STATEMENT OF PURPOSE AND USAGE

The Medical Dosimetrist Certification Board ("MDCB") continues to develop and administer certification examinations intended to measure skill and knowledge. Successful completion of the MDCB's examinations and certification by it is intended to act as an indicator to medical professionals, patients and the general public that an individual possesses a specific level of skill. Because persons who require the services of a Medical Dosimetrist are generally suffering from serious conditions and diseases, treatment by and with a certified expert is intended to provide a level of assurance as to the professional's qualifications.

Test integrity and security are paramount concerns. The use of legitimate study, reference and preparation materials is appropriate and expected. For that reason, the MDCB has assembled the Sample Practice Tests Manual (the "Manual") for use by candidates. The items contained in the Manual are retired test questions. They provide a candidate with examples of the type of questions, which may appear on the actual examination, and the possible format of the questions. They also demonstrate difficulty levels and may provide some information relating to test content, which has been addressed in prior examinations.

None of the items in the Manual should be relied upon for accuracy or correctness. Because of progress in the field and changes in the scientific arts, content, which may have been current when an item was in use, may no longer be accurate. What was once the best answer to a question may no longer be current. Candidates are advised that the information in the Manual should be confirmed by independent study and research. The Manual is intended to provide candidates with a general familiarity of the examination style and format and is meant to foster study and preparation. It should not be relied upon as authoritative or necessarily substantive.

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1. The most radiosensitive phase for mental retardation in the fetus from RT accidental exposure is:

   A. 0-7 weeks.
   B. 8-15 weeks.
   C. 16-24 weeks.
   D. more than 25 weeks.

2. A radioactive source is considered to be isotropic if it exhibits which of the following characteristics?
   A. Summation of the total dose is proportional to the point source.
   B. Dose at depth is variable in all directions based on the placement of the source.
   C. Intensity around the source is equal in all directions.
   D. The total dose is a function of the size of the source calculated based on kerma rate.

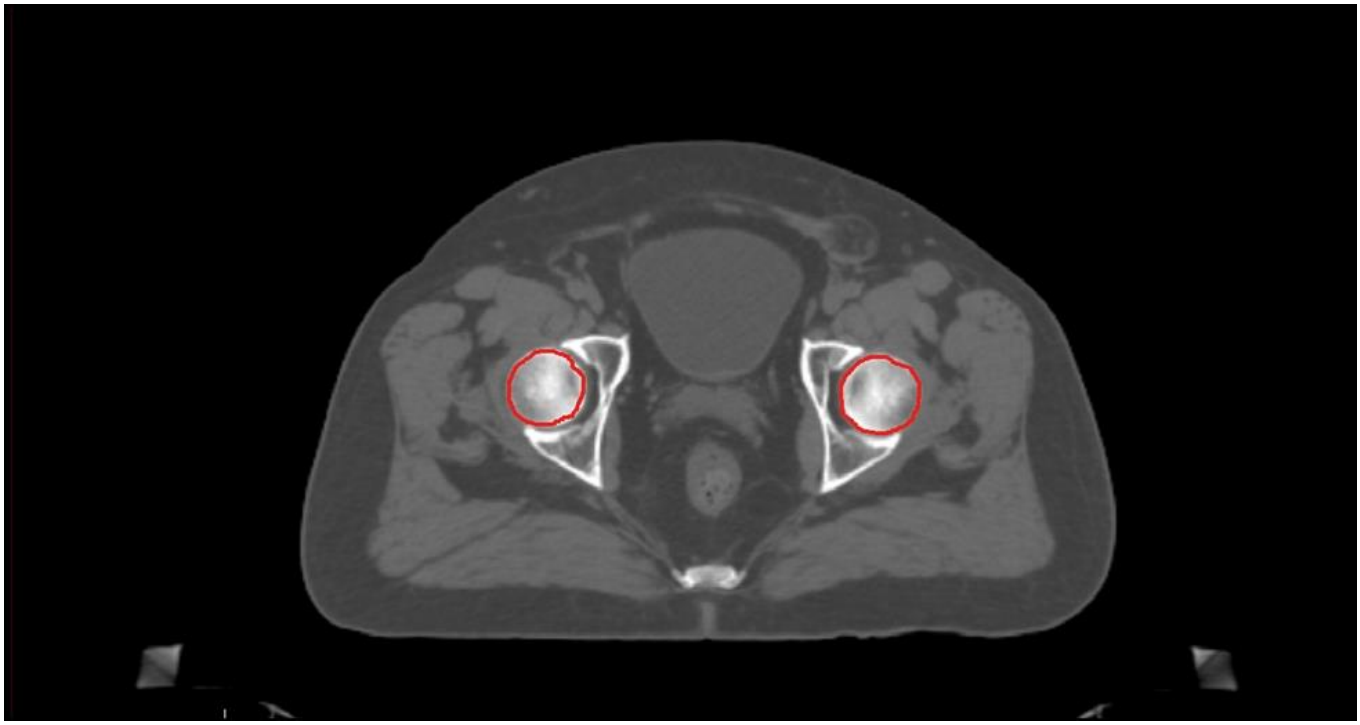
3. For which of the following malignancies has hypofractionation radiation therapy been shown to significantly improve local control compared with standard fractionation?

   A. low-grade sarcomas
   B. adult high-grade gliomas
   C. head and neck cancer
   D. inflammatory breast cancer

4. As per the American Brachytherapy Society guidelines, the dose required to treat uveal melanomas with Iodine-125 plaque brachytherapy is:
   A. 50Gy prescribed to 0.5cm depth.
   B. 65Gy prescribed to apex.
   C. 85Gy prescribed to apex.
   D. 100 Gy prescribed to 0.5cm depth.

5. Which of the following statements is true for clinical electron beams?
   A. The mean energy decreases as a quadratic function of depth.
   B. The maximum energy is the same as the most probable energy.
   C. The surface dose is inversely proportional to the electron beam energy.
   D. The most probable energy is a function of the practical range (R_p).

6. In order to avoid a 5% risk of necrosis at 5 years, what dose should the structures outlined not exceed?



A. 42 Gy
B. 52 Gy
C. 62 Gy
D. 72 Gy

7. According to QUANTEC guidelines, the dose limit to the spinal cord using conventional fractionation with a 0.2% rate of myelopathy is:
   A. D_{max} = 50 Gy Including full cord cross-section
   B. D_{max} = 45 Gy Including full cord cross-section
   C. D_{max} = 50 Gy Including partial cord cross-section
   D. D_{max} = 45 Gy Including partial cord cross-section

8. A patient arrives to begin radiotherapy three weeks after the treatment plan was completed when it is determined that the patient has gained considerable weight and there is increased girth over the treatment area, the CMD should:
   A. inform the radiation oncologist that there is an apparent change in the patient's size and a new treatment plan may be needed.
   B. treat the patient as planned and then notify the radiation oncologist.
   C. make arrangements for the patient to see the department's medical dietician.
   D. advise the radiation therapy technologists to monitor the patient for any adverse effects.

9. Presence of which of the following viruses indicates a favorable prognosis in patients with oropharyngeal cancer?
   A. Human papilloma virus
   B. Herpes simplex virus
   C. Coxsackievirus
   D. Epstein Barr virus

10. According to AAPM TG Report #142, which of the following tests should be performed daily on a linear accelerator?
    A. constancy factor of energy
    B. beam profile constancy
    C. optical distance indicator
    D. respiratory gating

11. A craniospinal patient is setup with conventional photon CSI simulation. The spine field is setup with an SSD of 100 cm and a field size of 5 x 26 cm. The whole cranium field has a field size of 22 x 18 cm at 100 cm SAD. Which of the relationships below correctly reflects the angle of rotation to be applied to the treatment couch?

    A. Tan^{-1} 13/100
    B. Tan^{-1} 11/100
    C. Tan^{-1} 9/100
    D. Tan^{-1} 5/100

Rationale: the couch angle is calculated from the length of the adjacent jaw from the whole brain treatment field. The inferior (adjacent) jaw = 9 cm. Tan^{-1} adj. jaw/SAD = Tan^{-1} 9/100 = couch angle.

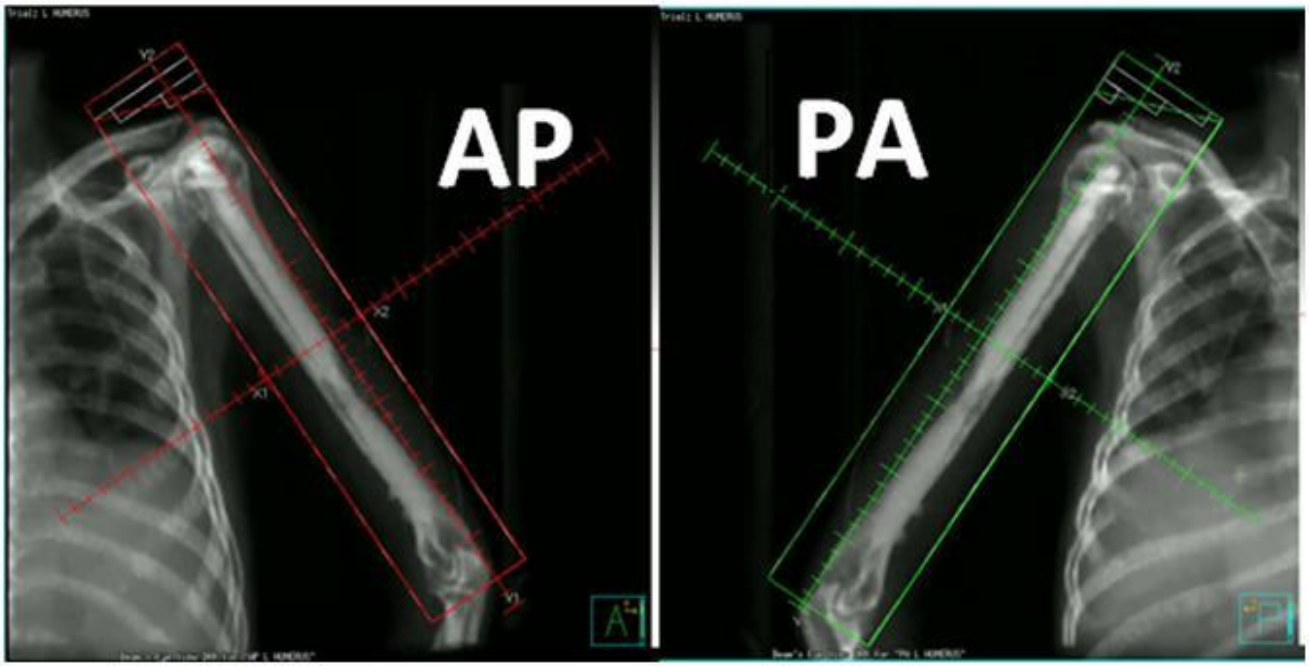
12. Which of the following is a type of computer operating system sometimes used for radiotherapy planning?
    A. DICOM-RT
    B. ASCII Code
    C. Unix
    D. PACS

13. ICRU Report #38 and Report #58 both define *total reference air kerma* as a method of reporting dose in brachytherapy. Which of the following descriptors illustrates *total reference air kerma* (TRAK)?
    A. the sum of the reference air kerma and the duration of the application for each source
    B. the product of the reference air kerma and the duration of the application for each source
    C. the sum of the products of the reference air kerma rate and the duration of the application for each source
    D. the product of the sums of the reference air kerma rate and the duration of the application for each source

14. What is the fundamental unit of data in a computer called?
    A. bit
    B. byte
    C. pixel
    D. voxel

15. A new software release is installed on your treatment planning system and all required beam data has been updated for your treatment unit. Before using the system for routine clinical use, it is prudent to:
    A. verify DICOM transfer connectivity is established.
    B. calculate and plot isodose distributions in penumbra region for a range of field sizes.
    C. print and compare scaled source parameters.
    D. check the calculation of doses in and beyond heterogeneities.

16. A patient is simulated head first supine for a left humerus irradiation with an isocentric technique. The AP BEV was used to create the field borders and blocking. The PA projection is a parallel opposed beam of the AP projection. The field size of the PA field, however, was enlarged to accommodate the same volume of the humerus. A reason for this is that the isocenter was placed in a coronal plane:



A. lateral to the humerus.
B. centered on the humerus.
C. posterior to the humerus.
D. anterior to the humerus.

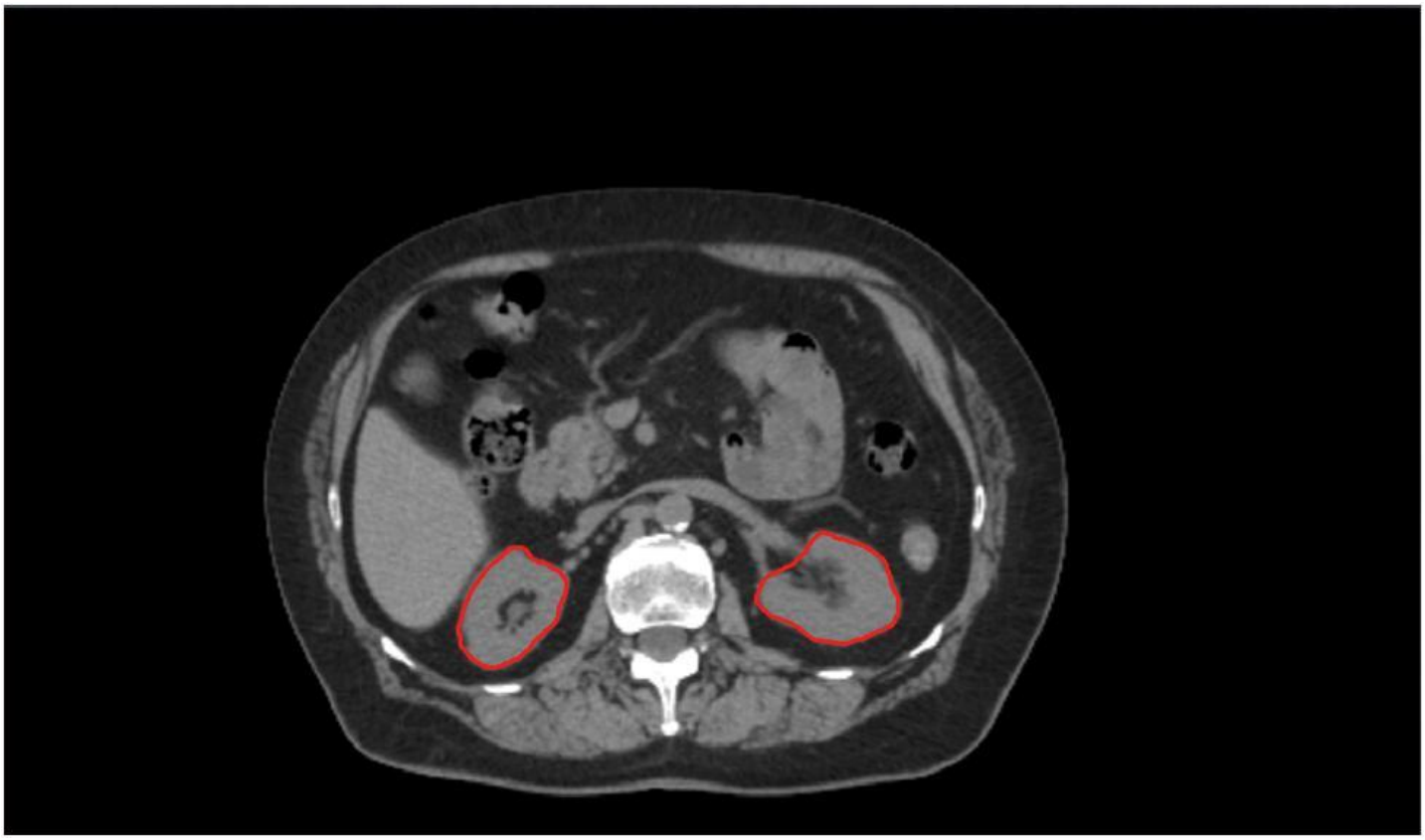
Rationale: Isocenter is anterior to the target volume, and fs is defined at isoc, the field divergence will be larger than at the stated field size when encompassing the humerus. This same field, from the PA direction, will be smaller than the stated field size at isocenter when encompassing the target volume, thus requiring the stated F.S. at the depth of isocenter to be larger from the PA direction so that it is the same size of the AP at the depth of the humerus.

17. In the production of characteristic X rays, which of the following is the type of energy an incident electron must have to strip an electron from an atom?
    A. transient absorption
    B. linear attenuation
    C. critical absorption
    D. secular activation

18. The tilt that an isodose curve makes with the central ray of a beam at a specified depth is called the:
    A. wedge factor
    B. hinge angle
    C. edge effect
    D. wedge angle

19. The standard of care primary treatment for cancer of the parotid gland is:
    A. photon beam radiotherapy
    B. neutron beam radiotherapy
    C. chemotherapy
    D. surgery

20. According to QUANTEC guidelines, in order to avoid a 5% risk of dysfunction, less than 55% of the volume of the structures outlined should receive what dose?



    A. 6 Gy
    B. 12 Gy
    C. 24 Gy
    D. 32 Gy

21. A radiation oncologist is designing a phase I clinical trial for lung cancer. Which of the following scenarios is an example of such a trial?
    A. Patients are treated in sequential groups with each subsequent group receiving a higher dose of Radiation Therapy until toxicity is noted and maximum tolerance is determined.
    B. Patients are assigned into two separate groups A and B. Group A is to receive Radiation Therapy once daily and Group B is to receive Radiation Therapy two times a day (BID).
    C. Testing of a drug in combination with Radiation Therapy (concurrent chemoradiation) is used to compare the survival of this group with patients that previously received radiotherapy alone.
    D. The radiation oncologist states that the study is being done to study the long-term side effects of a drug used in combination with Radiation Therapy.

22. Prescriptions for dose and monitor unit calculations for intensity modulated radiation therapy (IMRT) treatment planning systems should be based on dose to:
    A. a single voxel.
    B. an off-axis point.
    C. target volumes.
    D. the isocenter.

    Rationale: ICRU Report #83

23. Which of the following describes a counting system used by computers that involve the digits 0 and 1?
    A. decimal system
    B. binary system
    C. hexadecimal system
    D. octal system

24. The 2010 ICRU Report # 83 recommends the use of the homogeneity index (HI) to assess the over and under dosages within the target volume. Which of the following descriptions best characterizes the homogeneity index?

    $$HI = [(D_2 - D_{98}) / D_{50}]$$

    A. An HI value of zero is not desirable for IMRT planning.
    B. The HI is used to determine the uniformity of dose distribution with the largest target volume.
    C. A larger HI value indicates a more inhomogeneous dose distribution
    D. A smaller HI value indicates a more inhomogeneous dose distribution.

25. Which of the following is the most accurate algorithm for electron beam calculations?
    A. Collapsed cone convolution
    B. Monte Carlo
    C. Clarkson
    D. Pencil beam

26. The cGy as a unit of absorbed dose:
    A. is equal to 100 Gy.
    B. only applies in water.
    C. may also be used as a unit for KERMA.
    D. is only defined for photon beams.

27. Internal conversion is followed by emission of:
    A. protons.
    B. positrons.
    C. auger electrons.
    D. neutrinos.

28. The off-axis factor (OAF) is dependent on which of the following?
    A. The degree of tilt the isodose curve endures at the central ray.
    B. An isodose curve profile at a depth of 10cm.
    C. The lateral distance between the 90% and 20% isodose lines at Dmax.
    D. Distance of a point from the central axis.

29. A computer network that is limited to a single division or small group in one geographical location is called a:
    A. Wide Area Network
    B. Distributed Switch Network
    C. Local Area Network
    D. Discrete Network

30. From the techniques listed below, select the **LEAST** desirable method for treating a 3.0cm non-secreting pituitary adenoma.
    A. opposed lateral fields
    B. opposed laterals plus a vertex field
    C. non-coplanar fields
    D. stereotactic radiosurgery

31. DICOM allows:
    A. Imaging modalities and PACS to communicate in the same language.
    B. A networked group of computers to manage digital images.
    C. X-ray absorber material and a charged coupled device to form an image.
    D. Improved image quality in digital portal films.

32. The Planning Target Volume provides margin around the Gross Tumor Volume and/or Clinical Tumor Volume to compensate for which of the following?
    A. positive margins at tumor bed.
    B. inconsistencies in physician drawing.
    C. dose fall off.
    D. variations in treatment setup.

33. Which of the following concepts of 3-dimensional conformal radiotherapy is/are correctly defined?
    A. Differential DVH: Plot of a volume of a structure receiving a certain dose as a function of dose
    B. BEV: display of target and normal tissues parallel to the beam
    C. GTV: gross demonstrable extent of tumor
    D. PTV: true extent and location of disease

34. Which statement is true about the benefits of PET-CT for use in Radiation Oncology treatment planning?
    A. PET images show chemical or metabolic activity within the body.
    B. PET images provide superior anatomical definition over CT images.
    C. PET images have an accuracy of 10-15 mm for anatomical location.
    D. PET imaging is ideal for diabetic patients.

35. In megavoltage therapy, all beam modifying devices should be placed at least 20.0 cm from the patient's skin surface because:
    A. the increase in half value layer (HVL) adversely affects skin dose.
    B. alpha particles will not reach the skin's surface
    C. percentage depth dose (PDD) is increased
    D. secondary electrons are scattered before reaching the patient.

36. Technical considerations in the post-operative treatment of high-grade soft tissue sarcomas of the extremities with external beam radiation should include:
    A. circumferential tissue sparing in the width of the field
    B. eliminating any shielding in the treatment field
    C. treating the tumor bed with minimal margins only
    D. using daily fractional doses of 250 cGy or more

37. For electron therapy, increasing the gap between cerrobend cut-out, placed at the end of the cone, and the treatment surface of the patient results in:
    A. a decrease in the physical penumbra at the patient surface
    B. a decrease of electron energy to achieve the same PDD
    C. an increase in the bremsstrahlung tail on the depth dose curve
    D. an increase in the monitor units to achieve the same dose

38. For external beam radiation, the use of multiple photon beams (3 or more) versus a single photon beam will:
    A. decrease the ratio of the tumor dose to the normal tissue dose
    B. decrease the amount of scatter dose to the tissue outside the irradiated volume
    C. increase the dose to treatment volume
    D. increase the homogeneity within the target

39. When acquiring cone beam computerized tomography (CBCT) images, the dose to sensitive structures can be reduced by:
    A. adjusting the collimator blades to reduce the volume of the patient being irradiated.
    B. using the x-ray technique to best match the clinical task.
    C. selecting the direction of the kV beam to avoid sensitive structures.
    D. decreasing the dose rate.

40. In electron beam therapy, if an air gap results in beam obliquity and is not accounted for in the plan, it:
    A. shifts the d_{max} deeper
    B. shifts d_{max} towards the surface
    C. changes the degree of lower isodose bulge
    D. decreases side scatter at d_{max}

41. When treating chest wall tumors with multiple electron fields, which of the following considerations should be taken?
    A. angle the beams towards each other
    B. use the same electron energies for field matching
    C. feather the junctions periodically
    D. overlap the fields purposely to account for motion

42. Which of the following criteria is information required to be included in the *written directive* for the medical use of radioactive materials?
    A. verification methods for confirming the patient identity
    B. the x, y and z coordinate locations of the radioactive source
    C. the total patient exposure time to the source
    D. authentication of the source license

43. Using non-coplanar beams and IMRT techniques to design a treatment plan of the pituitary gland is advantageous over traditional 3D techniques in reducing the dose to the:
    A. optic chiasm and temporal lobes.
    B. optic chiasm and cochlea.
    C. temporal lobes and brainstem.
    D. brainstem and cerebrum.

44. The use of stereotactic radiotherapy is frequently used to treat which of the following cancers of the thorax?
    A. small cell lung cancer
    B. non-small cell lung cancer
    C. thymoma
    D. mesothelioma

45. When using radiotherapy for SBRT treatment of liver disease, the most dose-limiting surrounding normal tissue to be considered is:
    A. the spinal cord
    B. the kidneys
    C. the bowel
    D. normal liver

46. Which of the following choices best reflects the role of radiation therapy in the treatment of cutaneous melanoma?
    A. definitive treatment of primary site
    B. palliative treatment to metastatic site
    C. adjuvant treatment following surgical resection
    D. definitive treatment for regional recurrence

47. When viewing the grayscale image on the computer screen, if the window range extends from (+400) to (-500), then the level is equal to:
    A. -500
    B. -50
    C. +400
    D. +900

48. Which of the following Window/Level settings represents a grayscale image appropriate for viewing the lung on a CT scan?
    A. Level = -700, Window = 1000
    B. Level = 250, Window = 500
    C. Level = 40, Window = 500
    D. Level = 40, Window = 120

49. Based on the RTOG published guidelines for contouring the pelvis, the femoral structure should include the head of the femur and extend inferiorly to:
    A. the inferior aspect of the lesser trochanter.
    B. the lowest level of the ischial tuberosities.
    C. 3 cm inferior to the head of the femur.
    D. the lowest level on which you can visualize the penile bulb.

50. Based on the RTOG published guidelines for contouring the pelvis, the bowel, including small bowel as well as the large bowel and colon, should be contoured as a single bowel bag when performing the treatment planning for which of the following type of cancer?
    A. pancreatic
    B. rectal
    C. uterine
    D. anal

51. A seminoma is being treated with radiation using conventional AP/PA treatment fields. Which of the following structures must be localized and monitored if a standard dose for seminoma is employed?
    A. liver
    B. kidneys
    C. spinal cord
    D. small bowel

52. Which of the following energies would have the highest skin dose?
    A. 4 MeV
    B. 6 MV
    C. 10 MV
    D. 16 MeV

53. The process of creating beam intensity profiles to meet the goals of a treatment plan is called:
    A. fluence mapping
    B. 3D conformal radiotherapy
    C. 4D treatment planning
    D. intensity modulation

54. When a coefficient of equivalent thickness (CET) is used for an inhomogeneity, the CET factor equates the inhomogeneity to an equivalent thickness of:
    A. air.
    B. water.
    C. lung.
    D. compact bone.

55. According to AAPM Task Group 142, regarding the QA of medical accelerators, what is the monthly tolerance for scaling when considering SRS/SBRT Planar kV imaging?
    A. ≤ 1mm
    B. ≤ 2mm
    C. baseline
    D. functional

56. Two adjacent posterior fields are used to treat the spine. The first field is 25.0 cm long at 100 cm SSD. The second field is 15.0 cm long at 100 cm SSD. The gap required on the skin in order to match the two fields at 6.0 cm depth is:
    A. 1.2 cm.
    B. 1.6 cm.
    C. 2.0 cm.
    D. 2.4 cm.

    Rationale: ½(Feld Length)(depth)/SSD for each field. (.5)(25)(6)/100 = .75 cm. .5)(15)(6)/100 = .45 cm
    0.75 + 0.45 = 1.2 cm

57. What is the decay constant of Co-60 in years?
    A. 0.01 yr^{-1}
    B. 0.13 yr^{-1}
    C. 0.69 yr^{-1}
    D. 7.59 yr^{-1}

    Rationale: Decay Constant = ln2/HL = .693/5.2 years = 0.133 yr^{-1}

58. Very accurate specification of dose at depth in a wedged field necessitates that the medical dosimetrist accounts for which of the following factors?
    A. same central axis percent depth dose that occurs in a wedged field
    B. wedge transmission factor is measured in air or in tissue
    C. no variations of the wedge transmission factor with field size
    D. reduction in collimator scatter that is reaching the patient

59. The similarities for depth dose characteristics of megavoltage electron and photon beams is/are:
    A. they have a finite range of penetration.
    B. the percent surface dose is high.
    C. the percent surface dose increases as the energy increases.
    D. the percent depth dose increases as the beam energy increases.

60. What factors affect depth dose?
    A. energy, depth, field size, SSD, blocked area
    B. energy, depth SSD, dose build up, collimation
    C. depth, field size, beam quality, source size
    D. depth, energy, absorbed energy, scatter

ANSWER KEY

1. **B**
2. **C**
3. **C**
4. **C**
5. **D**
6. **B**
7. **A**
8. **A**
9. **A**
10. **C**
11. **C**
12. **C**
13. **C**
14. **B**
15. **D**
16. **D**
17. **C**
18. **D**
19. **D**
20. **B**
21. **A**
22. **C**
23. **B**
24. **C**
25. **B**
26. **C**
27. **C**
28. **D**
29. **C**
30. **A**
31. **A**
32. **D**
33. **C**
34. **A**
35. **D**
36. **A**
37. **D**
38. **D**
39. **A**
40. **B**
41. **C**
42. **C**
43. **A**
44. **B**
45. **D**
46. **C**
47. **B**
48. **A**
49. **B**
50. **C**
51. **B**
52. **D**
53. **D**
54. **B**
55. **B**
56. **A**
57. **B**
58. **B**
59. **D**
60. **A**