMINATIONS

2021/2022 ACADEMIC YEAR

THIRD YEAR SECOND SEMESTER EXAMINATIONS

FOR THE DEGREE

OF

BACHELOR OF SCIENCE AND EDUCATION (SCIENCE)

COURSE CODE: SCH 312

COURSE TITLE: RADIATION AND NUCLEAR CHEMISTRY

DATE: 2nd August, 2022 **TIME: 8 – 10 a.m**

INSTRUCTIONS TO CANDIDATES

- Answer all the Questions
- Attached find periodic table

TIME: 2 Hours

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 4 Printed Pages. Please Turn Over.

QUESTION ONE (17 Marks)

a. Complete the following nuclear equations that describe the processes used to create these elements.(3 marks)

   i. $^{244}_{96}Cm + {}^{4}_{2}He \rightarrow ? + {}^{1}_{1}H + 2{}^{1}_{0}n$ (1 mark)

   ii. $^{238}_{92}U + ? \rightarrow {}^{246}_{98}Cf + 4{}^{1}_{0}n$ (1 mark)

   iii. $? + {}^{10}_{5}B \rightarrow {}^{257}_{103}Lr + 5{}^{1}_{0}n$ (1 mark)

b. Ionizing and non-ionizing radiations are used in different fields. Explain with the use of examples. (2 marks)

c. With the use of an example, describe neutron capture. (2 marks)

d. Give any two electrical effects of ionizing radiation. (2 marks)

e. What is your understanding of cosmic radiation? (2 marks)

f. What is a scintillation counter and how does it work? (2 marks)

g. Knowledge about interaction of ionizing radiation with matter is essential in a variety of areas of nuclear science. Discuss. (4 marks)

QUESTION TWO (17 Marks)

a. Explain the theory behind radiocarbon-14 dating. (4 marks)

b. Describe how E. Rutherford and F. Soddy stumbled upon radioactive decay. (4 marks)

c. Give the two very significant consequences of the early study of the emanations from thorium, radium, and actinium. (2 marks)

d. Nuclear stability can be considered from both a kinetic and a thermodynamic point of view. Differentiate between thermodynamic stability and kinetic stability. (3 marks)

e. Depending on the energy imparted, radiation interaction with matter may lead to excitation or ionization. Differentiate between the two. (2 marks)

f. How does radiation affect an unborn child? (2 marks)

QUESTION THREE (18 Marks))

a. Illustrate the following terms:

   i. Beta production (2 marks)

   ii. Alpha production (2 marks)

   iii. Gamma ray production (2 marks)

b. In radioactive decay, A and Z are conserved. What does this mean? (2 marks)

c. Answer the following questions

   i. What is the half-life equation for radioactive decay processes? (1 mark)

   ii. How does the half-life depend on how many nuclides are present? (1 mark)-

   iii. Uranium-238 is one of the radioactive nuclides sometimes found in soil. It has a half-life of 4.51×10^9 years. What fraction of a sample is left after 9.02×10^9 years? (3 marks)

d. Briefly explain how nuclear reactors work. (5 marks)

QUESTION FOUR (18 Marks)

a. What is your understanding of electron-positron pair production? (2 marks)

i. Explain why ^{14}C and ^{32}P radioactive nuclides would be very helpful in learning about metabolic pathways. (2 marks)

ii. Why is I-131 useful for diagnosis of diseases of the thyroid? (2 marks)

b. The biological effects of a particular source of radiation depend on several factors. List and explain some of these factors.(8 marks)

c. Although gamma rays are far more penetrating than alpha particles, the latter are more likely to cause damage to an organism. Why? (2 marks)

d. How is radiation used in cancer treatment? (2 marks)

Periodic Table of the Elements