RADIATION PROTECTION IN MEDICAL RADIOGRAPHY

CHAPTER 1 – INTRODUCTION TO RADIATION PROTECTION

1. The use of radiation in the healing arts did not begin until the discovery of x-rays in what year?
    a. 1870
    b. 1902
    c. 1898
    d. 1895
2. What is defined as the effective measures employed by radiation workers to safeguard patients, personnel, and general public from unnecessary exposure to ionizing radiation?
    a. Safe guards
    b. Patient safety
    c. Radiation protection
    d. Radiation reduction
3. The need for safeguarding against significant and continuing radiation exposure is based on evidence of harmful _____.
    a. Physical determents
    b. Human exposure
    c. Patient harm
    d. Biologic effects
4. What is the degree to which the diagnostic study accurately reveals the presence or absence of disease in the patient?
    a. Study efficacy
    b. Diagnostic efficacy
    c. Essential images
    d. Realized benefits
5. The philosophy of as low as reasonably achievable (ALARA) should be what part of every health care facility's personnel radiation control program?
    a. Small
    b. Technical
    c. Selective
    d. Main
6. What are the three basic principles of radiation protection?
    a. Time, patient positioning and shielding
    b. Time, shielding and mAs/kVp selection
    c. Time, patient positioning and mAs/kVp selection
    d. Time, distance and shielding
7. Who is responsible for providing the necessary resources and appropriate environment in which to execute an ALARA program?
    a. Staff
    b. Radiologist
    c. CMS
    d. Employer

8. In a hospital setting who is expressly charged by the administration to be directly responsible for the ALARA program?
    a. Radiology Director
    b. Medical Director
    c. Radiation Safety Officer
    d. Lead Radiologic Technologist

CHAPTER 2 – RADIATION: TYPES, SOURCES AND DOSES RECEIVED

9. Radiation refers to _____energy that passes from one location to another and can have many manifestations.
    a. kinetic
    b. electric
    c. proton
    d. neutron
10. The amount of energy transferred to electrons by ionizing radiation is the basic concept for radiation dose.
    a. True
    b. False
11. What form of radiation includes alpha and beta particles?
    a. Particulate radiation
    b. Nonionizing radiation
    c. Ionizing radiation
    d. Electromagnetic radiation
12. Equivalent dose is a radiation _____ used for radiation protection purposes when a person receives exposure from various types of ionizing radiation.
    a. Quality
    b. Quantity
    c. Particle
    d. Term
13. What is a classic example of organic damage that results from non-negligible exposure to ionizing radiation?
    a. Cell count changes
    b. Heart function changes
    c. Tissue changes
    d. Changes in blood count
14. Radon is the _____decay product of radium and is produced as radium decays in the soil.
    a. Final
    b. First
    c. Large
    d. Relative

15. According to the Environmental Protection Agency radon is the second leading cause of what type of cancer in the United States?
    a. Colon
    b. Breast
    c. Lung
    d. Brain
16. What was the average dose received by the population living within a 50-mile radius of the Three Mile Island plant?
    a. 0.05 mSv
    b. 0.06 mSv
    c. 0.07 mSv
    d. 0.08 mSv
17. What was the amount of radiation released at Chernobyl when compared to the radioactivity of Hiroshima and Nagasaki combined?
    a. 5-10 times
    b. 15-20 times
    c. 21-29 times
    d. 30-40 times

CHAPTER 3 – INTRODUCTION OF X-RADIATION WITH MATTER

18. A diagnostic x-ray beam is produced when a stream of high-speed _____ bombard a positively charged target.
    a. Protons
    b. Neutrons
    c. Electrons
    d. Particles
19. What is the most common method to eliminate the effects of indirectly transmitted x-ray photons?
    a. Air gap technique
    b. Reduced kVp
    c. Radiographic grids
    d. A&C
20. What are the two important types of interactions between x-ray radiation and matter in diagnostic radiology?
    a. Photoelectric scattering, pair production
    b. Compton scattering, photoelectric absorption
    c. Pair production, Compton scattering
    d. Photoelectric scattering and Compton scattering
21. Photoelectric absorption is an interaction between an x-ray photon and an inner-shell electron.
    a. True
    b. False
22. Characteristic x-rays are also known as:
    a. Spontaneous x-rays
    b. Low-energy radiation
    c. Fluorescent radiation
    d. Non-binding x-ray

23. What is the effective atomic number of bone?
    a. 10.5
    b. 12.2
    c. 13.1
    d. 13.8
24. If two structures have the same density and atomic number, but one is twice as thick as the other, the thicker one will absorb how many more photons?
    a. 2 times
    b. 3 times
    c. 5 times
    d. 10 times
25. Contrast media is used to visualize similar structures or tissues because it consists of solutions containing elements having what difference compared to the surrounding soft tissue?
    a. Higher kinetic energy
    b. Higher atomic number
    c. Higher mass density
    d. Higher photoelectric absorption
26. In the Compton process which name **does not** refer to the freed electron?
    a. Compton scatter electron
    b. Kinetic electron
    c. Secondary electron
    d. Recoil electron

CHAPTER 4 – RADIATION QUANTITIES AND UNITS

27. In November 1895 William Roentgen took the world's first x-ray of his wife's _____.
    a. Skull
    b. Arm
    c. Hand
    d. Foot
28. Who was the first American to die of radiation-induced cancer?
    a. Thomas Edison
    b. Clarence Dolly
    c. Benjamin Franklin
    d. Henry Ford
29. What term is based on the energy deposited in biologic tissue by ionizing radiation?
    a. Tissue dose
    b. Effective dose
    c. Dose quantity
    d. Environmental dose
30. Fluoroscopic entrance dose rates can now be measured in _____.
    a. Milligray per minute
    b. Roentgens per minute
    c. Bragg-Gray units per minute
    d. A&B

31. In what year did the Roentgen become internationally accepted as the unit of measurement for exposure to x-radiation and gamma radiation?
    a. 1931
    b. 1937
    c. 1946
    d. 1948
32. The entire amount of energy delivered to the patient by the x-ray beam is referred to as what?
    a. Air kerma
    b. Absorbed dose
    c. Skin dose
    d. Dose area product
33. What is defined as the amount of energy per unit mass absorbed by an irradiated object?
    a. Kinetic energy
    b. Absorbed dose
    c. Ionizing radiation
    d. Skin dose

CHAPTER 5 – RADIATION MONITORING

34. Exposure monitoring is required whenever radiation workers are likely at risk to receive more than _____ of the annual occupational limit.
    a. 5%
    b. 10%
    c. 15%
    d. 20%
35. The personnel dosimeter
    a. Indicates the working habits of imaging personnel and determines occupational exposure
    b. Does not protect the wearer from exposure
    c. Should be worn only during fluoroscopy exams
    d. A&B
36. During fluoroscopy the head, neck and lens of the eye receive how much more radiation than the trunk of the body?
    a. 2-4 times
    b. 5-8 times
    c. 10-20 times
    d. 20-30 times
37. What is sent back to the dosimetry monitoring company with the exposed film badge and serves as the basis for comparison?
    a. Film holder
    b. Control badge
    c. Exposure report
    d. OSL dosimeter

38. The cumulative column of the personnel monitoring report provides a continuous audit of the actual absorbed radiation equivalent dose.
    a. True
    b. False
39. Which of the following detectors are used as field instruments?
    a. Ionization chamber-type survey meter
    b. Proportional counter
    c. GM detector
    d. All the above
40. The Geiger-Muller is the primary survey detector used in what area?
    a. Diagnostic radiology
    b. Special procedures
    c. Mammography
    d. Nuclear Medicine

CHAPTER 6 – OVERVIEW OF CELL BIOLOGY

41. Cells are made of what building material?
    a. Protein
    b. Glucose
    c. Protoplasm
    d. Calcium
42. What enables the cell to perform the vital functions of synthezing proteins and producing energy?
    a. Reproduction
    b. Compounds
    c. Conduction
    d. Metabolism
43. Of all organic compounds what contains the most carbon?
    a. Hydrogen
    b. Calcium
    c. Protein
    d. Oxygen
44. Proteins constitute about what percent of cell content?
    a. 10%
    b. 12%
    c. 15%
    d. 20%
45. What are chemical secretions manufactured by the endocrine glands and carried to the body?
    a. Proteins
    b. Enzymes
    c. Hormones
    d. Glucose

46. What is the primary energy source for the cell?
    a. Glucose
    b. Sucrose
    c. Lactose
    d. Fructose
47. Lipids constitute what percent of cell content?
    a. 1
    b. 2
    c. 4
    d. 6
48. What are tiny rod-shaped bodies that, under a microscope, appear to be long, thread like structures?
    a. Genome
    b. DNA
    c. RNA
    d. Chromosomes
49. Inorganic compounds are compounds that do not contain what?
    a. Carbon
    b. Hydrogen
    c. Oxygen
    d. Nitrogen
50. Water is approximately what percent of the body's weight?
    a. 40-45%
    b. 60-65%
    c. 70-75%
    d. 80-85%
51. The motion of water moving across cell surfaces or membranes into areas with high concentration of ions called what?
    a. Stabilization
    b. Osmosis
    c. Balancing
    d. Regulation
52. What is the heart of the living cell?
    a. Chromosome
    b. Nucleus
    c. DNA
    d. RNA

CHAPTER 7 – MOLECULAR AND CELLULAR RADIATION BIOLOGY

53. Characteristics of ionizing radiation **do not** include charge, mass and energy.
    a. True
    b. False

54. Because of wave-particle duality x-rays and gamma rays can also be referred to as a stream of particles called what?
    a. Electrons
    b. Neutrons
    c. Photons
    d. Positrons
55. Exposure to ionizing radiation is observed on the molecular, cellular and organic levels resulting from what?
    a. Oxygen reaction
    b. Biologic damage
    c. Oxygen effect
    d. Peroxide compounds
56. Mutation is the interaction of high energy radiation with _____.
    a. RNA
    b. DNA
    c. Chromosomes
    d. Cells
57. Ionizing radiation adversely affects the cell primarily by transferring energy to what part of the cell?
    a. Nucleus
    b. Molecules
    c. DNA
    d. Chromosomes
58. Reproductive death generally results from exposure of cells to doses from ionizing radiation in what range?
    a. 1-10 Gy
    b. 20-30 Gy
    c. 40-50 Gy
    d. 60-70 Gy
59. What level of whole-body dose delivered within a few days produces a measurable hematologic depression?
    a. 0.0025 Gy
    b. 0.025 Gy
    c. 0.25 Gy
    d. 2.5 Gy
60. White blood cells are collectively called what?
    a. Stem cells
    b. Undifferentiated cells
    c. Vessels
    d. Leukocytes

CHAPTER 8 – EARLY DETERMINISTIC RADIATION EFFECTS ON ORGANS

61. When living organisms experience biologic damage from exposure to radiation, the results of the exposure are classified as what?
    a. Radiation effect
    b. Tissue damage
    c. Lethal effect
    d. Somatic effect
62. Nausea, fatigue, hair loss and skin redness are all consequences of what?
    a. Low level dose
    b. High level dose
    c. Genetic damage
    d. Organ damage
63. What is the medical term that defines a collection of symptoms?
    a. Pathology
    b. Complaint
    c. Sickness
    d. Syndrome
64. The gastrointestinal form of ARS appears at a threshold dose of approximately _____ and peaks after a dose of _____.
    a. 2 Gy, 10 Gy
    b. 3 Gy, 10 Gy
    c. 4 Gy, 10 Gy
    d. 6 Gy, 10 Gy
65. What term signifies the whole-body dose of radiation that can be lethal to 50% of the exposed population within 30 days?
    a. LD 50/20
    b. LD 50/30
    c. LD 50/40
    d. LD50/50
66. The significant reddening experienced by early radiologists and dentists as a result of excessive exposure is called what?
    a. Skin cancer
    b. Blisters
    c. Radiodermatitis
    d. Blotching
67. Dose as low as what can depress the male sperm population, and also has the potential to cause genetic mutations?
    a. 0.01 Gy
    b. 0.1 Gy
    c. 0.2 Gy
    d. 0.3 Gy

68. Permanent sterility is most likely induced by what dose to the testes?
    a. 1 or 2 Gy
    b. 3 or 4 Gy
    c. 5 or 6 Gy
    d. 7 or 8 Gy

CHAPTER 9 – LATE DETERMINISTIC AND STOCHASTIC RADIATION EFFECTS ON ORGAN SYSTEMS

69. Epidemiology is the study of science that deals with the incidence, distribution and control of disease in a population.
    a. True
    b. False
70. Which one of the following health concerns **does not** follow the linear-quadratic nonthreshold curve (LQNT)?
    a. Leukemia
    b. Colon cancer
    c. Breast cancer
    d. Heritable damage
71. Consequences of radiation exposure that appears months or years after the exposure is called what?
    a. Late somatic effect
    b. Radiation poisoning effect
    c. Biological effect
    d. Fertility effect
72. How many radiologic technologists are participating in the 1982 study to evaluate the long-term health risks of ionizing radiation?
    a. 142,000
    b. 146,000
    c. 150,000
    d. 162,000
73. How much radiation delivered in a single dose will induce the formation of cataracts?
    a. 2 Gy
    b. 3 Gy
    c. 4 Gy
    d. 6 Gy
74. During pregnancy, what is the most crucial time with respect to adverse consequences from ionizing radiation?
    a. Months 1-3
    b. Months 4-5
    c. Months 6-7
    d. Months 8-9
75. The only concrete evidence showing that ionizing radiation causes genetic effects comes from extensive experimentation with _____ and _____ at a high radiation dose.
    a. Monkeys, mice
    b. Mice, dogs
    c. Fruit flies, mice
    d. Monkeys, fruit flies

76. Information obtained from hereditary experiments indicates that hereditary effect **does have** a threshold dose.
    a. True
    b. False

CHAPTER 10 – DOSE LIMITS FROM EXPOSURE TO IONIZING RADIATION

77. The International Commission of Radiological Protection (ICCP) is considered the international authority on the _____ use of sources of ionizing radiation.
    a. Global
    b. Best
    c. Safe
    d. Unsafe
78. United States regulatory agencies include:
    a. Nuclear Regulatory Commission, Environmental Protection Agency
    b. U.S. Food and Drug Administration, OSHA
    c. Internal Revenue Service
    d. A&B
79. What year was the Environmental Protection Agency (EPA) established?
    a. 1968
    b. 1970
    c. 1976
    d. 1980
80. Implementation of an effective facility radiation safety program begins with:
    a. Radiologist
    b. Radiation Safety Officer
    c. Administration
    d. Radiology staff
81. What does the Nuclear Regulatory Commission mandate be established in each facility to oversee safe operations?
    a. Administrative committee
    b. Radiology department committee
    c. Policy committee
    d. Radiation safety committee
82. Who is specifically responsible for developing an appropriate radiation safety program for the facility?
    a. Administration
    b. Radiologist
    c. Radiation Safety Officer
    d. Radiology Director
83. What year did the code of standards for diagnostic x-ray equipment go into effect?
    a. 1955
    b. 1972
    c. 1974
    d. 1982

84. What concept puts forth the principle that radiation should be kept as low as reasonably possible?
    a. OSHA
    b. EPA
    c. ALARA
    d. CMS
85. What is the upper boundary dose of ionizing radiation that results in a negligible risk of bodily injury or hereditary damage called?
    a. Radiation exposure limit
    b. Effective dose limit
    c. Effective risk limit
    d. Radiation risk limit
86. What is the whole body annual occupational dose limit?
    a. 10 mSv
    b. 40 mSv
    c. 50 mSv
    d. 60 mSv
87. For pregnant workers, what is the monthly dose limit to the embryo?
    a. 0.05 mSv
    b. 0.25 mSv
    c. 0.5 mSv
    d. 0.60 mSv

CHAPTER 11 – EQUIPMENT FOR RADIATION PROTECTION

88. The x-ray table is commonly made of what?
    a. Plastic fiber
    b. Aluminum
    c. Carbon fiber
    d. Reinforced plastic
89. The radiation that arises from interaction of an x-ray beam with the atoms of a patient is called what?
    a. Optimal radiation
    b. Leakage radiation
    c. Scattered radiation
    d. Primary radiation
90. It is imperative that the x-ray beam and the image receptor be correctly aligned with each other.
    a. True
    b. False
91. What shaped aperture diaphragm is most commonly used in trauma, chest and dental radiographic units?
    a. Round
    b. Square
    c. Oblong
    d. Rectangle

92. Because of filtration the overall intensity of the incidental radiation is:
    a. Increased
    b. Hardened
    c. Improved
    d. Decreased
93. What is the aluminum filtration requirement for x-ray units operating above 70 kVp?
    a. 2.0 mm
    b. 2.2 mm
    c. 2.5 mm
    d. 3.0 mm
94. What percentage of image density results from the visible light photons emitted by the intensifying screens?
    a. 60%
    b. 75%
    c. 90%
    d. 95%
95. What intensifying screens are more efficient than calcium tungstate in converting x-ray energy into light photons?
    a. Carbon fiber
    b. Rare earth
    c. Silver bromide
    d. Halide crystal
96. The use of a grid to remove scattered x-ray photons significantly improves:
    a. Patient dose
    b. Radiographic contrast
    c. Visibility of detail
    d. B&C
97. The minimal source-skin distance (SSD) to use for mobile radiographic units is:
    a. 20 cm
    b. 30 cm
    c. 36 cm
    d. 40 cm
98. Computed radiography involves the use of which of the following?
    a. Conventional radiographic equipment and patient positioning
    b. Selection and use of standard exposure factors
    c. Analog imaging
    d. A&B
99. What diagnostic radiology procedure produces the greatest patient radiation exposure?
    a. Chest x-ray
    b. Lumbar spine x-ray
    c. Fluoroscopy
    d. Mammogram

CHAPTER 12 – MANAGEMENT OF PATIENT RADIATION DOSE

100. How much more radiation does a female patient receive to their reproductive organs during a pelvis exam than a male patient?
    a. Two times more
    b. Three times more
    c. Four times more
    d. Five times more
101. It is absolutely essential every imaging department establish a _____ to ensure the production of optimal quality images.
    a. Film reject analysis
    b. Quality control program
    c. Patient safety program
    d. Radiation control program
102. To reduce the dose to patients during screening mammography, which projection **should not** be routinely performed?
    a. Axillary
    b. Cranial caudal
    c. Mediolateral
    d. A&C
103. Direct patient shielding is not typically used in CT
    a. True
    b. False
104. Using the recommendations of the Image Gently Campaign the pediatric dose from a CT examination could be reduced by how much?
    a. 10%
    b. 20%
    c. 50%
    d. 60%

CHAPTER 13 – MANAGEMENT OF IMAGING PERSONNEL RADIATION DOSE

105. The cumulative effective dose limit for the whole body that limits a radiation worker's lifetime effective dose is determined by which of the following calculations?
    a. Person's years times 1 rem
    b. Person's years times 2 rem
    c. Person's years times 3 rem
    d. Person's years times 4 rem
106. What type of radiation poses the greatest occupational hazard in diagnostic radiology?
    a. Alpha radiation
    b. Beta radiation
    c. Scattered radiation
    d. Gamma radiation

107. What is the standard lead equivalent of a lead apron?
    a. 0.03
    b. 0.25
    c. 0.5
    d. 1.0
108. How often should a lead apron be inspected for cracks or other defects?
    a. Twice a year
    b. Once a year
    c. Every two years
    d. Every three years
109. What is the most effective means of protection for the radiologic technologist to reduce their radiation dose?
    a. Reduce mAs
    b. Reduce kVp
    c. Increase distance from the radiation source
    d. Wear a lead apron
110. What are the two most common materials used for structural protective barriers?
    a. Lead and concrete
    b. Lead and aluminum
    c. Concrete and wood
    d. Concrete and aluminum
111. What is the minimal amount of lead in protective eyeglasses?
    a. 0.3 mm
    b. 0.35 mm
    c. 0.5 mm
    d. 0.06 mm
112. Radiographers must never stand in the primary beam to restrain a patient.
    a. True
    b. False

CHAPTER 14 – RADIOISOTOPES AND RADIATION PROTECTION

113. Iodine-131 joined with sodium chloride is used in the treatment of what type of cancer?
    a. Colon
    b. Breast
    c. Brain
    d. Thyroid
114. What is the most common radioisotope used in nuclear medicine studies?
    a. Iodine-131
    b. Technetium-99m
    c. Fluorine-18
    d. Sodium Iodide

115. In PET scanning Flourine-18 can be attached to what molecule which is then taken up by cancerous cells?
    a. Hydrogen
    b. Oxygen
    c. Glucose
    d. Nitrogen
116. A half value layer is the amount of lead needed to attenuate high-energy radiation by what amount?
    a. 20%
    b. 30%
    c. 40%
    d. 50%
117. Designing a PET/CT suite **does not** present a unique radiation safety problem.
    a. True
    b. False
118. During a PET/CT prep time the patient's degree of radioactivity will decrease by what percentage by the time of scanning?
    a. 5-10
    b. 15-20
    c. 25-30
    d. 35-40
119. After the PET/CT scan patients should maintain what distance from others for the remainder of the day?
    a. 1 meter
    b. 2 meters
    c. 3 meters
    d. 4 meters
120. A dirty bomb is a radioactive source mixed with conventional explosives.
    a. True
    b. False