takece.com
Continuing Education Simplified!

Course Title: Nuclear Medicine Handbook- Part I
Test Questions

Chapter 1

1. Who discovered natural radioactivity?
A. Röntgen
B. Newton
C. Becquerel
D. Tesla

2. A _____ is defined as a quantity that can be used in mathematical equations of science and technology.
A. physical quantity
B. kilogram
C. radiation
D. x-ray quality

3. The currently used metric system of units is known as the _____.
A. Tesla
B. Gauss
C. Traditional Radiation units
D. International System of Units (SI)

4. The electric current is measured in _____.
A. kilogram (kg)
B. ampere (A)
C. second (s)
D. kelvin (K)

5. Which of the following is a SI unit of power?
A. joule (J)
B. watt (W)
C. newton (N)
D. pascal (Pa)

6. Non-ionizing radiation cannot ionize matter because its energy per quantum is below the ionization potential of atoms.
A. True
B. False

7. Which of the following are examples of ionizing radiation?
A. X rays and γ rays
B. energetic neutrons, electrons and protons
C. heavier particles
D. All of the above

8. Ionizing radiation can be categorized into which of the following types?
A. directly ionizing radiation
B. indirectly ionizing radiation
C. ultrasonic waves
D. Both A and B

9. Directly ionizing radiation consists of which of the following charged particles?
A. electrons and protons
B. α particles
C. heavy ions
D. all of the above

10. Indirectly ionizing photon radiation consists of which of the following main categories?
A. ultraviolet
B. X ray
C. γ ray
D. All of the above

11. Orbital _____ have a natural tendency to configure themselves in such a manner that they inhabit a minimal energy state for the atom.
A. protons
B. neutrons
C. electrons
D. none of the above

12. When light charged particles are slowed down or 'negatively' accelerated by interactions with other charged particles in matter, the kinetic energy that they lose is converted to electromagnetic radiation, referred to as _____.
A. pair production
B. bremsstrahlung radiation
C. scattered radiation
D. none of the above

13. Gamma rays typically have energies above _____ keV and wavelengths less than 0.1 Å.
A. 1
B. 10
C. 100
D. none of the above

14. When a parent nucleus undergoes β plus decay or a high energy photon interacts with the electric field of either the nucleus or the orbital electron, an energetic positron may be produced.
A. True
B. False

15. During annihilation, the positron and electron disappear and are replaced by two oppositely directed annihilation quanta, each with an energy of _____ MeV.
A. 0.511
B. 1.500
C. 2.567
D. 4.875

16. In radiotherapy, the prescribed dose must be delivered accurately and precisely to maximize the tumor control probability (TCP) and to minimize the normal tissue complication probability (NTCP).
A. True
B. False

17. _____ is defined as energy absorbed per unit mass of medium.
A. Absorbed dose
B. Exposure X
C. Kerma K
D. Effective dose E

18. _____ of a radioactive substance is defined as the number of nuclear decays per time.
A. Absorbed dose
B. Activity A
C. Kerma K
D. Effective dose E

19. Atomic number symbolized by letter _____ is the number of protons and number of electrons in an atom.
A. A
B. Z
C. K
D. E

20. Atomic mass number (A) is the number of _____ in an atom.
A. electrons
B. protons
C. nucleons
D. hydrogens

21. According to the _____, most of the atomic mass is concentrated in the atomic nucleus consisting of Z protons and neutrons, where Z is the atomic number and A the atomic mass number of a given nucleus.
A. Rutherford–Bohr atomic model
B. electromagnetic spectrum
C. inverse square law
D. none of the above

22. A nuclide is an atomic species characterized by its nuclear composition that is composed of A, Z and the arrangement of nucleons within the nucleus.
A. True
B. False

23. The isotopes have the same number of _____.
A. neutrons
B. protons
C. electrons
D. none of the above

24. _____ is a spontaneous process by which an unstable parent nucleus emits a particle or electromagnetic radiation and transforms into a more stable daughter nucleus that may or may not be stable.
A. MRI
B. Electricity
C. Radioactivity
D. none of the above

25. The SI unit of radioactivity is the _____.
A. becquerel (Bq)
B. rad
C. kerma K
D. effective dose E

26. In _____ Frédèric Joliot and Irène Curie-Joliot discovered artificial radioactivity.
A. 1895
B. 1900
C. 1915
D. 1934

27. _____ is important in production of radionuclides used for external beam radiotherapy, brachytherapy, therapeutic nuclear medicine and nuclear medicine imaging also referred to as molecular imaging.
A. proton activation
B. Neutron activation
C. Magnet activation
D. Sonowave

28. To bind the nucleons into a stable nucleus, a delicate equilibrium between the number of protons and the number of _____ must exist.
A. neutrons
B. electrons
C. hydrogens
D. carbons

29. Naturally occurring α particles have kinetic energies between _____ MeV.
A. 1 and 1.5
B. 2 and 2.7
C. 4 and 9
D. 50 and 76

30. A large number of radionuclides used in nuclear medicine (e.g. 99mTc, 123I, 201Tl, 64Cu) decay by electron capture and/or internal conversion.
A. True
B. False

31. Coulomb interactions between the incident electron or positron and nuclei of the absorber atom result in _____.
A. proton activation
B. particle scattering
C. Magnet activation
D. ghost image

32. _____ is defined as the thickness of a homogeneous absorber that attenuates the narrow beam intensity I(0) to one half (50%) of the original intensity.
A. Detective Quantum Efficiency (DQE)
B. Inverse Square Law
C. PACS
D. Half Value Layer (HVL)

33. Which of the following are considered as photon interactions with atoms of the absorber?
A. Compton and Photoelectric effect
B. Nuclear and Electronic pair production
C. Photonuclear reactions
D. All of the above

34. The Compton effect is also called by which of the following?
A. Incoherent scattering
B. Compton scattering
C. Rayleigh scattering
D. Both A and B

Chapter 2
35. _____ is the study (both qualitative and quantitative) of the actions of ionizing radiations on living matter.
A. Radiobiology
B. Radiology
C. Cardiology
D. Anthropology

36. In nuclear medicine, which of the following types of radiation play a relevant role in tumor and normal tissue effects?
A. gamma (γ) radiation
B. beta (β) radiation
C. alpha (α) particles and Auger electrons
D. All of the above

37. _____ is emitted when heavy, unstable nuclides undergo decay.
A. Solar radiation
B. Alpha radiation
C. Ultraviolet radiation
D. Microwave radiation

38. _____ occur when a cell which has not been traversed by a charged particle is damaged as a result of radiation interactions occurring in neighboring cells.
A. Scatter radiation
B. Photoelectric effect
C. Bystander effects
D. Lethal dose

39. _____ damage is the primary cause of cell death caused by radiation.
A. Muscle
B. Red blood cells
C. DNA
D. Skin

40. _____ is a form of cell death associated with loss of cellular membrane activity.
A. Necrosis
B. Alopecia
C. Erythema
D. Cataract

41. _____ is a measure of the linear rate at which radiation is absorbed in the absorbing medium by the secondary particles.
A. LET
B. DQE
C. HVL
D. LD

42. Targeted radionuclide therapy normally involves irradiation of the tumor/normal tissues at a dose rate which is not constant but which reduces as treatment proceeds, as a consequence of the combination of radionuclide decay and biological clearance of the radiopharmaceutical.
A. True
B. False

43. _____ damage in which the cellular DNA is irreversibly damaged to such an extent that the cell dies or loses its proliferative capacity.
A. Sublethal
B. Lethal
C. Reversible
D. Minor

44. The _____ of a particular radiation treatment is a measure of the resultant damage to the tumor vs the damage to critical normal structures.
A. lethal index
B. toxicity
C. therapeutic index
D. none of the above

Chapter 3
45. Medical exposure is the largest human-made source of radiation exposure, accounting for more than _____ of radiation exposure.
A. 50%
B. 66%
C. 73%

D. 95%

46. Worldwide, the total number of nuclear medicine examinations is estimated to be about _____ per year.
A. 10 thousand
B. 50 thousand
C. 1 million
D. 35 million

47. The use of radiation in nuclear medicine is a planned exposure situation and it needs to be under regulatory control, with an appropriate authorization in place from the regulatory body before operation can commence.
A. True
B. False

48. _____ refers primarily to exposure incurred by patients for the purpose of medical diagnosis or treatment.
A. Cosmic exposure
B. Public exposure
C. Medical exposure
D. None of the above

49. _____ is the exposure of workers incurred in the course of their work.
A. Occupational exposure
B. Medical exposure
C. Public exposure
D. Hazard exposure

50. The ICRP system has which of the following fundamental principles of radiological protection?
A. The principle of justification
B. The principle of optimization of protection (ALARA)
C. The principle of limitation of doses
D. All of the above

51. According to table 3.1, what is the maximum recommended occupational dose to lens of the eye?
A. 10 mSv
B. 20 mSv
C. 500 mSv
D. 900 mSv

52. The _____ is a body set up by the United Nations in 1955, that compiles, assesses and disseminates information on the health effects of radiation and on levels of radiation exposure due to different sources.
A. UNSCEAR
B. WHO
C. NMTCB
D. ARRT

53. The International System of Units (SI) unit of mean organ dose is joules per kilogram (J/kg) which is termed _____.
A. rem
B. gray (Gy)
C. rad
D. becquerel

54. Regarding internal exposure from radionuclides, the equivalent dose and the effective dose are not only dependent on the physical properties of the radiation but also on which of the following?
A. biological turnover
B. retention of the radionuclide
C. NM equipment

D. Both A and B

55. The SI unit of equivalent dose is joules per kilogram (J/kg), which is termed _____.
A. radiation (R)
B. rem
C. sievert (Sv)
D. none of the above

56. The relationship between the probability of stochastic effects and equivalent dose is found to depend on the _____.
A. organ or tissue irradiated
B. step-up transformer
C. anode
D. cathode

57. To achieve a high standard of radiation protection, the most important thing is to establish a safety-based attitude in every individual, such that protection and accident prevention are regarded as a natural part of daily duties.
A. True
B. False

58. The high standard of radiation protection is achieved by which of the following?
A. education and training
B. encouraging questioning and learning attitude
C. positive and cooperative attitude from the national authorities and the employer
D. all of the above

59. Which of the following have key roles and responsibilities in implementing radiation protection in a nuclear medicine facility?
A. nuclear medicine physician and medical physicist
B. nuclear medicine technologist and radiopharmacist
C. radiation protection officer (RPO)
D. All of the above

60. Which of the following must be established for education and training of personnel?
A. Health insurance coverage
B. Quality assurance (QA) programme
C. Human resource training
D. Monthly staff meeting

61. When the patient presents in the nuclear medicine facility, the _____ has the responsibility for the overall radiation protection of the patient.
A. radiology nurse
B. general physician
C. nuclear medicine specialist
D. none of the above

62. All employer should appoint _____ to oversee and implement radiation protection matters.
A. radiation safety officer
B. human resource manager
C. radiology supervisor
D. pharmacist

63. Which of the following are important tasks for the medical physicist for nuclear medicine staff and other health professionals?
A. quality assurance (QA)
B. continuing education in radiation protection
C. teaching pharmacology

D. Both A and B

64. Which of the following factor needs to be considered when planning and designing the nuclear medicine facility?
A. Optimization of protection for staff and the general public
B. Preventing uncontrolled spread of contamination
C. Fulfilment of national requirements regarding pharmaceutical work
D. all of the above

65. Isolation wards for patients treated with radionuclides should be located inside of the nuclear medicine facility.
A. True
B. False

66. Which of the following is a special concern in a nuclear medicine facility?
A. scatter radiation
B. toxicity
C. risk of contamination
D. high magnetic area

67. When a radioactive source is not in use, it should always be stored.
A. True
B. False

68. _____ should be considered for radiation protection in a busy facility where large activities are handled and where many patients are waiting and examined.
A. High ceiling
B. Structural shielding
C. Revolving doors
D. None of the above

69. Regarding occupational exposure, the basic safety standards (BSS) require the classification of workplaces as controlled areas or as supervised areas.
A. True
B. False

70. A _____ area is any area for which occupational exposure conditions are predictable and stable.
A. public
B. hazardous
C. supervised
D. non-controlled

71. In a nuclear medicine facility, which of the following are controlled areas?
A. the rooms for preparation
B. storage (including radioactive waste)
C. injection of the radiopharmaceuticals
D. All of the above

72. _____ monitoring consists of measuring radiation levels at various points using an exposure meter or survey meter.
A. Exposure
B. Contamination
C. Patients
D. None of the above

73. Contamination monitoring is the search for extraneous _____ deposited on surfaces.
A. scattered radiation
B. radioactive material

C. contrast agents
D. none of the above

74. Radioactive waste needs to be safely managed because it is potentially hazardous to human health and the environment.
A. True
B. False

75. Each type of radioactive waste should be kept in separate containers that are properly labelled to supply information about which of the following?
A. radionuclide type
B. radionuclide physical form
C. radionuclide activity and its external dose rate
D. all of the above

76. The final disposal of the radioactive waste produced in the nuclear medicine facility includes which of the following options?
A. storage for decay and disposal as cleared waste into the sewage system (aqueous waste)
B. through incineration or transfer to a landfill site (solid waste)
C. transfer of sources to the vendor or to a special waste disposal facility outside of the hospital
D. All of the above

77. High equivalent dose to the _____ can be received in preparation and administration of radiopharmaceuticals, even if proper shielding is used.
A. feet
B. fingers
C. gonads
D. none of the above

78. It is generally accepted that the unborn child should be afforded the same protection level as a member of the general public, meaning that a dose limit of _____ should be applied once pregnancy is declared.
A. 0 mSv
B. 1 mSv
C. 10 mSv
D. 100 mSv

79. In order to minimize external exposure, which of the following fundamental measures of protection should be applied?
A. time
B. distance
C. shielding
D. All of the above

80. _____ should be used to reduce the radiation exposure by increasing the distance between the source and the hands.
A. Gonadal shielding
B. Thyroid cover
C. Forceps or tongs
D. Dosimeter

81. Which of the following can be used during examinations, when the distance to the patient is short?
A. low kVp
B. personal dosimeter
C. movable transparent shield
D. curtain

82. _____ should not be subject to therapy with a radioactive substance unless the application is life-saving.
A. Pregnant women
B. Elderly patients
C. Cancer patients
D. Pediatric patients

83. For children or young patients, _____ should always be measured and the adult administered activity should then be scaled down.
A. height
B. body weight
C. age
D. none of the above

Chapter 4
84. All matter in the universe has its origin in an event called the _____, a cosmic explosion releasing an enormous amount of energy about 14 billion years ago.
A. theory of relativity
B. big bang
C. atomic theory
D. gravity theory

85. Which of the following form the building blocks of nuclei?
A. Protons
B. Neutrons
C. Electrons
D. Both A and B

86. The discovery of radioactive atoms was first made by Henri Becquerel in 1990.
A. True
B. False

87. _____ was the first person to apply the radioactive tracer technique in biology when he investigated lead uptake in plants (1923) using ^{212}Pb.
A. Röntgen
B. Newton
C. De Hevesy
D. Becquerel

88. Before the second world war, the ____ was the main producer of radionuclides since the neutron sources at that time were very weak.
A. Cyclotron
B. Fuji
C. Kodak
D. GE

89. Generally, reactor produced radionuclides are most suitable for laboratory work, whereas accelerator produced radionuclides are more useful clinically.
A. True
B. False

90. Radionuclides have which of the following physical quality?
A. half-life
B. emitted type of radiation
C. energy
D. all of the above

91. The _____ was organized according to the number of protons (atom number) in the nucleus, which is equal to the number of electrons to balance the atomic charge.
A. human genome
B. periodic system
C. chemical chart
D. DNA strand

92. Which of the following contains constant number of protons?
A. Isotones
B. Isotopes
C. Isobars
D. none of the above

93. The stability of the nucleus is determined by which of the following competing forces?
A. strong force that binds the nucleons (protons and neutrons) together
B. Coulomb force that repulses particles of like charge
C. electromagnetic force
D. Both A and B

94. For best stability, the nucleus has an equal number of protons and electrons.
A. True
B. False

95. The energy gained or lost in a nuclear reaction is called the _____.
A. M-value
B. N-value
C. P-value
D. Q-value

96. Since all radioactive decays are spontaneous, they need to have _____ Q-values.
A. negative
B. positive
C. neutral
D. none of the above

97. Usually, the irradiating particles have a large _____ energy that is transferred to the target nucleus to enable a nuclear reaction.
A. potential
B. magnetic
C. kinetic
D. stable

98. In radionuclide production, the nuclear reaction always involves a change in the number of protons or neutrons.
A. True
B. False

99. Neutrons can penetrate the target at down to thermal energies, but the charged particles need to overcome the _____ to penetrate the nucleus
A. Blood brain barrier
B. Coulomb barrier
C. Cellular wall
D. None of the above

100. There are two major ways to produce radionuclides: using reactors (neutrons) or particle accelerators (protons, deuterons, α particles or heavy ions).
A. True
B. False

101. Most nuclear reactors in the world are for energy production and, for safety reasons, cannot be used for radionuclide production.
A. True
B. False

102. The most typical neutron reaction is the (n, γ) reaction in which a _____ is captured by the target nucleus forming a compound nucleus.
A. orbiting electron
B. hydrogen proton
C. thermal neutron
D. none of the above

103. Many reactors produced radionuclides emit high energy _____ that contribute to the absorbed dose (but not the imaging signal) to patients, which is a drawback in diagnostic procedures.
A. x-ray
B. magnetic force
C. β particles
D. solar radiation

104. Which of the following are used in radionuclide therapy that emits high energy β radiation?
A. [sup]90[/sup]Y
B. [sup]131[/sup]I
C. [sup]177[/sup]Lu
D. All of the above

105. _____ is not only used as fuel in a nuclear reactor but it can also be used as a target to produce radionuclides.
A. Barium sulfide
B. Uranium-235
C. Gadolinium
D. Isovue 500

106. Iodine-131 is the only radionuclide with a mass of 131 that has a half-life of more than 1 h, meaning that all the others will soon have decayed to 131I.
A. True
B. False

107. An accelerator in particle physics can be huge, as in the European Organization for Nuclear Research (CERN), with a diameter of more than _____ kilometer.
A. .5
B. 1
C. 2
D. 4

108. According to table 4.2, accelerated particles of <10 MeV proton energy are used for _____.
A. MRI
B. PET
C. Radiography
D. Ultrasound

109. The cyclotron for radionuclide production was invented by Ernest Lawrence in the early _____.
A. 1800s
B. 1890s
C. 1930s
D. 1990s

110. Cyclotrons were first installed in hospitals in the _____, but during the past two decades, hospital based small cyclotrons yielding 10–20 MeV protons have become common, especially with the rise of PET.
A. 1960s
B. 1970s
C. 1980s
D. 1990s

111. A cyclotron is composed of which of the following systems?
A. A resistive magnet
B. A vacuum and high frequency systems
C. An ion source
D. all of the above

112. In modern nuclear accelerators, negative ions, protons or deuterium with _____ orbit electrons are usually used.
A. one
B. two
C. three
D. four

113. Since the vacuum chamber of nuclear accelerators is in a _____, the ions move in a circular orbit.
A. extracted beam
B. deflecting electrode
C. magnetic field
D. step-up transformer

114. Commercial accelerators dedicated to PET radioisotope production are limited both in energy (<20 MeV) and in beam current (<100 µA).
A. True
B. False

115. _____ is produced by deuteron bombardment of natural nitrogen through the 14N(d, n)15O nuclear reaction.
A. Oxygen-15
B. Helium
C. Carbon dioxide
D. Calcium

116. When the _____ is hit by an energetic particle, a complex interplay between physical and statistical laws determines the result.
A. nucleus
B. electrons
C. cell membrane
D. protons

117. Whenever a radionuclide (parent) decays to another radioactive nuclide (daughter), this is called a_____.
A. ionization
B. photoelectric effect
C. radionuclide generator
D. magnetization

Chapter 5
118. Which of the following are sources of errors in Nuclear Medicine measurement?
A. blunders
B. systematic errors or accuracy of measurements
C. random errors or precision of measurements
D. All of the above

119. Measurement results having systematic errors will be _____.
A. inaccurate or biased
B. accurate
C. analytically correct
D. justified

120. When an incorrectly calibrated ionization chamber is used for measurement of radiation dose, it is an example of _____ error.
A. regular
B. systematic
C. routine
D. normal

121. Systematic errors can be detected by using _____.
A. reference standards
B. H & D curve
C. pie chart
D. histograms

122. Random errors are rarely present when radiation measurements are performed because the measured quantity, namely the radionuclide decay, is a random varying quantity.
A. True
B. False

123. The energy spectrum represented by square markers is the measured energy spectrum with random noise due to _____.
A. scattered radiation
B. primary photons
C. radionuclide decay
D. none of the above

124. The width of the _____ determines the energy resolution of the detection system.
A. photopeak
B. target angle
C. collimation shutters
D. gamma camera

125. The random error as a result of the measured quantity, namely radionuclide decay, will significantly influence the _____ of the image.
A. collimation
B. absorption
C. visual quality
D. magnification

126. When the total number of counts per image are increased, the counts per pixel increase and the random error decreases, resulting in improved visual image quality.
A. True
B. False

127. Random errors are always present and play a significant role in which of the following?
A. radiation counting
B. imaging
C. radio frequency signals
D. Both A and B

128. The _____ is an important measure to evaluate variability in measurements of radioactivity.
A. air gap technique

B. fractional standard deviation
C. inverse square law method
D. none of the above

129. A _____ of the relative frequency distribution of the fluctuations in the measurements can be constructed by plotting the relative frequency of the measured counts (Fig. 5.3(b)).
A. histogram
B. radio frequency signals
C. T[sub]2[/sub] signal
D. magnification

130. The _____ is a useful tool to provide a quick visual summary of the distribution of measurement values and can be used to identify outliers such as blunders or the correct functioning of equipment.
A. H & D curve
B. grayscale window
C. relative frequency distribution
D. computer aided diagnosis (CAD)

131. The mode of a frequency distribution is defined as the most frequent value or the value at the maximum probability of the frequency distribution.
A. True
B. False

132. The probability that a single measurement will be close to the true mean depends on the relative width or dispersion of the _____.
A. frequency distribution curve
B. non-stochastic curve
C. sigmoidal chart
D. none of the above

133. The light photons generated in the scintillator following interaction with an incoming γ ray will eject electrons at the photocathode of the _____.
A. x-ray tube
B. photomultiplier tube (PMT)
C. Picture archiving and communication system (PACS)
D. anode filaments

134. The _____ must be used when a radionuclide with a very short half-life is counted with a high counting efficiency.
A. heat unit chart
B. binomial distribution
C. pixel count sheet
D. none of the above

135. For the calculation of binomial distribution, which of the following parameters are required?
A. Number of trials (*n*)
B. Individual success probability (*p*)
C. Signal to noise ratio (SNR)
D. Both A and B

136. The _____ of imaging devices such as scintillation cameras and positron emission tomography equipment is determined as the full width at half maximum (FWHM) response of a normal distribution fitted to a point or line spread function.
A. spatial resolution
B. matrix size
C. thermal heat units
D. digital noise signal

137. The energy resolution of scintillation detectors is expressed as the FWHM of the photopeak distribution divided by the photopeak energy E.
A. True
B. False

138. The precision of a single measurement is very important during radionuclide imaging and if the number of counts acquired in a picture element or pixel is low, a low precision is obtained.
A. True
B. False

139. The sensitivity of nuclear medicine equipment can be increased by increasing the _____.
A. Source to image distance (SID)
B. Radiation dose
C. FWHM spatial resolution
D. Collimation

140. Most procedures in nuclear medicine involve multiple nuclear measurements and imaging procedures for the calculation of which of the following results on which clinical diagnosis is based?
A. thyroid iodine uptake
B. ejection fraction and renal clearance
C. blood volume or red cell survival time
D. All of the above

141. In imaging, when scatter or background correction is performed by _____, image quality deteriorates as a result of the increased uncertainty in the pixel values.
A. collimation
B. subtraction
C. filtration
D. magnification

142. The background counts during sample counting consist of which of the following?
A. electronic noise and detection of cosmic rays
B. natural radioactivity in the detector
C. down scatter radioactivity from non-target radionuclides in the sample
D. All of the above

143. A plasma volume (PV) measurement is required on a patient and the uncertainty in the PV measurement needs to be calculated.
A. True
B. False

144. The plasma volume (PV) is measured by using the _____.
A. collimation
B. subtraction
C. dilution principle
D. magnification

145. A _____ determines the energy resolution of a detector or the uncertainty associated with the energy measurement of a detected photon.
A. IP process
B. analog to digital converter
C. statistical process
D. flux gain

146. Which of the following determines the energy resolution or uncertainty in the energy of a detected photon?
A. type of detector
B. energy of the detected photons

C. target angle
D. both A and B

147. Which of the following is widely used in nuclear medicine for sample counting and imaging?
A. scintillation detectors
B. radio frequency signals
C. T[sub]2 [/sub]signal
D. step up transformer

148. The operation of scintillation detectors involves which of the following process?
A. Number x of light photons produced in the scintillator by the detected γ ray
B. Fraction p of the light photons that will eject electrons from the photocathode of the PMT
C. Multiplication M of these electrons multiplied at successive dynodes before being collected at the anode
D. all of the above

Chapter 6
149. A _____ is a sensor that upon interaction with radiation produces a signal that can preferably be processed electronically to give the requested information.
A. x-ray tube
B. radiation detector
C. transformer
D. mA meter

150. Charged particles, such as α particles, transfer their energy directly by which of the following method?
A. ionization
B. excitation
C. magnetic signal
D. Both A and B

151. The quality of a radiation detector is expressed in terms of which of the following characteristics?
A. sensitivity, energy and time
B. position resolution
C. counting rate a detector can handle
D. All of the above

152. In radiation detection, the sensitivity depends on which of the following?
A. the solid angle subtended by the detector
B. the efficiency of the detector for interaction with the radiation
C. magnet size
D. Both A and B

153. In Nuclear Medicine, _____ depends primarily on two factors, the rise time and the height of the signal pulses.
A. IP process
B. filtration
C. time resolution
D. flux gain

154. In nuclear medicine, _____ is an issue in γ ray detection in the gamma camera and in single photon emission computed tomography (SPECT) and PET detection systems.
A. ghost images
B. position resolution
C. metal artifacts
D. blurring

155. The mode of operation of a gas filled detector depends strongly on the applied _____.
A. voltage
B. radio frequency signals

C. mAs
D. contrast

156. A semiconductor detector is also called a _____.
A. capacitor
B. step-up transformer
C. anode
D. cathode

157. Which of the following semiconductor detector material is primarily of interest for (position sensitive) detection of low energy X rays, β particles and light quanta?
A. Lead
B. Tungsten
C. Silicon
D. Wood

158. _____, with its higher density and atomic number, is the basic material for high resolution γ ray spectroscopy.
A. Lead
B. Tungsten
C. Germanium
D. Wood

Chapter 7
159. Nuclear medicine imaging is generally based on the detection of X rays and γ rays emitted by _____ injected into a patient.
A. barium sulfide
B. radionuclides
C. iodine
D. gadolinium

160. Photon counting places a heavy burden on the electronics used for nuclear medicine imaging in terms of _____.
A. electronic noise and stability
B. ghost images
C. blurring
D. magnification

161. The methods used for the detection of X ray and γ ray photons fall into which of the following categories?
A. scintillation counter
B. gas filled detectors
C. semiconductors
D. All of the above

162. Gas filled imaging systems convert the energy deposited by a γ ray photon directly into _____.
A. digital signal
B. analog signal
C. ion pairs
D. scatter radiation

163. Which of the following produces images from signals by ionizing radiation detection processes in nuclear medicine?
A. gamma camera
B. positron camera
C. imaging plates (IP)
D. Both A and B

164. The gamma camera was invented by _____.
A. Hal Anger
B. Fuji
C. Kodak
D. GE

165. The amplified signal from the photo-multiplier can be converted to a digital pulse train using an _____.
A. analogue to digital converter (ADC)
B. digital to analogue converter (DAC)
C. step-up transformer
D. ionization chamber

166. _____ is based on the use of radioactive labels to determine the microscopic distribution of pharmaceuticals in tissues excised from humans or animals.
A. Radiobiology
B. Autoradiography
C. Cardiology
D. Oncology

167. _____ is a problem when an amplifier produces a pulse that either oscillates before reaching its maximum value or where the tail oscillates before reaching the baseline.
A. Artifact
B. Ghost image
C. Ringing
D. Scatter radiation

168. Analogue signals are converted into _____ that are subsequently used to provide spatial and temporal information about each detected event.
A. electric signal
B. x-ray signal
C. digital signals
D. radio-frequency signal

Chapter 8
169. The first stage of a generic nuclear medicine imager is the _____ emitted by the radionuclide.
A. detection of the γ rays
B. capture of scattered radiation
C. elimination of signals
D. none of the above

170. _____ reflect the performance of a sub-part of the imager under ideal conditions.
A. Statistic counting
B. Intrinsic measurements
C. QA
D. QC

171. The _____ is an intrinsic measure of detector performance.
A. magnification
B. energy resolution
C. flux gain
D. histogram

172. The _____ of a nuclear medicine imager characterizes the system's ability to resolve spatially separated sources of radioactivity.
A. grid lines
B. DQE
C. spatial resolution
D. none of the above

Chapter 9

173. The instrument that is used in nuclear medicine to measure radioactivity is the calibrated re-entrant ionization chamber, commonly known by which of the following name?
A. radionuclide calibrator
B. dose calibrator
C. imaging plates (IP)
D. Both A and B

174. The calibrated re-entrant ionization chamber is typically shielded by the manufacturer with 6 mm of _____ to ensure low background readings.
A. lead
B. wood
C. plastic
D. concrete

175. _____ measure the current output from the ionization chamber ranging from tens of femtoamperes up to micro-amperes.
A. Electrometers
B. Sensitometer
C. Densitometer
D. kVp meter

176. The dose calibrator response from β particles will be almost entirely from _____.
A. compton and photoelectric effect
B. nuclear and electronic pair production
C. bremsstrahlung radiation
D. magnetic source

177. The proportion of the total radioactivity that is present as a specific radionuclide is defined as the radionuclide purity.
A. True
B. False

178. Acceptance tests for dose calibrators should include measurements of which of the following?
A. accuracy
B. reproducibility and linearity
C. geometry response
D. All of the above

179. Children are approximately three times more radiosensitive than adults, so determining the appropriate activity to be administered for pediatric procedures is essential.
A. True
B. False

180. Surface contamination with radioactivity could lead to contamination of a radiation worker and/or external irradiation of the _____ of the worker.
A. eyes
B. skin
C. thyroid
D. none of the above

181. Internal contamination could arise from inhalation and/or ingestion of the radionuclide.
A. True
B. False

182. Systematic studies of the dose to the hands of staff working in radio-pharmacies have shown that finger doses may approach or exceed the annual dose limit of _____ mSv to the extremities.
A. 5

B. 50
C. 500
D. 5,000

183. The ICRP has recommended that ____ dose monitoring be undertaken for any person handling more than 2 GBq/d and regular monitoring should be carried out if doses to the most exposed part of the hand exceed 6 mSv/month.
A. eye
B. finger
C. gonad
D. thyroid

184. A _____ mounted in a plastic ring is usually the most convenient type of monitor that is worn on the finger.
A. ionizing pen
B. film-badge dosimeter
C. G M monitor
D. thermoluminescent dosimeter chip

185. The ICRP recommends that the ring monitor be worn on the middle finger with the element positioned on the palm side, and that a factor of three should be applied to derive an estimate of the dose to the tip.
A. True
B. False

186. A _____ is an enclosed workplace designed to prevent the spread of fumes to the operator and other persons.
A. dark room
B. fume cupboard
C. processing room
D. lead curtain

187. During radiopharmaceutical preparation, dispensing and administration to the patient, the activity is usually manipulated in _____.
A. cups
B. bottles
C. syringes
D. spoons

188. The radiopharmacy should be located in an area that is not accessible to members of the public.
A. True
B. False

189. Radioactive waste generated within a nuclear medicine facility usually consists of radionuclides with half-lives of less than _____.
A. one day
B. one month
C. one year
D. none of the above

Chapter 10
190. In scintillation detectors, radiation interacts with and deposits energy in a scintillator, most commonly, a crystalline solid such as _____.
A. thallium-doped sodium iodide (NaI(Tl))
B. mercury
C. helium
D. sodium bromide

191. Among ionization detector survey meters, so-called _____ are relatively low sensitivity ionization chambers that are designed for use where relatively high fluxes of X rays and γ rays are encountered.
A. ionizing pen
B. film-badge dosimeter
C. G M monitor
D. cutie-pies

192. Well counters are used for high sensitivity counting of radioactive specimens such as blood or urine samples or 'wipes' from surveys of removable contamination (i.e. 'wipe testing').
A. True
B. False