CHAPTER 1: **BASIC PHYSICS FOR NUCLEAR MEDICINE**

1. Indirectly ionizing radiation consists of ——— particles, which deposit energy in the absorber through a two step process.

A charged **B** uncharged **C** electron **D** α

2. ——— is defined for indirectly ionizing radiation as energy transferred to charged particles per unit mass of the absorber.

A Kerma K **B** Dose **C** Effective Dose **D** Equivalent Dose

3. A(n) ——— is an atomic species characterized by its nuclear composition (A, Z, and the arrangement of nucleons within the nucleus).

A Isotope **B** neuron **C** nuclide **D** radioisotope

4. ——— of two nuclei of very small mass will create a massive nucleus and release a certain amount of energy.

A Collision **B** Bombardment **C** Fission **D** Fusion

5. Each two-particle collision possesses a characteristic ——— value that can be either positive, zero, or negative.

A *A* **B** *M* **C** *Q* **D** *T*

6. Specific activity a of a radioactive atom depends on the decay constant ——— and on the atomic mass number A of the radioactive atom.

A β **B** λ **C** π **D** Δ

7. In ———, Henri Becquerel discovered natural radioactivity.

A 1896 **B** 1934 **C** 1943 **D** 1955

8. Excited nuclei decay to their ground state through ——— decay.

A α **B** β **C** β^+ **D** γ

9. In electron capture, the atomic number of the daughter decreases by ———, and its atomic mass number remains constant.

A one **B** two **C** three **D** four

10. Coulomb interactions between the incident electron or positron and nuclei of the absorber atom result in particle scattering.

A True **B** False

11. The photon ——— is the average distance a photon of energy hν travels through a given absorber before undergoing an interaction.

A HVL **B** TVL **C** MFP **D** beam

12. A loosely bound electron is an electron whose binding energy E_B is much ——— in comparison with the photon energy $h\nu$.

A stronger **B** weaker **C** larger **D** smaller

13. For ——— to happen, the photon energy $h\nu$ must exceed the binding energy E_B of the orbital electron to be ejected.

A the photoelectric effect **B** a photonuclear reaction **C** Rayleigh scattering **D** the Compton effect

14. ——— is described as an interaction between a photon and a free as well as stationary electron.

A The photoelectric effect **B** A photonuclear reaction **C** Rayleigh scattering **D** The Compton effect

15. In ——— there is no energy transfer to charged particles.

A the photoelectric effect **B** a photonuclear reaction **C** Rayleigh scattering **D** the Compton effect

CHAPTER 2: **BASIC RADIOBIOLOGY**

16. ——— radiation is an electromagnetic radiation of high energy and is produced by subatomic particle interactions.

A α **B** β **C** γ **D** Auger

17. DNA damage is the primary cause of cell death caused by radiation.

A True **B** False

18. ——— or programmed cell death can occur naturally or result from insult to the cell environment.

A Necrosis **B** Apoptosis **C** Reproductive **D** Mitotic catastrophe

19. ——— damage is when partially damaged DNA is left with sufficient capacity to restore itself over a period of a few hours.

A Lethal **B** Sublethal **C** Potentially Lethal **D** Reversible

20. Cells which are lethally affected by radiation may continue to function for some time, only dying when attempting to undergo:

A mitosis **B** transcription **C** translation **D** energy conversion

21. In ——— radiotherapy, the normal tissues at risk will be those immediately adjacent to the tumour being treated.

A conventional **B** tumour targeted **C** whole body irradiation **D** radionuclide targeting

22. ——— effects are those for which the likelihood of them occurring is dose related, but the severity of the result is not related to dose.

A Deterministic **B** Dynamic **C** Stochastic **D** Incidental

CHAPTER 3: **RADIATION PROTECTION**

23. The principle of ——— states any decision that alters the radiation exposure situation should do more good than harm.

A diligence **B** limitation **C** optimization **D** justification

24. The international system of units (si) unit of mean organ dose is joules per kilogram (J/kg) which is termed:

A dose **B** gray **C** committed dose **D** operational quantity

25. The general medical and health care of the patient is the responsibility of the individual physician treating the patient.

A True **B** False

26. In a ——— area, individuals follow specific protective measures to control radiation exposures.

A supervised **B** restricted **C** controlled **D** monitored

27. With regard to workers, of special concern is contamination of the ———, since this can result in extremely high local equivalent doses.

A head **B** skin **C** organs **D** eyes

28. The primary purpose of ——— is to assess the initial and continuing fitness of employees for their intended tasks.

A finger monitoring **B** dosimetry systems **C** health surveillance **D** gamma cameras

29. The ——— has the ultimate responsibility for the control of all aspects of the conduct and extent of nuclear medicine examinations.

A quality assurance specialist **B** protection committee **C** BSS representative **D** nuclear medicine specialist

30. It is generally considered that for a fetal dose of less than ———, termination of pregnancy is not justified from radiation risks alone.

A 75 mGy **B** 100 mGy **C** 125 mGy **D** 150 mGy

31. Exposure as part of biomedical research is treated on the same basis as ——— exposure and, therefore, is not subject to dose limits.

A public **B** occupational **C** medical **D** potential

32. The most likely accident in a nuclear medicine facility is contamination of workers, patients, equipment and facilities.

A True **B** False

33. The BSS require the licensee of the nuclear medicine facility to have established a ——— programme.

A nuclear research **B** QA **C** reporting **D** BSS training

CHAPTER 4: **RADIONUCLIDE PRODUCTION**

34. A search to find a more long lived isotope of carbon resulted in the 1939 discovery of ——— produced in the nuclear reaction $^{13}C(d, p)^{14}C$.

A ^{12}C **B** ^{14}C **C** ^{16}C **D** ^{22}C

35. For best stability, the nucleus has an equal number of protons and neutrons.

A True **B** False

36. The ——— states that the position and the momentum of particles cannot be simultaneously known to arbitrarily high precision.

A principle of complementary **B** Pauli exclusion principle **C** equivalence principle **D** Heisenberg uncertainty principle

37. There are two major ways to produce radionuclides: using ——— or particle accelerators.

A reactors **B** CERN **C** radionuclide generators **D** large hadron colliders

38. In radionuclide therapy, in contrast to diagnostic applications, the emission of high energy ——— radiation is desirable.

A α **B** β **C** γ **D** X

39. In a reactor, the particles come from all directions.

A True **B** False

40. Commercial accelerators dedicated to PET radioisotope production are limited both in energy (<20 MeV) and in:

A gases **B** materials **C** mass **D** beam current

41. ——— is produced by proton bombardment of natural nitrogen.

A Carbon-11 **B** Carbon-12 **C** Carbon-13 **D** Carbon-14

42. Most commercial generators use ——— chromatography, in which ^{99}Mo is adsorbed onto alumina.

A ion exchange **B** supercritical fluid **C** column **D** gas

43. In the ion exchange mechanism, an ion in the ——— phase is transferred to a solid phase.

A gas **B** liquid **C** plasma **D** liquid crystal

CHAPTER 5: **STATISTICS FOR RADIATION MEASUREMENT**

44. ——— errors produce results that differ consistently from the correct results by some fixed amount.

A Blunder **B** Random **C** Precision **D** Systematic

45. When a ——— photon is detected with the scintillation detector, the number of charge carriers generated will vary randomly.

A α **B** β **C** γ **D** δ

46. The ——— of a frequency distribution is the most frequent value or the value at the maximum probability of the frequency distribution.

A mode **B** median **C** mean **D** average

47. The ——— of measurements will determine the precision of a single measurement as an estimate of the true value.

A median **B** frequency distribution **C** standard deviation **D** mean

48. The Poisson distribution is a normalized frequency distribution.

A True **B** False

49. In radionuclide energy spectroscopy, the photopeak distribution can be fitted to a ——— distribution.

A binomial **B** polynomial **C** normal **D** Poisson

50. The sensitivity of imaging equipment can be increased by increasing the FWHM spatial resolution.

A True **B** False

51. In imaging, when scatter or background correction is performed by subtraction, ——— deteriorates.

A precision **B** image quality **C** accuracy **D** shutter speed

52. ——— counts are those counts that do not originate from the sample or target volume or are unwanted counts such as scatter.

A Superfluous **B** Arbitrary **C** Foreground **D** Background

53. The fractional σ_F and percentage σ_P standard deviations significantly increase when the background increases relative to the net counts.

A True **B** False

54. In scintillation cameras the location of the position of incoming photons is based on the ——— detected by the detectors.

A movement **B** outgoing photons **C** surfaces **D** pulses

55. In the ——— dead time model, a fixed dead time τ follows each event during the live period of the detector.

A generalized **B** paralysable **C** non-paralysable **D** non-extendable

CHAPTER 6: **BASIC RADIATION DETECTORS**

56. Charged particles, such as α particles, transfer their energy directly by ——— and excitation.

A ionization **B** photonization **C** electron affinity **D** polarization

57. Time resolution depends primarily on two factors, the ——— time and the height of the signal pulses.

A start **B** end **C** rise **D** down

58. To make a diode, n-type silicon is the starting material and a narrow zone is doped with impurities to make a p^+n junction.

A True **B** False **C** **D**

59. ——— of a material is the prompt emission of light upon interaction with radiation.

A Photoluminescence **B** Radioluminescence **C** Luminescence **D** Scintillation

60. PMTs are available with a large variety of specifications, including circular, square or hexagonal photocathodes.

A True **B** False

61. The silicon photomultiplier (SiPM) is an array of tiny APDs that operate in ——— mode.

A switch **B** linear **C** Geiger **D** LIDAR

62. The scintillation mechanism of ——— scintillators is based on molecular transitions.

A gaseous **B** plastic **C** inorganic **D** organic

CHAPTER 7: **ELECTRONICS RELATED TO NUCLEAR MEDICINE IMAGING DEVICES**

63. If the signal from the photomultiplier tube (PMT) anode is small, a(n) ——— is needed prior to full amplification.

A preamplifier **B** expander **C** booster **D** microamplifier

64. Invented by ———, the gamma camera is usually based on the use of a single large area phosphor coupled to up to a hundred PMTs.

A Wilhelm Roentgen **B** Godfrey Hounsfield **C** Edward Hoffman **D** Hal Anger

65. ——— photodiodes have been used as an alternative to PMTs for both gamma camera and positron camera designs.

A Plastic **B** Silicon **C** Crystal **D** Liquid Crystal

66. The output current from a PMT is ——— proportional to the amount of light received from the phosphor.

A directly **B** inversely **C** not **D** usually

67. Analogue signals are converted into digital signals that are then used to provide spatial and ——— information about each detected event.

A photographic **B** chromatic **C** technical **D** temporal

68. Flash ADC is done using a(n) ——— number of comparators, each having a different reference level.

A large **B** small **C** even **D** odd

69. Full-wave rectification is achieved by using a diode bridge that allows both halves of the AC signal to be used, with one half being:

A inverted **B** converted **C** weakened **D** amplified

70. In ——— power supplies, the output power comes from the storage battery via some form of inverter.

A DC **B** AC **C** uninterruptible **D** linear

CHAPTER 8: **GENERIC PERFORMANCE MEASURES**

71. The ——— stage of a generic nuclear medicine imager is the detection of the γ rays emitted by the radionuclide.

A first **B** second **C** third **D** fourth

72. With regard to scanner performance, ——— measurements reflect the performance of a sub-part of the imager under ideal conditions.

A extrinsic **B** intrinsic **C** spatial **D** energy

73. The intrinsic ability of a detector to distinguish γ rays of different energies is reflected in its ——— resolution.

A extrinsic **B** intrinsic **C** spatial **D** energy

74. The ——— of a nuclear medicine imager characterizes the system's ability to resolve spatially separated sources of radioactivity:

A extrinsic resolution **B** intrinsic resolution **C** spatial resolution **D** energy resolution

75. On gamma cameras, the ——— is determined using a bar phantom with narrow slits of activity across the detector.

A extrinsic resolution **B** intrinsic resolution **C** spatial resolution **D** energy resolution

76. At moderate count rates, paralysable and non-paralysable dead times are the same; it is only at high count rates that they differ.

A True **B** False

77. All performance measurements of sensitivity are ———.

A extrinsic **B** intrinsic **C** spatial **D** energy

78. ——— uniformity is measured without a collimator by exposing the detector to a uniform activity distribution.

A Extrinsic **B** Intrinsic **C** Spatial **D** Energy

CHAPTER 9: **PHYSICS IN THE RADIOPHARMACY**

79. Dose calibrators with ——— gas pressure are available for PET production facilities where very large activities may be measured.

A mild **B** moderate **C** reduced **D** increased

80. Electrometers measure the current output from the ——— chamber ranging from tens of femtoamperes up to microamperes:

A ionization **B** combination **C** radiation **D** absorption

81. The dose calibrator response from β particles will be almost entirely from ——— radiation.

A α **B** bremsstrahlung **C** β **D** γ

82. The proportion of the total radioactivity that is present as a specific radionuclide is defined as the radionuclide:

A ratio **B** clarity **C** integrity **D** purity

83. A long lived check source should be used on a(n) ——— basis to confirm the constancy of the response of the dose calibrator.

A daily **B** monthly **C** yearly **D** hourly

84. The recommendations of the ICRP specifically exclude ——— exposures from its system of dose limits.

A incidental **B** public **C** occupational **D** medical

85. ——— contamination could arise from inhalation and/or ingestion of the radionuclide.

A External **B** Internal **C** Surface **D** Underlying

86. Laminar flow cabinets provide a non-turbulent airstream of near constant velocity.

A True **B** False

87. During radiopharmaceutical preparation, dispensing and administration to the patient, the activity is usually manipulated in:

A computer system **B** test tubes **C** vials **D** syringes

88. There should be an area within the radiopharmacy designated as a ——— area that is used for record keeping and/or computer entry.

A holding **B** data **C** non-active **D** storage

89. Sources categorized by the IAEA as 1, 2 or 3 are known as ——— sources.

A low risk **B** security enhanced **C** enhanced risk **D** hazardous

CHAPTER 10: **NON-IMAGING DETECTORS AND COUNTERS**

90. The principal difference between dose calibrators and Geiger counters is the magnitude of the ——— between the anode and cathode.

A force **B** bias voltage **C** resistance **D** pressure

91. The pertinent difference among (crystalline) solids is related to the widths of their respective electron ——— energy gaps.

A forbidden **B** restricted **C** suspended **D** vacated

92. There are two distinct components of overall sensitivity, geometric sensitivity and ——— sensitivity.

A internal **B** external **C** spatial **D** intrinsic

93. ——— are portable, battery operated, gas filled ionization detectors (or solid state scintillation detectors) used to monitor exposure rates.

A Radiation meters **B** Dosimeters **C** Survey meters **D** Geiger counters

94. Well counters are used for high sensitivity counting of radioactive specimens such as blood or urine samples.

A True **B** False

95. Advantages of ——— based probes include relatively low cost and high sensitivity.

A semiconductor **B** scintillation detector **C** well counter **D** organ uptake

96. Which type of probe can be used to measure total body activity?

A semiconductor **B** scintillation detector **C** well counter **D** organ uptake

97. Among routine dose calibrator QC tests[3], constancy must be checked daily and accuracy and linearity at least:

A hourly **B** monthly **C** quarterly **D** yearly

98. As ——— probes may not provide a display of the energy spectrum, it may not be possible to visually check that it is properly peaked.

A intra-operative **B** organ uptake **C** well counter **D** dose calibrator

CHAPTER 11: **NUCLEAR MEDICINE IMAGING DEVICES**

99. Collimators consist of a set of holes in a dense material with a high atomic number, typically:

A tungsten **B** lead **C** bismuth **D** platinum

100. Foil fabrication techniques are especially appropriate for low energy collimators.

A True **B** False

101. Frequency response can be described by the collimator modulation ——— function.

A scatter **B** alteration **C** transer **D** displacement

102. For a parallel-hole collimator, the sensitivity is ——— the distance to the collimator face.

A directly proportional to **B** inversely proportional to **C** dependent on **D** independent of

103. The ——— of the photodetector array is used to compute the interaction position of the γ ray in the scintillator.

A input **B** output **C** frequency **D** location

104. The goal of the radiation detector is to provide a(n) ——— of the energy and interaction position of each γ ray incident on the detector.

A input **B** output **C** estimate **D** precise reading

105. The goal of ——— correction is to make images of a flood source as uniform as possible.

A image **B** output **C** sensitivity **D** consistency

106. ——— refers to building spatial histograms of the counts as a function of position and possibly other variables.

A Energy correction **B** Spatial correction **C** image framing **D** image building

107. One function of the ——— is to provide mounting for the collimators.

A camera housing **B** hood **C** camera platform **D** framing system

108. In addition to the rotational motion required for SPECT, ——— is also required in the relative positioning of the detector heads.

A resilience **B** vertical motion **C** stability **D** flexibility

109. ——— has the advantage of having much higher sensitivity and of requiring lower activity sources.

A Fan-beam geometry **B** Parallel-beam geometry **C** Half-cone geometry **D** Radionuclide transmission

110. Scatter correction requires estimating the scatter component of the projection data combined with a(n) ——— method.

A integration **B** compensation **C** attainment **D** finalization

111. Radioactive decay via positron emission is at the heart of the PET image formation process.

A True **B** False

112. The best possible spatial resolution that can be obtained by a PET system is not always achieved due to ——— in the measured data.

A artefacts **B** statistical noise **C** inconsistencies **D** irregularities

113. Although different radiation detector designs have been used in PET, almost all current systems adopt an approach based on:

A Geiger-Mueller tubes **B** gas-filled detectors **C** scintillation detectors **D** solid-state detectors

114. A photodetector is a device that produces a(n) ——— signal when stimulated by light of the sort emitted by a scintillation detector.

A radio **B** electrical **C** digital **D** power

115. The dominant design of scanner configurations consists of a(n) ——— of detectors that completely surrounds the patient in one plane.

A cluster **B** array **C** line **D** ring

116. ——— detection assumes that only two photons were detected.

A Coincidence **B** Concurrence **C** Circumstantial **D** Incident

117. The advantage of 3-D acquisition is its large increase in ——— compared to 2-D acquisition.

A sensitivity **B** scope **C** reach **D** statistical quality

118. The total number of ring combinations contributing to a direct plane plus those contributing to a cross plane is sometimes referred to as:

A cover **B** span **C** range **D** reach

119. In addition to the high performance required for conventional PET, TOF PET requires scanners optimized for high ——— resolution.

A intrinsic **B** energy **C** timing **D** spatial

120. One of the advantages of PET over SPECT is the ease with which attenuation correction can be performed.

A True **B** False

121. With the introduction of PET/CT, the need for radionuclide transmission systems was:

A increased **B** decreased **C** eliminated **D** no different

122. Detector dead time losses occur mostly in the detector ——— electronics.

A compilation **B** processing **C** back-end **D** front-end

123. The main advantage of CT based attenuation correction is the ——— with which the data can be acquired.

A accuracy **B** speed **C** clarity **D** sensitivity

CHAPTER 12: **COMPUTERS IN NUCLEAR MEDICINE**

124. ——— states that new memory chips have twice the capacity of prior chips, and that new chips are released every 18 to 24 months.

A Grosch's law **B** Haitz's law **C** Bell's law **D** Moore's law

125. A ——— is usually the smallest unit of storage that is used for a pixel.

A byte **B** bit **C** kilobyte **D** kilobit

126. Most positron emission tomography (PET) cameras have discrete crystals, so that the lines of response are intrinsically:

A compressed **B** uncompressed **C** analogue **D** digital

127. A common use of eigenfunctions in nuclear medicine is in measuring the modulation transfer function (MTF).

A True **B** False

128. ——— can be used to describe any linear-time-invariant or linear- shift-invariant system.

A Complexity **B** Contortion **C** Convolution **D** Undulation

129. The word 'filtering' refers to processing data in the ——— domain by multiplying the data by a function, the filter.

A time **B** Fourier **C** spectral **D** sweep source

130. The ——— filter has two parameters, k_0 and n.

A Wiener **B** Bessel **C** Butterworth **D** band-pass

131. A ——— filter, which passes intermediate frequencies and stops both low and high frequencies, will both smooth and edge enhance.

A Wiener **B** Bessel **C** Butterworth **D** band-pass

132. ——— filtering is used when the statistical properties of the signal and of the noise are known.

A Wiener **B** Bessel **C** Butterworth **D** band-pass

133. For a normal large FOV Anger camera, a ——— matrix is more than sufficient for most imaging situations.

A 64 x 64 **B** 128 x 128 **C** 256 x 256 **D** 256 x 1024

134. ——— graphics define an image in terms of components such as points, lines, curves and regions, e.g. polygons.

A Raster **B** Vector **C** Array **D** Scalar

135. ——— has the advantage that it can be read by humans and can be edited with any text editor.

A Binary **B** ASCII **C** Unicode **D** Markup

136. The only task of a(n) ——— is to connect systems, translating messages so that they can be understood by other systems.

A API **B** Radiology Information System **C** information gateway **D** compiler

CHAPTER 13: **IMAGE RECONSTRUCTION**

137. The X ray transform has an adjoint operation that appears in both analytical and iterative reconstruction.

A True **B** False

138. The ——— can be directly applied to reconstruct an unknown image $\Lambda(x, y)$ from its known projections $y(s, \phi)$.

A X ray transform **B** kernel **C** FBP algorithm **D** central slice theorem

139. Several methods in image reconstruction, including Fourier rebinning, are based on the so-called ——— relation.

A wavelength-speed **B** frequency-range **C** frequency-distance **D** frequency-wavelength

140. The basic idea of ——— algorithms is to compute estimates of the direct sinograms from the oblique sinograms.

A FBP **B** rebinning **C** reprojection **D** TOF

141. Multislice rebinning is superior to single slice rebinning, but the ——— characteristics are not optimal.

A latency **B** xy blurring **C** noise **D** inconsistent

142. An example of an 'exact' rebinning algorithm is:

A FOREX **B** FBP **C** single-slice **D** multi-slice

143. After discretization, the unknown image values and the known measured values can be represented as column vectors ——— and *y*.

A i **B** x **C** α **D** λ

144. The ——— distribution can be well approximated with a Gaussian distribution, where the variance of the Gaussian equals its mean.

A binomial **B** discrete uniform **C** Poisson **D** geometric

145. The ——— gradient algorithm is designed to avoid the preconditioned gradient method oscillations.

A amalgamated **B** conjugate **C** compound **D** condensed

146. The idea of ——— is to replace the problematic log-likelihood function with another function $\Phi(\lambda)$ that leads to a simpler set of equations.

A function transfer **B** function optimization **C** function exchange **D** optimization transfer

147. The MLEM algorithm is multiplicative, implying that it cannot change the value of a reconstruction voxel, when the current value is zero.

A True **B** False

148. Data acquired from an object dynamically changing with time in activity distribution, and/or in morphology (shape), is referred to as:

A fluid data **B** varying data **C** dynamic data **D** fluctuating data

149. The ——— of OSEM is initially much faster but otherwise similar to that of MLEM.

A confluence **B** convergence **C** consolidation **D** coalescence

150. The distortion effects in typical emission data include resolution effects and ——— effects.

A interference **B** obstruction **C** noise **D** motion

151. The main additive contaminations are ——— (SPECT and PET) and random events (PET).

A scatter **B** dispersion **C** noise **D** motion

152. Artefacts caused by ——— are becoming the single most important factor for image degradation.

A scatter **B** dispersion **C** noise **D** motion

153. Post-smoothed ——— produces fairly uniform spatial resolution, in combination with a non-uniform variance.

A MAP **B** MLEM **C** WLS **D** FBP

CHAPTER 14: **NUCLEAR MEDICINE IMAGE DISPLAY**

154. When displaying digital images, each matrix element corresponds to a ——— of the image.

A hue **B** hexadecimal value **C** pixel **D** megapixel

155. The ——— is a fast, specialized processor optimized for graphics and image processing operations.

A AMD Ryzen **B** liquid crystal display **C** CPU **D** GPU

156. A typical liquid crystal cell consists of a liquid crystal in twisted nematic phase between two ——— plates.

A crystal **B** glass **C** backlit **D** polycarbonate

157. Today's ubiquity of ——— enables deployment of display devices at all locations where access to medical images is needed.

A PACs **B** APIs **C** display databases **D** international display standards

158. The quality of a colour image depends on the colour ——— with which each subpixel contributes.

A hue **B** depth **C** intensity **D** caliber

159. The intensity histogram of an image represents the distribution of the ——— values in an image.

A pixel **B** RGB **C** grey **D** photo

160. ——— improves the visualization of small isolated hot areas by enhancing the contrast.

A Contrast rendering **B** Sharpening **C** Voxel projection **D** MIP

161. Voxel gradient shading is the most successful technique to produce illuminated and shaded surfaces.

A True **B** False

162. The purpose of ——— is to ensure that the performance of equipment complies with the specifications established in the sales contract.

A acceptance testing **B** routine quality control **C** integration testing **D** smoke/sanity testing

163. An increase in the level of ——— results in poorer discrimination of structures in the darker parts of the image.

A motion **B** ambient light **C** noise **D** interference

CHAPTER 15: **DEVICES FOR EVALUATING IMAGING SYSTEMS**

164. ——— is the process by which the performance level of a product is measured and then compared against the existing standards.

A Quality management **B** Quality improvement **C** Quality control **D** Quality assurance

165. This test shows the current status of the gamma camera and allows monitoring of any possible deterioration in its performance:

A integrity **B** precision **C** resolution **D** uniformity

166. ——— phantoms are made of lead strips embedded into plastic and typically arranged in four quadrants.

A Bar **B** Defrise **C** Triple-point source **D** Carlson

167. ——— phantoms are used for measuring the SPECT resolution in air or measuring centre of rotation (COR) alignment.

A Bar **B** Defrise **C** Triple-point source **D** Carlson

168. The ——— phantom is frequently used for evaluating the tomographic uniformity, image contrast, noise, and linearity.

A bar **B** Defrise **C** triple-point source **D** Carlson

169. ——— phantoms are designed for measuring the performance of small animal imaging systems.

A Bar **B** Defrise **C** Triple-point source **D** Carlson

170. The scatter phantom is used to measure the count rate performance of PET scanners in the presence of scatter.

A True **B** False

171. ——— models simulate the organs with geometric primitives such as ellipsoids, cylinders, spheres and rectangular ellipsoids.

A Voxelized computational **B** Mathematical **C** Hybrid computational **D** Geometric

172. SimSET is a simulation package that can simulate PET and SPECT emission tomography systems using ——— simulations.

A bootstrap **B** Bayesian **C** Monte Carlo **D** Markov chain

173. The ——— level of acceptance testing is the testing performed after the scanner arrives at the site.

A first **B** second **C** third **D** fourth

174. The ——— should produce reference tests during acceptance testing.

A user **B** engineer **C** manufacturer **D** medical physicist

CHAPTER 16: **FUNCTIONAL MEASUREMENTS IN NUCLEAR MEDICINES**

175. Images may be used for non-imaging measurements but only to provide ——— for subsequent quantification of function.

A parameters **B** baseline data **C** regions of interest **D** supplemental information

176. The original radioisotope used in the measurement of thyroid function, ^{131}I, has been replaced by ^{99m}Tc and:

A ^{123}I **B** ^{129}I **C** ^{132}I **D** ^{134}I

177. The basis of measurements of most renal functions is ——— obtained by imaging the kidneys using a gamma camera.

A filtrate **B** tubular reabsorption levels **C** the Glomerular-filtration rate **D** time activity curves

178. The two main classes of cardiac function are blood flow in the ——— and in the blood pool and ventricles.

A pericardium **B** myocardium **C** endocardium **D** aorta

179. Gamma camera images, unlike X ray ones, are always subject to lack of counts and are, therefore, prone to statistical errors.

A True **B** False

CHAPTER 17: **QUANTITATIVE NUCLEAR MEDICINE**

180. As alternatives to manually drawing ROI boundaries, semi-automatic and automatic methods use ——— techniques.

A organ mapping **B** slice specification **C** edge detection **D** thermal imaging

181. The ——— PVE correction method can only be used to correct the spillover between two structures.

A image reconstruction **B** deconvolution **C** RC **D** geometric transfer matrix

182. Bias is the difference between a population ——— of the measurements or test results and an accepted reference or true value.

A average **B** mean **C** median **D** range

CHAPTER 18: **INTERNAL DOSIMETRY**

183. The time-integrated activity equals the number of ——— that take place in a certain source region.

A absorbed doses **B** pass throughs **C** grays **D** decays

184. The total mean absorbed dose to the target region $D(r_T)$ is given by ——— the separate contributions from each source region r_S.

A summing **B** subtracting **C** multiplying **D** dividing

185. The S value for a certain radionuclide and source–target combination is generated from ——— simulations in a computer model.

A bootstrap **B** Bayesian **C** Monte Carlo **D** Markov chain

186. The absorbed fractions for photons and electrons vary according to the ——— energy and the volume/mass of the target region.

A average **B** initial **C** final **D** continuous

187. ——— means that the energy entering the volume must equal the energy leaving the volume for both charged and uncharged radiation.

A Radiation equilibrium **B** Radiation congruence **C** Radiation uniformity **D** Radiation stasis

188. Dosimetry on a(n) ——— level could be performed from activity quantification using either 2-D or 3-D images.

A organ **B** skin **C** internal **D** voxel

189. The concept of ——— (dVhs) can be used to display the non-uniformity in the absorbed dose distribution from radionuclide procedures:

A True **B** False

CHAPTER 19: **RADIONUCLIDE THERAPY**

190. Bony metastases arise predominantly from prostate and ——— cancer.

A bone **B** thyroid **C** breast **D** lung

191. There are several types of neuroendocrine cancer, including ———, which originates in the chromaffin cells of the adrenal medulla.

A adrenal cancer **B** pheochromocytoma **C** medullary thyroid carcinoma **D** carcinoid tumours

192. Leukaemia and ——— account for nearly 50% of cancer cases in children.

A retinoblastoma **B** neuroblastoma **C** bone cancer **D** lymphoma

193. ——— corrections are frequently overlooked in the imaging of patients undergoing radionuclide therapy.

A Scatter **B** Sensitivity **C** Dead time **D** Attenuation

CHAPTER 20: **MANAGEMENT OF THERAPY PATIENTS**

194. In radionuclide therapy nuclear medicine, most of the occupational exposures come from ——— which emits 356 keV photons.

A ^{123}I **B** ^{129}I **C** ^{131}I **D** ^{134}I

195. The IAEA's safety reports series No. 40 [20.7] recommends cessation of breast-feeding for a patient given 5550 Mbq of ^{131}I-NaI.

A True **B** False

196. For ——— patients, there is no need for collection of excreta and ordinary toilets can be used.

A therapy **B** diagnostic **C** adult **D** young

197. ——— is required to source storage, preparation areas and rooms for hospitalized patients undergoing radionuclide therapy.

A Contactless entry **B** Climate control **C** Control of access **D** Ease of access

198. Patients in medical confinement should be resurveyed ——— at the point of maximal uptake of the radiopharmaceutical.

A every hour **B** every other day **C** twice a day **D** each day

199. For dialysis patients, there may be ——— contamination of disposable items (e.g. liners and waste bags), which may require storage.

A slight **B** mild **C** moderate **D** excessive

200. The dose constraints applying to pathology staff responsible conducting autopsies will be either those for the general public or those for:

A incidental exposure **B** researchers **C** radiation workers **D** medical workers

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