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JABI - ABUJA.

FACULTY OF SCIENCES
DEPARTMENT OF PURE AND APPLIED SCIENCE
SECOND SEMESTER EXAMINATION 2020...

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)**
- $${}_{27}^{60}\text{Co} \rightarrow {}_{28}^{60}\text{Ni} + {}_{-1}^0\beta + {}_0^0\alpha$$
- 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.

(7¹/₂ 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.

(7¹/₂ marks)