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
SECOND SEMESTER EXAMINATION 2020ₜₘ

COURSE CODE: CHM 406
COURSE TITLE: Nuclear and radiochemistry
COURSE UNIT: 2
TIME: 2 Hours
INSTRUCTION: Answer question one and any three questions.

QUESTION ONE

a) How does radioactivity contradict Dalton's postulate on indestructibility of an atom.

(3 marks)

b) A cobalt-60 nucleus decays with the emission of beta particle-gamma rays with half-life of 5.27 years. How much of a 3.42 mg sample remain in 30.0 years?   **(8 marks)**

$$^{60}_{27}Co \rightarrow \, ^{60}_{28}Ni + \, ^{0}_{-1}\beta + \, ^{0}_{0}\alpha$$

c) Briefly explain the collective nuclear model   **(5 marks)**

d) Show five (5) mathematical expressions to describe the conservation laws as applicable in nuclear reactions   **(5 marks)**

e) Write a note on Elastic Scattering   **(4 marks)**

QUESTION TWO

2a) In tabular form, show the properties of the basic constituents of an atomic element.

(9 marks)

2b) Give the rules that guide the prediction of nuclear stability   **(3 marks)**

2c) Describe two (2) uses of the neutron-proton ratio   **(3 marks)**

QUESTION THREE

3a) Can radiation of sub atomic particles improve agricultural practices? Explain.   **(6 marks)**

3b) List major rules guiding how to write chemical equation for nuclear reactions   **(5 marks)**

3c) With a suitable example explain artificial radioactivity, using a chemical equation **(4 marks)**

QUESTION FOUR

4a) Write short notes on the neutron-rich region as related to particles emission and position of stable region. **(7 marks)**

4b) (i) With an equation, briefly explain positron emission **(4 marks)**

(ii) With explanation and one equation, discuss electron captures (K capture) **(4 marks)**

QUESTION FIVE

5 a) What do you understand by spontaneous nuclear transmutation or transformation of unstable nuclei. Briefly discuss.

($7^1/_2$ marks)

5b) Consider the reaction: $X_1 + X_2 \rightarrow X_3 + X_4$, where X represents nucleus or elementary particles. X_1 and X_2 may be unstable nuclei and bombarding particles while X_3 and X_4 are products formed. So, for this general reaction, list the five (5) conservation law that holds.

($7^1/_2$ marks)