

SELF-STUDY COURSE 3010-G

Radiation Uses and Protection



**Environmental Health Sciences
Self-Study Course SS3010**

Lesson 7: *Radiation Uses and Protection*

I. Lesson Consists of

- A. Part I: 25 multiple choice questions
- B. Part II: 25 multiple choice questions
- C. Part III: 25 true-false questions
- D. Part IV: 25 true-false questions

II. Reference

Salvato, J. A. *Environmental Engineering and Sanitation*. 3rd ed. New York: John Wiley & Sons, 1982.

III. Topics and Reading Assignments

Chapter 7 - Radiation Uses and Protection *Environmental Engineering and Sanitation*

	(Page No.)
A. Radiation Fundamentals	677 to 687
B. Biological Effects of Radiation	687 to 691
C. Types of X-Ray Units and Common Hazards	691 to 699
D. Radiation Protection	699 to 707
E. Waste Disposal	707 to 710
F. Environmental Radiation Surveillance and Monitoring	710 to 714
G. Radiation Protection Program	714 to 719
H. Other Radiation Sources, Non-ionizing	719 to 722

IV. Supplementary Readings

Basic Radiation Protection Criteria. Washington, D.C.: National Council on Radiation Protection and Measurements, January 15, 1971; Rep. no. 39.

Radiation Exposure from Consumer Products and Miscellaneous Sources. Washington, D.C.: National Council on Radiation Protection and Measurements, 1977; Rep. no. 56.

Radiological Health Handbooks. Washington, D.C.: Government Printing Office, 1970; DHEW (PHS).

Environmental Health Sciences

Radiological Health Handbooks. Washington, D.C.: Government Printing Office, 1970; DHEW (PHS).

Morgan, K. S. "Exposure to non-ionizing radiation." In: McKee, W. D., ed. *Environmental Problems in Medicine*. Springfield, Illinois: Charles C. Thompson, 1974.

V. Objectives

Upon successful completion of Lesson 7, students should be able to correctly

- recognize radiation protection problems when doing a field study
- identify various health hazards from radiation monitoring
- demonstrate fundamental knowledge of medical, occupational, and industrial radiation protection
- apply various principles as they relate to radiation protection.

**Environmental Health Sciences
Self-Study Course SS3010**

Lesson 7: *Radiation Uses and Protection*

Part I: Multiple Choice

1. The term "frequency" is not typically described as
 - a. waves
 - b. particles
 - c. vibrations
 - d. oscillations.
2. The shorter the wave length
 - a. the higher the frequency and lower the energy
 - b. the lower the frequency and energy
 - c. the lower the frequency and higher the energy
 - d. the higher the frequency and energy.
3. The roentgen is a measure of the ionization in air produced by exposure to
 - a. x-rays or gamma rays
 - b. alpha particles
 - c. beta particles
 - d. all of the above.
4. The absorption of how many ergs (energy-per-gram) of air represents one roentgen?
 - a. about 150
 - b. about 100
 - c. about 86
 - d. about 50.

5. The term "rad" means
 - a. required administered dose
 - b. radiation admitted dose
 - c. roentgen absorbed dose
 - d. radiation absorbed dose.
6. The term "rem" is short for
 - a. roentgen energy measure
 - b. roentgen equivalent measure
 - c. radiation energy measure
 - d. none of the above.
7. Which term is used to show the exposure of large populations to low level radiation?
 - a. person-rem
 - b. gamma-rem
 - c. radiation-rem
 - d. quantum-rem.
8. The energy of ionizing radiation is measured as
 - a. electron volts
 - b. thousands of electron volts
 - c. millions of electron volts
 - d. all of the above.
9. The rate at which atoms of radioactive sources (radionuclides) disintegrate are measured in
 - a. rems
 - b. rods
 - c. curies
 - d. roentgens.

Environmental Health Sciences

10. Isotopes of the same element have
- a. the same mass number but different atomic numbers
 - b. the same atomic number but different mass numbers
 - c. different atomic and mass numbers
 - d. the same atomic and mass numbers.
11. The common types of radiation are
- a. x-rays and gamma rays
 - b. alpha and beta particles
 - c. neutrons
 - d. all of the above.
12. Which of the following have little penetrating power and are normally a hazard to health only in the form of internal radiation received through ingestion, inhalation, or open wounds?
- a. x-rays
 - b. alpha particles
 - c. beta particles
 - d. gamma rays.
13. The only difference between gamma rays, x-rays, and visible light is
- a. their charge
 - b. their particle size
 - c. their frequency
 - d. none of the above.
14. Neutrons can have
- a. biological effects
 - b. the ability to make other substances radioactive
 - c. both of the above
 - d. none of the above.

Environmental Health Sciences

15. It takes _____ half-lives to reduce the radioactivity of a radionuclide to about 1% of what it was when first measured
- a. 200
 - b. 125
 - c. 75
 - d. 7.
16. Which of the following best describes sources of radiation?
- a. natural background
 - b. radioactive fallout from nuclear testing or use of nuclear devices
 - c. radiation from medical diagnosis and treatment, industrial, or other man-made sources
 - d. all of the above.
17. What material has a high melting point and high atomic number and is used to make a target which stops x-rays?
- a. copper
 - b. lead
 - c. aluminum
 - d. tungsten.
18. The term genetic effects refers to effects of radiation on
- a. the elderly
 - b. generations yet unborn
 - c. all living organisms
 - d. young adults.
19. Which of the following exposures should be considered in assessing radiation hazard?
- a. natural background
 - b. medical or occupational
 - c. radiation ingested through air, water, and food
 - d. all of the above.

Environmental Health Sciences

20. "GSD" refers to
- a. genetic somatic dosage
 - b. genetically significant dose
 - c. gonadal somatic dosage
 - d. none of the above.
21. Factors that could determine the effect of radiation on the body include
- a. rate of absorption
 - b. individual variability
 - c. nutrition, oxygen tension, metabolic state
 - d. all of the above.
22. When the whole body is irradiated, the most radiosensitive area(s) is (are)
- a. spleen
 - b. lymph nodes
 - c. bone marrow
 - d. all of the above.
23. The median lethal dose of radiation (at which about 50% of the persons exposed will probably die in one month) is considered to be
- a. 150 to 250 roentgens
 - b. 350 to 550 roentgens
 - c. 550 to 750 roentgens
 - d. 1000 roentgens.
24. "MPD" is the abbreviation for
- a. maximum person dosimeters
 - b. maximum permissible dose
 - c. none of the above
 - d. minimum permissible dose.

25. Common deficiencies regarding fluoroscopy units may be
- a. inadequate shielding
 - b. absence of lead aprons
 - c. timing device not functioning properly
 - d. all of the above.

Environmental Health Sciences

Choice Part II: Multiple

1. CAT scanners are used to locate
 - a. tumors
 - b. blood clots
 - c. anatomical malformations
 - d. all of the above.
2. Filters will
 - a. add haze on the film
 - b. reduce stray radiation
 - c. not effect radiation absorbed by the patient
 - d. cause a greater exposure time.
3. To reduce patient and individual exposure
 - a. utilize proper collimation (limit x-ray beam to area needed)
 - b. use of fast film
 - c. tighten tube housing
 - d. all of the above.
4. Sealed radioactive sources used in medicine include in addition to radium 226
 - a. gold 198
 - b. phosphorus 32
 - c. strontium 89
 - d. all of the above.
5. A principle(s) for effecting external radiation protection is (are)
 - a. distance
 - b. time of exposure
 - c. shielding
 - d. all of the above.

Environmental Health Sciences

6. The term "half-value layer" (HVL) is used to designate the thickness of a particular material that will reduce, by one-half, the intensity of radiation passing through the material. Beta radiation is commonly eliminated by
 - a. lead
 - b. concrete
 - c. glass or plastic
 - d. aluminum.
7. Radiation could scatter and bounce off the
 - a. floor
 - b. wall
 - c. ceiling
 - d. all of the above.
8. High radiation area(s) are posted as
 - a. "Radiation Area"
 - b. "Radiation Zone"
 - c. "Restricted Area"
 - d. all of the above.
9. High-level, long-lived liquid wastes are commonly concentrated by
 - a. evaporation and filtration
 - b. precipitation of a soluble material with an insoluble preceptor
 - c. ion exchange
 - d. all of the above.
10. The Department of Energy regulations require solidification of high-level radioactive wastes within _____ of their production.
 - a. 1 year
 - b. 5 years
 - c. 10 years
 - d. 20 years

Environmental Health Sciences

11. The siting of nuclear facilities is subject to extensive regulation and licensing by the
- a. federal health department
 - b. national environmental protection agency
 - c. nuclear regulatory commission
 - d. consumer product safety commission.
12. The FDA requires that sunlamps that radiate UV rays be equipped with timers which automatically shut off after
- a. 30 minutes or less
 - b. 20 minutes or less
 - c. 10 minutes or less
 - d. none of the above.
13. _____ has the responsibility for internal housekeeping and for monitoring all waste discharges in terms of types and quantities.
- a. Industry
 - b. NCR
 - c. NEPA
 - d. State health departments.
14. _____ routinely sample air, water, and food supplies for radionuclides.
- a. the FDA
 - b. the USEPA
 - c. the NRC
 - d. all of the above.
15. A state radiation protection program may involve control of
- a. x-ray units and radioactive materials
 - b. waste disposal
 - c. environmental monitoring and surveillance
 - d. all of the above.

16. Plutonium 239 has a half-life of _____ years
- a. 1 year
 - b. 4,600 years
 - c. 10,000 years
 - d. 24,400 years
17. X-ray units are generally due for reinspection
- a. every year
 - b. every 2 to 3 years
 - c. every 5 years
 - d. every 6 years.
18. An unacceptable use of radiation is
- a. osteopathy
 - b. chiropody
 - c. fluoroscopy for the purpose of fitting shoes
 - d. all of the above.
19. Regarding radiation exposure, the state has a responsibility to:
- a. carry out training
 - b. evaluate and make recommendations for program improvement
 - c. require that a competent program can be conducted
 - d. all of the above.
20. Lasers emit
- a. mechanical radiation
 - b. ionizing radiation
 - c. electromagnetic radiation
 - d. none of the above.

21. Microwave ovens use which of the following energy sources?
- a. mechanical
 - b. electromagnetic
 - c. ultraviolet
 - d. radio waves.
22. Microwave ovens which have magnetron tubes use electrical energy to generate
- a. low frequency, short wave energy
 - b. high frequency, long wave energy
 - c. high frequency, short wave energy
 - d. low frequency, low wave energy.
23. To produce thermal effects, microwave energy is converted to _____ in the body or organism.
- a. chemical energy
 - b. mechanical energy
 - c. power
 - d. heat.
24. Microwaves are reflected by
- a. metals
 - b. plastic
 - c. glass
 - d. human tissues.
25. In medical diathermy, heat produced by microwave radiation is used for
- a. therapeutic treatment
 - b. cardiovascular disorders
 - c. tumor reduction
 - d. none of the above.

Environmental Health Sciences

Part III: True-False

Mark answer sheet under column "A" if the statement is true, or under column "B" if the statement is partially or totally false.

1. The longer the wave length, the lower the frequency and energy.
2. The nature of all radiation is the same, and the difference lies only in the frequency and wave length.
3. Survey meters are usually read in roentgens or milliroentgens per hour.
4. "R" is the symbol used for the term "roentgen".
5. An ordinary chest x-ray produces an exposure of about ~~10~~ rad; a very heavy diagnostic series, about 10 rads.
6. The term "rem" does not take into consideration the biological effect of different kinds of radiation from the same dose in rads.
7. If 5000 persons were exposed to a background radiation of 0.1 rem per year, this would represent a person-rem exposure of 500.
8. Alpha particles have a negative electric charge.
9. A thin sheet of paper will stop a beta particle.
10. In practice, exposure to ionizing radiation is controlled by the use of shields of lead.
11. Carbon 14, a radioactive isotope of carbon, has a half-life of almost 6000 years.
12. Beta particles can be stopped by a few millimeters of aluminum.
13. A radioisotope is an artificially created radioactive isotope of a chemical element that is normally not radioactive.

Environmental Health Sciences

14. Beta particles can be a health hazard either as internal or external radiation because of the ionization in tissues.
15. Gamma rays come from the nucleus of an atom; x-rays come from the electrons around the nucleus and are produced by electron bombardment.
16. Neutrons are charged, high-energy particles.
17. If the radioactivity of a material is not known, the half-life cannot be determined.
18. The effective half-life of an injected radionuclide is determined by the length of time the nuclide remains in the body and its radioactive half-life.
19. One of the common types of ionizing radiation is the x-ray.
20. Sources of x-rays that operate at a voltage above 10 kilovolts may be less hazardous than sources less than 10 kV.
21. Energy is measured in kilovolts, and quantity of x-rays is measured in milliamperes.
22. Medical uses can present a hazard to technicians, patients, and others through the improper handling of radionuclides and contaminated wastes.
23. Long-term effects of radiation are known.
24. Biological effects of radiation on all living organisms, including human beings, are termed somatic.
25. Genetic effects from radiation exposure are usually immediately evident.

Part IV: True-False

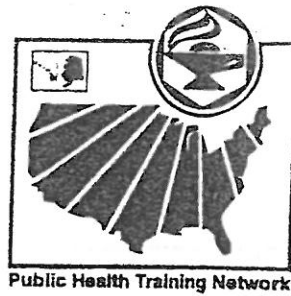
Mark answer sheet under column "A" if the statement is true, or under column "D" if the statement is partially or totally false.

1. Most cells, tissues, and organs of the body are independent, and the destruction of one will not affect the other.
2. Only sperm and nerve cells can apparently replace themselves or recover, to some extent, from radiation exposure if the dose is not excessive.
3. Biological effects should govern the required standards of radiological protection.
4. In assessing radiation hazard, the sum total of all exposures should be considered.
5. Exposure of the gonads (ovaries or testes) is necessary to cause genetic effects from ionizing radiation.
6. Everyone is subject to natural background radiation.
7. The genetic harm done by radiation is not cumulative.
8. Actual amounts of radiation exposure received in different parts of the world will vary with altitude, background, and medical practices.
9. More information is known about effects of trace amounts of toxic substances than radiation effects.
10. Large doses of radiation can be applied to local areas, as in therapy, with little danger.
11. With dental x-rays, it is necessary to establish the correct exposure time for kilovoltage, milliamperage, and source-to-skin distance.
12. Background radiation cannot be eliminated.

Environmental Health Sciences

13. It is believed by some researchers that the hazards of low level radiation may be worse than previously predicted, supporting the principle that "x-rays should be used only when there is good medical reason."
14. Fluoroscopy exams should be done before x-rays.
15. Lead shielding devices are not necessary for chest or upright x-rays.
16. Common deficiencies regarding therapy units may include filtration, exposure control, and calibration.
17. A concentration of x-ray machines in one building will not affect scatter radiation.
18. A CAT scanner is a combination computer and x-ray machine.
19. It is not necessary for a dental unit to have filters.
20. In many cases, x-ray beams or fluoroscopes will extend past the fluoroscopic screen and protective lead, thereby exposing the operator to the direct beam.
21. Many defects in x-ray units are easy to find and need no instruments.
22. A filter of 2 mm of aluminum will absorb the soft, or less penetrating, radiation.
23. Radon is an alpha emitter; daughter decay products are alpha, beta, and gamma emitters.
24. Medical personnel involved in radium therapy can become unnecessarily exposed during handling of the source needle.
25. Radioactive substances used in medicine are always sealed.

SELF-STUDY COURSE 3010-G



Answer Keys



Self-Study Course SS3010
Environmental Health Sciences
Answer Keys (Page No.)

Lesson 7: Part I

1. B (846)	6. D (848)	11. D (851)	16. D (853)	21. D (858)
2. D (846)	7. A (849)	12. B (851)	17. D (855)	22. D (858)
3. A (846)	8. D (846)	13. C (851)	18. B (857)	23. C (859)
4. C (848)	9. C (849)	14. C (851)	19. D (857)	24. B (859)
5. D (848)	10. B (850)	15. D (853)	20. B (857)	25. D (862-863)

Part II

1. D (864)	6. C (870)	11. C (881)	16. D (880)	21. B (891)
2. B (866)	7. D (870)	12. D (895)	17. B (889)	22. C (892)
3. D (866)	8. D (873)	13. A (882)	18. C (890)	23. D (892)
4. A (868)	9. D (878)	14. D (875)	19. D (890)	24. A (892)
5. D (869)	10. B (877)	15. D (888)	20. C (891)	25. A (892)

Part III

1. A; true (846)	6. B; false (848)	11. A; true (870)	16. B; false (853)	21. A; true (855)
2. B; false (846)	7. A; true (851)	12. A; true (870)	17. B; false (853)	22. A; true (856)
3. A; true (887)	8. B; false (851)	13. A; true (853)	18. B; false (851)	23. B; false (856)
4. A; true (848)	9. B; false (851)	14. A; true (851)	19. A; true (851)	24. A; true (857)
5. A; true (864)	10. B; false (851)	15. A; true (851)	20. B; false (855)	25. B; false (857)

Part IV

1. B; false (857)	6. A; true (857)	11. A; true (862)	16. A; true (864)	21. A; true (866)
2. B; false (857)	7. B; false (857)	12. A; true (859)	17. B; false (864)	22. A; true (866)
3. B; false (857)	8. A; true (858)	13. A; true (859)	18. A; true (862)	23. A; true (868)
4. A; true (857)	9. B; false (858)	14. B; false (862)	19. B; false (865)	24. A; true (868)
5. A; true (857)	10. A; true (858)	15. B; false (863)	20. A; true (866)	25. B; false (868)