



KENYATTA UNIVERSITY

**EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE
(MEDICAL LABORATORY SCIENCE)**

HML 417: NUCLEAR MEDICINE

1ST SEMESTER 2022/2023

TIME: 2 HOURS

INSTRUCTIONS:

SECTION A: ANSWER ALL QUESTIONS (4 MARKS EACH)

1. An electrically neutral sodium-23 ($^{23}_{11}\text{Na}$) atom has 11 protons.
 - a) How many neutrons are present in the atom? (1 mark)
 - b) Using the principle of quantum, calculate the number of electrons expected in the L-shell and M-shell. (3 marks)
2.
 - a) Define annihilation radiation ionizing radiation. (2 marks)
 - b) Describe beta plus (β^+) decay giving an example of a particle that transforms from an excited state to a ground state. (2 marks)
3. Magnesium ($Z=12$) with mass number 23 decays to sodium ($Z=11$). Z is atomic number.
 - a) What type of particle is emitted during decay? Show equation. (1 marks)
 - b) The half-life of the decay scheme is 12 seconds. How much time will elapse before a mixture of 90% magnesium-23 and 10% sodium-23 (by the number of atoms) converts itself into a mixture of 10% magnesium-23 and 90% sodium-23? (3 marks)
4. Using a graph, explain radiation spectrum of beta particles. (4 marks)
5.
 - a) List advantages of a film badge. (2 marks)
 - b) What is the relationship between half life and decay constant? (2 marks)

SECTION B: ANSWER ANY ONE QUESTION (20 MARKS EACH)

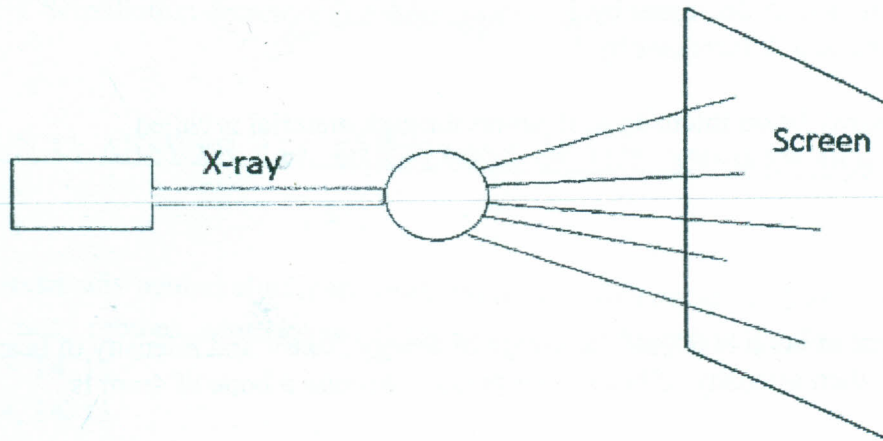
6. Carbon-11 has a half-life of about 20.33 minutes. A certain container initially had 5.0mg of carbon-11 (use time in minutes).
- a) Calculate the number of carbon-11 atoms present initially and the maximum activity (rate of decay). (4marks)
 - b) Calculate the activity after 90 minutes. (4 marks)
 - c) Discuss stages in the induction of biological radiation damage. (12 marks)
7. a) Describe factors that affect attenuation of gamma and x-ray radiation. (4 marks)
- b) Discuss:
- i. Geiger Muller counters and their applications. (8 marks)
 - ii. Scintillation detectors and their applications. (8 marks)

SECTION C: ANSWER ALL QUESTIONS IN THE ANSWER BOOKLET (½ MARK EACH)

1. An electrically neutral aluminum atom has an atomic number of 13 and a mass number of 27. How many protons, neutrons and electrons are there respectively in an atom of aluminum?
- a) 13, 14, 13
 - b) 14, 14, 13
 - c) 14, 40, 14
 - d) 14, 40, 27
2. Gamma-ray photons have:
- a) no mass and no electric charge
 - b) no mass and an electric charge of +1
 - c) no mass and an electric charge of +2
 - d) no mass and an electric charge of -1
3. What is a radioimmunoassay intended to measure?
- a) RIA measure the concentration of antigen by the use of antibodies.
 - b) RIA measure the concentration of Antibody by the use of antigen.
 - c) RIA measure the concentration of Protein by the use of antibodies.
 - d) RIA measure the concentration of Insulin by the use of glycoproteins.

- meric Transition involves:
- a) the emission of a gamma-ray
 - b) the conversion of a neutron to a proton
 - c) the conversion of a proton to a neutron
 - d) ejecting an orbital electron from the shell
5. In spontaneous fission:
- a) nuclear stability is always achieved
 - b) the nucleus splits into 2 or 3 fragments
 - c) the fragments are never radioactive
 - d) the nucleus is unchanged
6. An alpha-particle consists of:
- a) one proton and two neutrons
 - b) Four protons and two neutron
 - c) two protons and two neutrons
 - d) one proton and one neutron
7. In Positron Emission:
- a) Z increases by 1 and A remains the same
 - b) Z decreases by 1 and A remains the same
 - c) Z remains the same and A decreases by 1
 - d) Z remains the same and A increases by 1
8. Gradual decrease in x-ray beam intensity as it passes through material is called
- a) Attenuation
 - b) Decay
 - c) Radioactivity
 - d) Imaging
9. Attenuation coefficient of bone is 600m^{-1} for x-rays of energy 20keV and intensity of beam of x-rays is 20 Wm^{-2} , then intensity of beam after passing through a bone of 4mm is
- a) 3 Wm^{-2}
 - b) 2 Wm^{-2}
 - c) 2.5 Wm^{-2}
 - d) 1.8 Wm^{-2}
10. Bones look white in x-ray photograph because
- a) They are bad absorbers of x-rays
 - b) They reflect x-rays
 - c) They are good absorbers of x-rays
 - d) They are bad absorbers of x-rays
11. As gamma ray pass through matter, its intensity
- a) Decreases
 - b) Increases
 - c) Remains the same
 - d) Deviates

12. In X-ray emission tubes, X-ray is emitted by the acceleration of _____
- a) Atoms
 - b) Protons
 - c) Electrons
 - d) Neutrons
13. X-Rays are not used in _____
- a) Photographic film
 - b) Photocells
 - c) Geiger tubes
 - d) Ionization Chamber
14. X-ray crystallography uses which characteristic of light?
- a) Polarization
 - b) Interference
 - c) Diffraction
 - d) Coherency
- View Answer
15. Which phenomenon is shown by the given figure?



- a) X-ray scan
 - b) C.T. scan
 - c) X-ray crystallography
 - d) X-ray production
16. What type of device is used to monitor individuals in order to determine their radiation exposure?
- a) Film badge
 - b) Geiger counter
 - c) Alarm rate meter
 - d) Ionization chambers

- Which type of tissue is most sensitive to ionizing radiation?
- a) Tissue that receives the largest dose
 - b) Tissue with cells that divide quickly
 - c) Tissue with cells that no longer divide
 - d) Tissue of the lower limb
18. Which isotope is used in radioimmunoassay?
- a) ^{125}I
 - b) ^{14}C
 - c) ^{24}NaH
 - d) ^{36}Cl
19. Which of the following is not the application of Radioimmunoassay _____
- a) RIA used to determine insulin, growth hormone.
 - b) Radioimmunoassay (RIA) can detect drugs such as Heroin & Morphine.
 - c) RIA used for determination of folic acid, vitamin B12.
 - d) RIA used to determine concentration of Glycoproteins
20. What is tracer in radioimmunoassay?
- a) Radioactive antigen
 - b) Unlabeled antigen
 - c) Radiolabeled antibody
 - d) Unlabeled antigen