



KIBABII UNIVERSITY

**UNIVERSITY EXAMINATIONS
2020/2021 ACADEMIC YEAR**

**THIRD YEAR SECOND SEMESTER
MAIN EXAMINATIONS**

FOR THE DEGREE OF BSc (CHEMISTRY)

COURSE CODE: SCH 322

COURSE TITLE: RADIATION AND NUCLEAR CHEMISTRY

DATE: 6/10/2021

TIME: 2:00-4:00PM

INSTRUCTIONS TO CANDIDATES:

TIME: 2 HOURS

ANSWER QUESTION ONE AND ANY TWO OF THE REMAINING

THIS PAPER CONSISTS OF 3 PRINTED PAGES

KIBU OBSERVES ZERO TOLERANCE TO examination

Question One (30 marks)

- (a) Define the following terms as used in radiation and nuclear chemistry (5 marks)
- (i) Radioactivity
 - (ii) Isotones
 - (iii) Radioactive isotopes
 - (iv) Isobars
 - (v) Radiation
- (d) Briefly describe the discovery of radioactivity (5 marks)
- (e) State and explain two artificial sources of radioactive radiations (4 marks)
- (f) How many α and β particles are emitted in passing down from ${}^{238}_{92}\text{U}$ to ${}^{206}_{82}\text{Pb}$ (2 marks)
- (g) State the Group Displacement Law (2 marks)
- (h)(i) Define decay series (1 mark)
- (ii) State the three radioactive decay series (3 marks)
- (I) Calculate the disintegration constant of cobalt 60 if its half-life to produce nickel – 60 is 5.2 years (4 marks)
- (j) Distinguish between nuclear reaction and chemical reaction (2 marks)
- (k) 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). A sample of 2 g ${}_{83}^{209}\text{Bi}$ 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 (5 marks)
- 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 (2 marks)
- 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 a fresh piece of wood. Calculate the age of old piece of wood (half-life = 5730 years) (3 Marks)

Question Three (20 marks)

- (b) Discuss the stability of nucleus in terms of neutron-proton ratio (4 marks)
- (a) Radioisotope Na_{11}^{24} has a half-life of 10 days. Calculate the time in which the radioactivity of its 2.0 mg quantity will fall to 10% of the initial value (5 marks)

