

CHUKA



UNIVERSITY

UNIVERSITY EXAMINATIONS

EXAMINATION FOR THE AWARD OF DEGREE OF MASTER OF SCIENCE IN
MEDICAL PHYSICS

MPHY 814: RADIATION PROTECTION AND SAFETY

STREAMS: MSC MPHY

TIME: 3 HOURS

DAY/DATE: MONDAY 08/04/2024

8.30 A.M – 11.30 A.M.

INSTRUCTIONS:

- ANSWER ANY FOUR QUESTIONS.

QUESTION ONE

- a) An x-ray technician works 4 days per week, 40 weeks per year. Assume that the technician takes an average of eight x-rays per day and receives a dose of 8.0 rem/yr as a result. (i) Estimate the dose in rem per x-ray taken. (ii) How does this result compare with the amount of low-level background radiation the technician is exposed to. (5marks)
- b) Explain seven common practices and measures which are crucial to minimize radiation exposure to staff and patients in medical settings. (7 marks)
- c) Describe the three principles of radiation protection. (3marks)

QUESTION TWO

- a) Describe the Four Radiation emergencies and their medical management. (8 marks)
- b) A 300-rad dose of radiation is administered to a patient in an effort to combat a cancerous growth. Assuming all of the energy deposited is absorbed by the growth, (i) calculate the amount of energy delivered per unit mass. (ii) Assuming the growth has a mass of 0.35 kg and a specific heat equal to that of water, calculate its temperature rise. (4marks)
- c) Describe three legal methods of disposing of radioactive waste. (3marks)

QUESTION THREE

- a) Radioactive waste emits radioactive particles that pose a severe risk to human health and the environment when exposed. Explain four common methods of radioactive waste disposal. (4 marks)
- b) Explain the six factors to consider when evaluating internal radiation hazards. (6 marks)
- c) Describe five factors that determine the biological and possible health consequences of radioactive contamination. (5 marks)

QUESTION FOUR

- a) Describe Safety in Industrial, Agricultural and Research uses of Radiation. (7 marks)
- b) Describe the responsibility of the following persons in radiation protection in a nuclear medicine facility (i) Medical physicist, (ii) Radiation protection officer, (iii) Nuclear medicine technologist (iv) Nuclear medicine specialist. (4 marks)
- b) Describe the following terms (i) radiation user, (ii) "normally exposed" radiation user, (iii) A "potentially exposed" radiation user (iv) A "minimally exposed" radiation user. (4 marks)

QUESTION FIVE

- a) Discuss the Uses of ionizing radiation in irradiator. (4 marks)
- b) A particular radioactive source produces 200 mrad of 2-MeV gamma rays per hour at a distance of 2.0 m. (i) How long could a person stand at this distance before accumulating an intolerable dose of 1 rem? (ii) Assuming the gamma radiation is emitted uniformly in all directions, at what distance would a person receive a dose of 10 mrad/h from this source. (4 marks)
- c) Describe the hierarchy of Safety standards in radiation protection. (4 marks)
- d) In terms of biological damage, Calculate the number of rad of heavy ions which is equivalent to 100 rad of x-rays. (1 mark)
- iii) A person whose mass is 75.0 kg is exposed to a whole-body dose of 25.0 rads. Calculate the number of joules of energy are deposited in the person's body. (2marks)
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