Radiation Oncology Handbook1 Test Questions
(hint: print questions & circle answers before starting online test)
Chapters 1 to 9

Chapter 1

1. Symbols for physical quantities are set in Italic type, while symbols for units are set in _____ type.
A. Greek
B. Hebrew
C. Roman
D. English

2. Which of the following units of current are used in radiation physics?
A. mA
B. μA
C. nA and pA
D. all of the above

3. Which of the following are fundamental forces in nature?
A. Strong and Weak
B. EM
C. Gravitational
D. all of the above

4. Radiation can be classified into which of the following categories?
A. Non-ionizing radiation
B. Ionizing radiation
C. Electrified radiation
D. Both A and B

5. The branch of medicine that uses radiation in the treatment of disease is called radiotherapy, therapeutic radiology or radiation oncology.
A. TRUE
B. FALSE

6. _____ are known as nucleons and form the nucleus of the atom.
A. Protons
B. Neutrons
C. Electrons
D. Both A and B

7. _____ is characterized by a transformation of an unstable nucleus into a more stable entity that may be unstable and will decay further through a chain of decays until a stable nuclear configuration is achieved.
A. Electricity
B. Radioactivity
C. Radio frequency
D. Pasteurization

8. The _____ of a radioactive substance is the time during which the number of radioactive nuclei decays to half of its initial value.
A. half-life $t_{1/2}$
B. therapeutic index
C. toxicity
D. pasteurization

9. _____ occurs when a stable parent isotope P is bombarded with neutrons in a nuclear reactor and transforms into a radioactive daughter D that decays into a granddaughter G.
A. Radioactivity
B. Ionization
C. Activation of nuclides
D. none of the above

10. Which of the following are modes of radioactive decay?
A. α, b$^-$ *and* b$^+$ decay
B. electron capture γ
C. internal conversion

D. all of the above

11. As an energetic electron traverses matter, it interacts with matter through _____ with atomic orbital electrons and atomic nuclei.
A. electrification
B. Coulomb interactions
C. chemical reaction
D. none of the above

12. Atomic excitations and ionizations result in collisional energy losses and are characterized by collision (ionization) stopping powers.
A. TRUE
B. FALSE

13. Which of the following are types of indirectly ionizing photon radiations?
A. Bremsstrahlung and γ rays
B. Characteristic X rays
C. Annihilation radiation
D. all of the above

14. The _____ is defined as that thickness of the material that attenuates the photon beam intensity to 50% of its original value.
A. radioactivity
B. reduction
C. half-value layer (HVL)
D. lethal dose

15. In _____ the photon interacts with a bound orbital electron (i.e. with the combined action of the whole atom).
A. photoelectric effect
B. coherent (Rayleigh) scattering
C. compton effect
D. pair production

Chapter 2
16. Which of the following quantities are used to describe a monoenergetic ionizing radiation beam?
A. particle and energy fluence
B. particle fluence rate
C. energy fluence rate
D. all of the above

17. _____ is an acronym for kinetic energy released per unit mass.
A. Kerma
B. Rem
C. CEMA
D. Stopping power

18. The unit of CEMA is _____.
A. joule per kilogram (J/kg)
B. rem
C. rad
D. dE/dx

19. The _____ is defined as the mean energy imparted by ionizing radiation to matter of mass in a finite volume.
A. half-value layer (HVL)
B. gonadal dose
C. absorbed dose
D. lethal dose

20. The _____ is defined as the expectation value of the rate of energy loss per unit path length (dE/dx) of the charged particle.
A. linear stopping power
B. atomic power
C. absorbed dose
D. lethal dose

21. The _____ is a geometric mean value of all ionization and excitation potentials of an atom of the absorbing material.
A. classical electron radius
B. mean excitation potential (I)
C. projectile charge
D. shell correction

22. The energy transferred to electrons by photons can be expended through which of the following ways?
A. collision interactions
B. radiative interactions
C. pasteurization
D. Both A and B

23. Which of the following is a formula for total kerma?
A. $K = K_{col} - K_{rad}$
B. $K = K_{col} / K_{rad}$
C. $K = K_{col} + K_{rad}$
D. $K = K_{col} \times K_{rad}$

24. The _____ was the **first** cavity theory developed to provide a relation between the absorbed dose in a dosimeter and the absorbed dose in the medium containing the dosimeter.
A. Bragg–Gray cavity theory
B. Big Bang theory
C. Planck's theory
D. Inverse Square Law

25. A _____ can be defined generally as any device that is capable of providing a reading that is a measure of the average absorbed dose deposited in its sensitive volume by ionizing radiation.
A. IP processor
B. *dosimeter*
C. PACS
D. gonadal shielding

Chapter 3

26. Which of the following are the desirable radiation dosimeter properties in radiation therapy?
A. accuracy and precision
B. linearity, dose or dose rate dependence
C. energy response, directional dependence and spatial resolution
D. all of the above

27. The _____ of dosimetry measurements specifies the reproducibility of the measurements under similar conditions and can be estimated from the data obtained in repeated measurements.
A. half-value layer (HVL)
B. quantity
C. precision
D. lethal dose

28. The response of a dosimetry system M/Q is generally a function of radiation beam _____.
A. half-value layer (HVL)
B. quantity
C. quality (energy)
D. toxicity

29. The variation in response of a dosimeter with the angle of incidence of radiation is known as the _____ of the dosimeter.
A. directional dependence
B. physical properties
C. size
D. type

30. _____ is basically a gas filled cavity surrounded by a conductive outer wall and having a central collecting electrode.
A. An ionization chamber
B. TLDs

C. The film-badge
D. none of the above

31. The most popular cylindrical ionization chamber is the _____ chamber designed by Farmer and originally manufactured by Baldwin, but now available from several vendors, for beam calibration in radiotherapy dosimetry.
A. 0.1 cm^3
B. *0.6 cm^3*
C. 6 cm^3
D. 16 cm^3

32. A typical H&D curve for a radiographic film is made of which of the following regions?
A. Fog and Toe
B. Linear portion
C. Shoulder
D. all of the above

33. Radiochromic films are generally less sensitive than radiographic films and are useful at higher doses, although the dose response non-linearity should be corrected for in the upper dose region.
A. TRUE
B. FALSE

34. Which of the following detects the thermoluminescence light emission and convert it into an electrical signal linearly proportional to the detected photon fluence in TLDs?
A. X-ray tube
B. Cathode
C. PMT
D. Anode

35. A silicon diode dosimeter is a _____ junction diode.
A. a- b
B. x- z
C. p–n
D. d-f

Chapter 4
36. Recommendations regarding dosimetric quantities and units in radiation protection dosimetry are set forth by the _____.
A. ARRT
B. *International Commission on Radiation Units and Measurements (ICRU)*
C. ASRT
D. CDC

37. Radiation instruments used as survey monitors are either _____ filled detectors or solid state detectors.
A. iodine
B. *gas*
C. barium sulfide
D. gadolinium

38. _____ operate in the proportional region so that the photon background can be easily discriminated against.
A. Neutron area survey meters
B. TLDs
C. The film-badge
D. X-ray transformer

39. Geiger–Müller (GM) counters exhibit strong energy dependence at low photon energies and are not suitable for use in pulsed radiation fields.
A. TRUE
B. FALSE

40. The ICRP has stated that, in practice, it is usually possible to achieve an uncertainty of about _____ at the 95% confidence level ($k = 2$) for measurements of radiation fields in laboratory conditions.
A. 1%
B. 3%

C. 10%
D. 90%

Chapter 5
41. The X rays were discovered by Roentgen in _____.
A. 1800
B. 1830
C. 1855
D. 1895

42. _____ are produced when electrons with kinetic energies between 10 keV and 50 MeV are decelerated in special metallic targets.
A. Magnetic waves
B. *X rays*
C. Soundwaves
D. Radioisotopes

43. _____ result from Coulomb interactions between the incident electrons and atomic orbital electrons of the target material (collision loss).
A. Pair production
B. Sonowave
C. Characteristic X rays
D. Radio frequency

44. _____ result from Coulomb interactions between the incident electron and the nuclei of the target material.
A. Magnetic waves
B. *Bremsstrahlung X rays*
C. Soundwaves
D. Radioisotopes

45. _____ are used in diagnostic radiology for diagnosis of disease and in radiation oncology (radiotherapy) for treatment of disease.
A. Magnetic waves
B. *X rays*
C. Soundwaves
D. Radioisotopes

46. X rays produced by electrons with kinetic energies between 10 keV and 100 keV are called _____.
A. nanovoltage X rays
B. megavoltage X rays
C. orthovoltage X rays
D. superficial X rays

47. Which of the following are the main components of a radiotherapeutic X ray machine?
A. an X ray tube including ceiling or floor mount
B. a target cooling system and a control console
C. an X ray power generator
D. all of the above

48. Most of the electron kinetic energy deposited in the X ray target (~99%) is transformed into _____ and must be dissipated through an efficient target cooling system.
A. heat
B. x-rays
C. radio frequency
D. digital signal

49. Which of the following are the important characteristics of radioisotopes in external beam radiotherapy?
A. High Y ray energy and specific activity
B. Relatively long half-life
C. Large specific air kerma rate constant
D. all of the above

50. Treatment machines incorporating Y ray sources for use in external beam radiotherapy are called _____.
A. PACS

B. IP processor
C. teletherapy machines
D. histograms

51. _____ of teletherapy machines provide square and rectangular radiation fields typically ranging from 5 × 5 to 35 × 35 cm2 at 80 cm from the source.
A. Step-wedge filters
B. *Collimators*
C. Grids
D. Gonadal shielding

52. Superficial and orthovoltage X ray therapy rooms are shielded with _____.
A. wood
B. *ordinary concrete (2.35 g/cm3) or lead*
C. plastic
D. aluminum

Chapter 6
53. Radiotherapy procedures fall into which of the following main categories?
A. external beam radiotherapy
B. brachytherapy
C. chemotherapy
D. Both A and B

54. Photon sources are either isotropic or non-isotropic and they emit either monoenergetic or heterogeneous photon beams.
A. TRUE
B. FALSE

55. Which of the following are the **most** common photon sources used in radiation oncology?
A. X ray machines
B. teletherapy radioisotope sources
C. linacs
D. all of the above

56. Which of the following law states that the photon fluence is inversely proportional to the square of the distance from the source?
A. Bragg–Gray cavity theory
B. Newton's law
C. Planck's theory
D. Inverse Square Law

57. In megavoltage photon beams, the surface dose depends on which of the following?
A. beam energy
B. field size
C. histogram
D. Both A and B

58. The dose region between the surface and depth in megavoltage photon beams is referred to as the _____.
A. air gap technique
B. restricted area
C. dose buildup region
D. controlled region

59. The dose delivered to the patient at the beam exit point is referred to as the _____.
A. skin entrance dose
B. *exit dose*
C. bone marrow dose
D. gonadal dose

60. External beam radiotherapy with photon beams is carried out with which of the following types of treatment machines?
A. X ray units
B. isotope teletherapy units

C. linacs
D. all of the above

61. Which of the following general groups of field shape are used in radiotherapy?
A. square
B. rectangular
C. circular and irregular
D. all of the above

62. Square and rectangular fields are usually produced with _____ installed in radiotherapy machines.
A. collimators
B. step-wedge filters
C. cones
D. shadow shields

63. The collimator factor (CF) is usually measured with _____ with a buildup cap of a size large enough to provide maximum dose buildup for the given energy beam.
A. ionization chamber
B. diodes
C. TLDs
D. radio frequency

64. While backscattering is largest at very low photon energies (classical scattering), the energy of backscattered photons is small at low photon energies, causing a rapid absorption of the scattered photons in the medium.
A. TRUE
B. FALSE

65. For a given photon beam at a given SSD, the dose rate at point P (at depth z_{max} in a phantom) depends on the _____.
A. air gap technique
B. grid ratio
C. field size (*A*)
D. AEC

66. Percentage depth dose (PDD) for radiotherapy beams are **usually** systematized for _____ fields.
A. square
B. rectangular
C. circular
D. irregular

67. In radiation dose calculations, it is often desirable to separate the scatter component from the _____ at Q.
A. skin entrance dose
B. *total dose*
C. bone marrow dose
D. primary dose

68. The scatter function (*S)* depends on which of the following parameters?
A. depth (*z)*
B. field size (*A)*
C. SSD (*f)* and beam energy (*hv)*
D. all of the above

69. When multiple fields are used for the treatment of a particular tumor inside the patient, _____ are often used because they are more practical in comparison with constant SSD set-ups.
A. air gap technique
B. step-wedge filters
C. *isocentric (SAD) set-ups*
D. contrast agents

70. In _____, the radiation source moves in a circle around the axis of rotation, which is usually inside the tumor.
A. rotational radiotherapy
B. gene therapy
C. chemotherapy

D. angiography

Chapter 7

71. _____ report No. 50 recommends a target dose uniformity within +7% and −5% of the dose delivered to a well defined prescription point within the target.
A. ARRT
B. *ICRU*
C. ASRT
D. CDC

72. Modern photon beam radiotherapy is carried out with a variety of beam energies and field sizes under one of two set-up conventions: a constant source to surface distance (SSD) for all beams or an isocentric set-up with a constant source to axis distance (SAD).
A. TRUE
B. FALSE

73. _____ is a prerequisite for meaningful 3-D treatment planning and for accurate dose reporting.
A. Air gap technique
B. Step-wedge filters
C. *Volume definition*
D. Contrast agents

74. According to the ICRU Report No. 50, the _____ is the gross palpable or visible/ demonstrable extent and location of malignant growth.
A. Therapeutic index
B. *Gross Tumor Volume (GTV)*
C. lethal dose
D. none of the above

75. The clinical target volume (CTV) is an anatomical–clinical volume and is usually determined by the _____, often after other relevant specialists such as pathologists or radiologists have been consulted.
A. cardiologist
B. *radiation oncologist*
C. urologist
D. primary care physician

76. The organ at risk is an organ whose sensitivity to radiation is such that the dose received from a treatment plan may be significant compared with its tolerance, possibly requiring a change in the beam arrangement or a change in the dose.
A. TRUE
B. FALSE

77. _____ are almost **always** required for treatment time or monitor unit (MU) calculations, whether read with a calliper, from CT slices or by other means.
A. Wall buckies
B. Step-wedge filters
C. *Patient dimensions*
D. Contrast agents

78. Landmarks such as _____ are required to match positions in the treatment plan with positions on the patient.
A. *organ positions*
B. *fracture sites*
C. *x-ray tube positions*
D. *bony or fiducial marks*

79. Figure 7.2 shows the typical outlining of target volume and organs at risk for a _____ treatment plan on one CT slice.
A. thyroid
B. *prostate*
C. lungs
D. pancreas

80. _____ was initially developed to ensure that the beams used for treatment were correctly chosen and properly aimed at the intended target.

A. Fasting
B. Chemotherapy
C. *Patient simulation*
D. Contrast agents

81. *Which of the following are the simplest immobilization tools?*
A. *masking tape*
B. velcro *belts*
C. *elastic bands*
D. all of the above

82. _____ *is used to immobilized patients for the head, neck or brain area treatments.*
A. Plastic mask
B. Sand bags
C. Lead apron
D. Sheet

83. *In* radiosurgery, a _____ is attached to the patient's skull by means of screws and is used for target localization, patient set-up on the treatment machine and patient immobilization during the entire treatment procedure.
A. plastic mask
B. sand bag
C. lead apron
D. stereotactic frame

84. *Which of the following can be used to image the patient during conventional treatment simulation?*
A. *diagnostic X ray tube*
B. *fluoroscopic system*
C. chemotherapy
D. Both A and B

85. *Which of the following are determined with respect to the anatomical* landmarks visible under fluoroscopic conditions?
A. *position of the treatment isocenter*
B. *beam geometry*
C. *field limits*
D. all of the above

86. *Once the final treatment geometry has been established,* _____ *are* taken as a matter of record and are used to determine shielding requirements for the treatment.
A. blood tests
B. *radiographs*
C. cardiograms
D. none of the above

87. _____ *provide excellent soft tissue contrast, allowing for greatly* improved tumor localization and definition in comparison with conventional simulation.
A. *Computed Tomography images*
B. Nuclear medicine
C. Ultrasound scan
D. none of the above

88. _____ *is the treatment simulation of patients based solely on* Computed Tomography information.
A. Histogram
B. Chemotherapy
C. *Virtual simulation*
D. H & D curve

89. *The soft tissue contrast offered by* _____ *in areas like the brain, is* superior to that of CT, and allows small lesions to be seen easily.
A. *MRI*
B. Nuclear medicine
C. Ultrasound scan
D. Radiography

90. Which of the following types of wedge filters are currently in use?
A. *manual*
B. *motorized*
C. dynamic
D. all of the above

91. A physical wedge is an angled piece of lead or steel that is placed in the beam to produce a _____ in radiation intensity.
A. shadow
B. *gradient*
C. scatter
D. none of the above

92. Wedge angles in the range from _____ are commonly available.
A. *1º to 9º*
B. *10º to 60º*
C. *70º to 80º*
D. *90º to 100º*

93. _____ is a tissue equivalent material placed in contact with the skin to achieve either an increase in the surface dose or compensate for missing tissue.
A. Gonadal shield
B. Grid
C. *Bolus*
D. Shadow shield

94. Compensating filters can be made of almost any material, but metals such as _____ are the most practical and compact.
A. lead
B. iodine
C. barium
D. gadolinium

95. The port films can be used in which of the following ways?
A. Localization (a fast film)
B. Verification (a slow film)
C. QA/QC
D. Both A and B

Chapter 8
96. Modern high energy linacs typically provide, in addition to two megavoltage photon energies, several electron beam energies in the range from _____.
A. *1 to 2 MeV*
B. *4 to 22 MeV*
C. *44 to 88 MeV*
D. *90 to 140 MeV*

97. The typical energy loss for a therapy electron beam, averaged over its entire range, is about _____ in water and water-like tissues.
A. 0.5 MeV/cm
B. 1 MeV/cm
C. *2 MeV/cm*
D. 8 MeV/cm

98. _____ may be used for small SSD differences from the nominal SSD to make corrections to the absorbed dose for variations in air gaps between the patient surface and the applicator.
A. Bragg–Gray cavity theory
B. Newton's law
C. Planck's theory
D. Inverse Square Law

99. Which of the following processes are responsible for the sharp drop-off in the electron dose at depths beyond z_{max}?
A. scattering

B. continuous energy loss by electrons
C. step-up transformer
D. Both A and B

*100. Which of the following is the **most** important parameter that determines the electron beam output?*
A. collimator jaw setting
B. densitometer
C. gonadal shielding
D. aluminum filtration

101._____ is a special radiotherapeutic technique in which a rotational electron beam is used to treat superficial tumor volumes that follow curved surfaces.
A. *MRI*
B. *Electron arc therapy*
C. *Chemotherapy*
D. *CT*

Chapter 9
102. The ICRU has recommended an overall accuracy in tumor dose delivery of ±5%, based on an analysis of dose response data and on an evaluation of errors in dose delivery in a clinical setting.
A. TRUE
B. FALSE

103. _____ refers to a determination by measurement and/or calculation of the absorbed dose or some other physically relevant quantity.
A. Scattered radiation
B. Air gap technique
C. *Radiation dosimetry*
D. Radiation shielding

104. Which of the following types of reference dosimetry techniques are currently known in radiotherapy?
A. *Calorimetry*
B. *Fricke dosimetry*
C. Ionization chamber dosimetry
D. all of the above

105. Which of the following types of absorbed dose calorimeters are currently used in standard labs?
A. Graphite calorimeters
B. Sealed water calorimeters
C. Sensitometer and Densitometer
D. A and B only

106. _____ depends on an accurate knowledge of the radiation chemical yield of ferric ions, measured in moles produced per 1 J of energy absorbed in the solution.
A. *Calorimetry*
B. *Fricke dosimetry*
C. Ionization chamber dosimetry
D. none of the above

*107. Which of the following is the **most** practical and **most** widely used dosimeter for accurate measurement of machine output in radiotherapy?*
A. *Calorimetry*
B. *Fricke dosimetry*
C. Ionization chamber dosimetry
D. PACS

108. Which of the following types of ionization chambers may be used in reference dosimetry as absolute dosimeters?
A. *Standard free air ionization chambers*
B. *Cavity ionization chambers*
C. Phantom embedded extrapolation chambers
D. all of the above

109. Cavity ionization chambers measure the air kerma in air for energies in the range from 0.6 to 1.5 MeV by making use of the _____ relationship.
A. Bragg–Gray cavity
B. Newton's law
C. Planck's theory
D. Inverse Square Law

110. The ionization chamber based dosimetry systems are made of which of the following components?
A. *A suitable ionization chamber*
B. *An electrometer*
C. A power supply
D. all of the above

111. _____ is usually used as the sensitive gas in an ionization chamber in radiotherapy.
A. *Air*
B. *Nitrogen*
C. Helium
D. Neon

112. _____ is the most universal soft tissue substitute material, useful in both photon and electron beam measurements.
A. *Calcium*
B. *Water*
C. Iron
D. Potassium

113. When calibrating an ionization chamber, the charge measured by the chamber depends on which of the following parameters?
A. *air temperature*
B. *pressure*
C. humidity
D. all of the above

114. Electric leakage in the ionization chamber and electrometer may also occur as a consequence of the irradiation of insulators and chamber parts, cables and electronics of the measuring equipment.
A. TRUE
B. FALSE

115. All dosimetry protocols aim at determination of the quantity absorbed dose to _____.
A. *Calcium*
B. *Water*
C. Iron
D. Potassium

116. Cylindrical chambers have a central electrode, which is usually made of aluminum but can be made of graphite.
A. TRUE
B. FALSE

117. The signal (current or charge) produced by an ionization chamber is measured by _____.
A. electrometer
B. densitometer
C. kVp meter
D. focusing cup

*118._____ represents the thickness of an attenuator that decreases the measured air kerma rate in air to half of its original value.
A. Radioactivity
B. Reducer
C. Half-value layer (HVL)
D. Lethal dose (LD)

119. For electron beams with energies equal to or above 10 MeV, a cylindrical or a parallel-plate ionization chamber is used at a reference depth in a water phantom.

A. TRUE
B. FALSE

120. Which of the following is defined as the difference between the measured value of a measurand and the true value.
A. *Calculations*
B. *An error*
C. Graphs
D. Numeric values