CHAPTER 1: **FUNDAMENTALS OF ATOMIC AND NUCLEAR PHYSICS**

1. Regarding electromagnetic radiation, the amplitude refers to the intensity of the wave.

A True **B** False

2. When interactions with matter are considered, electromagnetic radiation is generally treated as series of individual particles, known as:

A orbitals **B** neutrons **C** photons **D** protons

3. The minimum energy required to ionize an atom, i.e. to remove an electron, is known as the ionization:

A lysis **B** reduction **C** latency **D** potential

4. The idea of a dense central nucleus surrounded by orbiting electrons was first proposed by ——— in 1911.

A Rizzo **B** Rutherford **C** Rosiello **D** Roberts

5. The probability of emission of a fluorescent X ray is known as the fluorescent:

A surplus **B** yield **C** production **D** output

CHAPTER 2: **INTERACTIONS OF RADIATION WITH MATTER**

6. The interactions of radiations such as photons and electrons are stochastic and obey the laws of chance.

A True **B** False

7. A characteristic X ray is also known as a ——— X ray.

A fluorescent **B** coincidental **C** deflected **D** compton

8. When a high energy photon passes near to an atomic nucleus, the photon may interact with the nuclear coulomb field by a process called:

A pair appropriation **B** pair lysing **C** pair reduction **D** pair production

9. The equation describing the exponential attenuation of a photon beam is known as:

A Baird's law **B** Blackwood's law **C** Beer's law **D** Busby's law

10. There are two main mechanisms of energy loss by electrons: ionizational or collisional losses and radiative losses or:

A backenhörnchen **B** bremsstrahlung **C** badeanstalt **D** bakterienkunde

CHAPTER 3: **FUNDAMENTALS OF DOSIMETRY**

11. Kerma is the acronym for kinetic energy ——— per unit mass.

A reacted **B** radiated **C** released **D** reabsorbed

12. Kerma is defined for ——— ionizing radiation — uncharged particles such as photons and neutrons.

A indirectly **B** directly **C** coincidental **D** scatter

13. Absorbed dose is expressed in the same units as kerma, i.e. joules per kilogram (J/kg) or:

A gray (Gy) **B** electron-volt (eV) **C** becquerel (Bq) **D** picocurie (pCi)

14. Determination of absorbed dose in an extended medium generally requires the use of a detector inside the medium.

A True **B** False

15. W.H. Bragg began the development of the Bragg–Gray cavity theory in:

A 1899 **B** 1927 **C** 1895 **D** 1910

CHAPTER 4: **MEASURES OF IMAGE QUALITY**

16. Most imaging systems are either approximately linear or can be linearized, or can be treated as being linear over a small range of signals.

A True **B** False

17. A digital image is only defined as discrete points in space, called ——— points.

A inversion **B** sampling **C** cohesive **D** latent

18. In the absence of blurring, the ratio of the image contrast to the subject contrast is defined as the ——— of the imaging system.

A tertiary function **B** passage function **C** transfer function **D** development function

19. The presampling MTF measurement starts with imaging a well defined edge placed at a small angle (———) to the pixel matrix/array.

A 3.5–7° **B** 7–10.5° **C** 12-15° **D** 1.5–3°

20. In general, the high contrast resolution is limited by the intrinsic blurring of the imaging system.

A True **B** False

CHAPTER 5: **X RAY PRODUCTION**

21. The production of X rays involves the bombardment of a thick target with energetic:

A hydrogen atoms **B** electrons **C** protons **D** neutrons

22. Principal components of an X ray include an electron source from a heated ——— filament.

A promethium **B** niobium **C** rubidium **D** tungsten

23. For common radiographic applications, a high ——— yield is mandatory, requiring materials with high atomic numbers.

A bußmann **B** brotkopf **C** bremsstrahlung **D** brünnhof

24. A failing tube vacuum, resulting from leakage or degassing of the materials, causes increased ionization of the gas molecules, which:

A slows down the electrons **B** speeds up the electrons **C** decreases electron count **D** increases electron count

25. The effect of added filtration on the X ray output is an increase in the mean photon energy and half value ——— (HVL).

A lysis **B** latency **C** layer **D** luminescence

CHAPTER 6: **PROJECTION RADIOGRAPHY**

26. Radiographs are a 2-D representation of a ——— object.

A 3-D **B** 4-D **C** 5-D **D** 1-D

27. The image size of objects depends on their actual size and on the OID and projection direction, leading to ambiguity.

A True **B** False

28. For an isotropic point source, the X ray beam intensity is ——— to the square of the distance from the source.

A conditionally proportional **B** not related **C** inversely proportional **D** directly proportional

29. Any increase in the OID leads to a reduction in image sharpness due to the geometric blur of the ——— spot.

A prime **B** salient **C** median **D** focal

30. A good grid will eliminate 80–90% of the scatter, while transmitting at least ——— of the useful beam.

A 50% **B** 75% **C** 45% **D** 95%

CHAPTER 7: **RECEPTORS FOR PROJECTION RADIOGRAPHY**

31. Conversion efficiency can be re-expressed as the conversion factor, i.e. in terms of the number of ——— particles released per X ray.

A secondary **B** gamma **C** alpha **D** primary

32. The gain fluctuation noise can be determined experimentally using the ——— height spectrum (PHS).

A pulse **B** parameter **C** primary **D** pixel

33. As the energy of the K fluorescent X ray is below the K edge, it has a(n) ——— versus the original incident X ray photon.

A zero interaction probability **B** stronger interaction probability **C** smaller interaction probability **D** equal interaction probability

34. The original screens used until the ——— were calcium tungstate.

A 1960s **B** 1980s **C** 1970s **D** 1990s

35. Film requires 3–10 photons per grain before a developable grain can be created.

A True **B** False

CHAPTER 8: **FLUOROSCOPIC IMAGING SYSTEMS**

36. Fluoroscopic imaging trades the high signal to noise ratio (SNR) of radiography for high temporal resolution.

A True **B** False

37. ——— gain is the product of the electronic gain and minification gain and is a measure of the overall system gain.

A Opacity **B** Density **C** Contrast **D** Brightness

38. ——— in fluoroscopic imaging usually stem(s) from image distortions caused by the image chain components.

A Noise **B** A lack of sharpness **C** Artefacts **D** Poor contrast

39. Blooming is caused by the input of signals to the video camera that exceed its dynamic range.

A True **B** False

40. ——— angiography is an adjunct imaging mode used most often in vascular, interventional and neurointerventional radiology.

A Orbital **B** Rotational **C** Circular **D** Revolution

CHAPTER 9: **MAMMOGRAPHY**

41. A typical mammographic screening examination consists of ——— views of each breast.

A three to four **B** five **C** one or two **D** seven

42. On modern equipment, the typical nominal focal spot size for contact mammography is:

A 0.1 mm **B** 0.7 mm **C** 1.5 mm **D** 0.3 mm

43. It is typical to use focused linear grids in mammography, with grid ratios from 3.5:1 to:

A 5:1 **B** 7:1 **C** 10:1 **D** 15:1

44. It has been recommended that illuminators for film mammograms be capable of producing a luminance of at least:

A 1000 cd/m2 **B** 3000 cd/m2 **C** 7000 cd/m2 **D** 9000 cd/m2

45. Mammographic images are generally acquired at a tube voltage ~ ——— kV.

A 40 **B** 50 **C** 30 **D** 60

CHAPTER 10: **SPECIAL TOPICS IN RADIOGRAPHY**

46. The challenge to create an image of all the teeth simultaneously is achieved, in part, with the application of ——— beam CT (CBCT).

A casting **B** corner **C** cone **D** conventional

47. Digital image capture can be achieved from an intensifying screen that is linked to a ——— coupled device (CCD) camera.

A conventional **B** casting **C** central **D** charge

48. Radiosensitive organs include the red bone marrow of the mandible and the brain.

A True **B** False

49. In DXA, the ——— score is used to diagnose low bone mass in young adults and children.

A Z **B** X **C** S **D** Q

50. Conventional tomography uses the principle of ——— to remove overlying structures from a radiological image.

A patient movement **B** image blurring **C** computer enhancement **D** post-processing techniques

CHAPTER 11: **COMPUTED TOMOGRAPHY**

51. A profile from each view is achieved primarily by using a detector ——— generally consisting of 800–900 detector elements.

A intersection **B** sphere **C** arc **D** tunnel

52. Owing to the high X ray flux required for CT, the X ray tube uses a ——— anode designed to withstand and dissipate high heat loads.

A tungsten **B** tellurium **C** terbium **D** technetium

53. The transformation from a polar coordinate system to a cartesian coordinate system may lead to artefacts in the reconstructed image.

A True **B** False

54. The SPR (scan ——— radiograph) is acquired with a static (non-rotating) X ray tube, a narrowly collimated fan beam and a moving table.

A procedure **B** protective **C** perception **D** projection

55. ——— resolution is the ability to resolve fast moving objects in the displayed CT image.

A Temporary **B** Latent **C** Tertiary **D** Temporal

CHAPTER 12: **PHYSICS OF ULTRASOUND**

56. Ultrasound accounted for approximately ——— of all imaging examinations performed worldwide at the beginning of the 21st century.

A 15% **B** 5% **C** 25% **D** 50%

57. The term ultrasound refers to acoustic waves at frequencies greater than the maximum frequency audible to humans - nominally:

A 20 kHz **B** 30 kHz **C** 40 kHz **D** 50 kHz

58. The term ——— encompasses all mechanisms by which the energy of a wave is dissipated as it propagates.

A sequencing **B** collimation **C** conation **D** attenuation

59. Scattering occurs when an ultrasonic wave encounters a variation in the acoustic impedance of the medium.

A True **B** False

60. The Doppler effect was studied in ——— by Christian Doppler.

A 1927 **B** 1915 **C** 1842 **D** 1892

CHAPTER 13: **ULTRASOUND IMAGING**

61. The earliest ultrasound systems would display the result of a single pulse acquisition in 1-D A-mode (——— mode) format.

A aliasing **B** acoustic **C** attenuation **D** amplitude

62. Grating lobes produce echoes from off axis targets that appear as ——— in images.

A artefacts **B** shadows **C** bright spots **D** a decrease in resolution

63. The frame rate of an ultrasound system is determined by the ——— resolution, the FOV, and the number of transmit focal zones.

A superior **B** lateral **C** axial **D** peripheral

64. **Gas filled, encapsulated microbubbles with sizes typically from ——— are used as blood pool contrast agents in diagnostic ultrasound.**

A 6 to 10 µm diameter **B** 15 to 24 µm diameter **C** 1 to 4 µm diameter **D** 30 to 40 µm diameter

65. **Colour Doppler and pulsed wave Doppler are sometimes combined in a mode known as:**

A tertiary Doppler **B** triplex Doppler **C** III Doppler **D** sequencing Doppler

CHAPTER 14: **PHYSICS OF MAGNETIC RESONANCE**

66. **Aside from a few exceptions encountered in research, MRi involves imaging the nucleus of the hydrogen atom, i.e. the proton.**

A True **B** False

67. **At a field strength of 1.5 T, in a collection of about 2 million spins, there will only be a net of ——— aligned with the field.**

A one thousand spins **B** one million spins **C** ten spins **D** a single

68. **The time between subsequent excitations is the ——— time.**

A acceleration **B** latent **C** flux **D** repetition

69. **In vivo, the protons of hydrogen atoms in water and fat are the most abundant source of MR signal.**

A True **B** False

70. **The field of view (FOV) and spatial resolution of the reconstructed image are determined by the manner in which the ——— is sampled.**

A z-space **B** k-space **C** y-space **D** q-space

CHAPTER 15: **MAGNETIC RESONANCE IMAGING**

71. **In practice, this solenoid design has been reduced to a number of coils, typically ———, separated by spacers.**

A almost two hundred **B** twenty five **C** four or six **D** ten

72. **The radiofrequency (RF) system comprises the generation of analogue audio frequency pulses modulating the RF ——— frequency.**

A Larmor **B** Fasquelle **C** Fecteau **D** Flavigny

73. **In the gradient echo sequence, the slice select pulse is generally a small angle (typically ———), allowing a very short TR to be employed.**

A 5–20° **B** 33° **C** 3° **D** 25–30°

74. **Bulk flow in blood vessels is most often measured by ———, which allows the direction and velocity of flowing blood to be measured.**

A segment contrast MRI **B** phase contrast MRI **C** diploid contrast MRI **D** ion-enhanced contrast MRI

75. **Aliasing or '———' occurs where the sample extends outside of the imaging FOV.**

A swap artifact **B** peripheral artifact **C** wrap around **D** ghost artifact

CHAPTER 16: **DIGITAL IMAGING**

76. **Pixels are typically:**

A triangular **B** square **C** circular **D** ovoid

77. **Display devices translate digital driving levels into light intensity (———) that is perceived by the human visual system.**

A retin translation **B** optication **C** luminance **D** projection

78. **The mechanism of scanning is transmissive rather than reflective, the range of ——— density (OD) of the film is high.**

A optical **B** overt **C** orbital **D** offset

79. **The first open standard effort for medical imaging was the ACR-NEMA standard published in:**

A 1981 **B** 1982 **C** 1983 **D** 1985

80. DICOM defines the combination of a service class and an IOD as a service–object ——— (SOP) class.

A plate **B** picture **C** position **D** pair

CHAPTER 17: **IMAGE POST-PROCESSING AND ANALYSIS**

81. ——— align images of different modalities and to find corresponding anatomical locations in images from different subjects.

A Intercross algorithms **B** Registration algorithms **C** Completion algorithms **D** Resolution algorithms

82. ——— is an operation that changes the observable quality of an image in terms of resolution, contrast and noise.

A Sifting **B** Modification **C** Speckling **D** Filtering

83. An edge in image processing is a discontinuity in the ——— function.

A brightness **B** intensity **C** density **D** scale of gray

84. The problem of finding objects in images, known as ———, is the central problem in the field of image analysis.

A segmentation **B** dissolution **C** demarcation **D** reduction

85. Image registration is the problem of finding ——— between images.

A density variations **B** a single difference **C** similarities **D** transformations

CHAPTER 18: **IMAGE PERCEPTION AND ASSESSMENT**

86. The ——— is the light sensitive part of the eye.

A cornea **B** retina **C** pupil **D** iris

87. A model for the contrast sensitivity of the human visual system has been developed by Barten.

A True **B** False

88. The GSDF (Greyscale ——— Display Function) defines the relationship between JND and display luminance for the standard target.

A Sensory **B** System **C** Standard **D** Station

89. The probabilistic approach to perception is also referred to as '——— theory'.

A determination **B** selection **C** decision **D** outcome

90. The '———' of the observer, is the decision threshold at which an observer will call an image 'normal' (negative) or 'abnormal' (positive).

A regulating point **B** finishing point **C** determining point **D** operating point

CHAPTER 19: **QUALITY MANAGEMENT**

91. 'Quality ———' form a set of accepted criteria against which the quality of particular activities can be assessed.

A expectations **B** standards **C** goals **D** measures

92. There are five stages applicable to QA for imaging equipment. The (ii) step is:

A Routine performance testing **B** Critical examination **C** Acceptance **D** Commissioning

93. A(n) ——— is appropriate when there could be radiation protection implications associated with an incorrect installation.

A critical examination **B** routine performance testing **C** commissioning **D** acceptance

94. The QC test '———' indicates that performance parameters are not changing over the period between QC tests.

A Repeatability **B** Achievable **C** Consistency **D** Desirable

95. Digital systems for radiography have an indication of the detector response to radiation, which is referred to as the exposure index.

A True **B** False

CHAPTER 20: **RADIATION BIOLOGY**

96. Radiation biology (radiobiology) is the study of the action of ionizing radiations on:

A living matter **B** specific cells **C** cells in fetal development **D** cancer cells

97. Somatic effects are divided into deterministic effects (also known as '——— reactions') and stochastic effects.

A potentially fatal **B** latent **C** cerebral **D** tissue

98. The backbone of the DNA strand is made of alternating sugar and ——— groups.

A amino **B** hydroxyl **C** carbonyl **D** phosphate

99. Radiosensitivity differs throughout the cell cycle with, in general, late ——— phase being most radioresistant.

A G1 **B** S **C** M **D** G2

100. The time interval between exposure to irradiation and the appearance of cancer is known as the ——— period.

A latency **B** suspension **C** dormancy **D** inactivity

CHAPTER 21: **INSTRUMENTATION FOR DOSIMETRY**

101. Measurements of absorbed dose (or air ———) are required in varying situations in diagnostic radiology.

A spin **B** kerma **C** cubit **D** kernel

102. For diagnostic dosimeters, the X ray spectrum (often referred to as the radiation or beam ———) is specified by the beam HVL.

A element **B** trait **C** quality **D** nature

103. Per the IEC-61674 standard, the leakage current shall not exceed ——— of the minimum effective air kerma rate for the range in use.

A 5% **B** 3% **C** 1% **D** 15%

104. A MOSFET is a miniature ——— transistor.

A germanium **B** gallium arsenide **C** carbon **D** silicon

105. Radiochromic films (e.g. Gafchromic®) contain colourless dyes (diacetylene) that become ——— after exposure.

A green **B** orange **C** blue **D** yellow

CHAPTER 22: **PATIENT DOSIMETRY**

106. The annual frequency of X ray examinations is ——— per 1000 individuals worldwide.

A 520 **B** 360 **C** 90 **D** 40

107. It is good practice to construct a TLD dosimeter comprising at least ——— TLD chip(s).

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

108. In the absence of a ——— meter, IAK or entrance surface air kerma are reasonable alternatives.

A APK **B** KAP **C** KKP **D** AKP

109. Measurements made using ——— phantoms are included in national QC programmes for mammography.

A PMAA **B** PMMA **C** PAAM **D** PMAM

110. As a result of the statistical nature of ——— simulations, the organ dose conversion coefficients have associated statistical errors.

A Monaco **B** Villefranche Sur Mer **C** Monte Carlo **D** Nice

CHAPTER 23: **JUSTIFICATION AND OPTIMIZATION IN CLINICAL PRACTICE**

111. Clinical ——— is a systematic review of the medical procedures against agreed standards for good procedures.

A survey **B** scrutiny **C** analysis **D** audit

112. Justification of medical exposures is the responsibility of both the radiological medical practitioner and the referring medical practitioner.

A True **B** False

113. The objective of ——— is to detect the disease while treatment will still have the greatest effect.

A radiation therapy **B** a scout film **C** screening **D** post-evac images

114. To further reduce local skin dose, ——— can be dynamically inserted into the X ray beam, provided the generator power is sufficient.

A additional radon filtration **B** additional copper filtration **C** additional iron filtration **D** additional carbon filtration

115. In fluoroscopy, reducing the radius of the primary beam from 12 cm to 9 cm will ——— the kerma area product.

A reduce by 25% **B** reduce by 15% **C** almost halve **D** reduce by 35%

CHAPTER 24: **RADIATION PROTECTION**

116. CT has been shown to be the greatest contributor to medical radiation exposure, accounting for 7.9% of examinations, but:

A 17% of the dose **B** 27% of the dose **C** 37% of the dose **D** 47% of the dose

117. The ——— for a radiology facility has responsibilities to oversee and implement radiation protection matters in the facility.

A radiologist **B** radiation protection officer **C** medical physicist **D** hospital chief-of-staff

118. In practice, the term 'weakly penetrating' radiation usually applies to photons below ——— and to β radiation.

A 45 keV **B** 15 keV **C** 35 keV **D** 5 keV

119. Protective eye wear, especially with side protection, can give a reduction of up to ———% for the dose to the eyes from scatter.

A 75 **B** one half **C** 80 or 90 **D** 15

120. The NCRPs factor U, the ——— factor, is the fraction of time that the primary beam is directed towards a particular primary barrier.

A use **B** utilization **C** unified **D** united

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19		43		67		91		115	
20		44		68		92		116	
21		45		69		93		117	
22		46		70		94		118	
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24		48		72		96		120	