1. Backscatter factor (BSF) is identical to tissue-air ratio (TAR) at:

(A) all depths.
(B) the isocenter.
(C) the surface.
(D) the depth of maximum dose.
(E) the exit surface.

2. The approximate density of fat is:

(A) 0.30 g/cc.
(B) 0.95 g/cc.
(C) 1.00 g/cc.
(D) 1.03 g/cc.
(E) 1.65 g/cc.

3. Which of the following is/are appropriate treatment techniques for delivering a boost dose of 26 Gy to a left anterior primary brain tumor following whole brain irradiation on a 6 MV linear accelerator?

(1) parallel opposed lateral fields, weighted 2:1 left to right
(2) single 6 MeV left lateral electron field
(3) wedge pair, 45 degree wedges, 90 degree hinge angle
(4) parallel opposed anterior and posterior fields

(A) (1), (2), and (3) only are correct.
(B) (1) and (3) only are correct.
(C) (2) and (4) only are correct.
(D) (4) only is correct.
(E) All are correct.

4. When simulating a plan utilizing Beam's Eye View treatment planning, it is necessary to:

(1) verify that the patient's position and alignment are equivalent to those at the CT plan acquisition.
(2) place the isocenter accurately in three dimensions with the aid of the CT scout image and the data from the planning "slice."
(3) verify the isocenter with an orthogonal pair of radiographs for future comparison to port films.
(4) use normal anatomy visible on radiographs and in particular bony landmarks to verify correctness of the simulation.

(A) (1), (2), and (3) only are correct.
(B) (1) and (3) only are correct.
(C) (2) and (4) only are correct.
(D) (4) only is correct.
(E) All are correct.

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5. After 6.5 years, the activity of a 25 mCi Cesium-137 source will be:

EXPONENTIALS AND POWERS OF 2.0

x	e^{-x}	2x
0.00	1.000	1.000
0.05	0.951	1.036
0.10	0.905	1.072
0.15	0.861	1.109
0.20	0.819	1.149
0.25	0.779	1.189
0.30	0.741	1.231

(A) 18.5 mCi.
(B) 19.5 mCi.
(C) 20.5 mCi.
(D) 21.5 mCi.
(E) 22.6 mCi.

6. Treatment planning for pediatric cancer patients assumes increased importance because:

(1) many pediatric patients are treated with curative intent.
(2) children often receive chemotherapy before, during, or after therapy which can interact with the complications of the radiation treatment.
(3) growth disturbances due to radiation treatment are expected so exposed tissues must be kept to a minimum volume.
(4) growth disturbances occur as a long term complication at relatively low doses (far below those required for control of many tumors).

(A) (1), (2), and (3) only are correct.
(B) (1) and (3) only are correct.
(C) (2) and (4) only are correct.
(D) (4) only is correct.
(E) All are correct.

7. Lipowitz's metal is used in place of lead to make customized shielding blocks for which of the following reasons?

(1) It provides a sharper beam edge.
(2) It requires less block thickness.
(3) It produces lighter blocks.
(4) It has a lower melting point.

(A) (1), (2), and (3) only are correct.
(B) (1) and (3) only are correct.
(C) (2) and (4) only are correct.
(D) (4) only is correct.
(E) All are correct.

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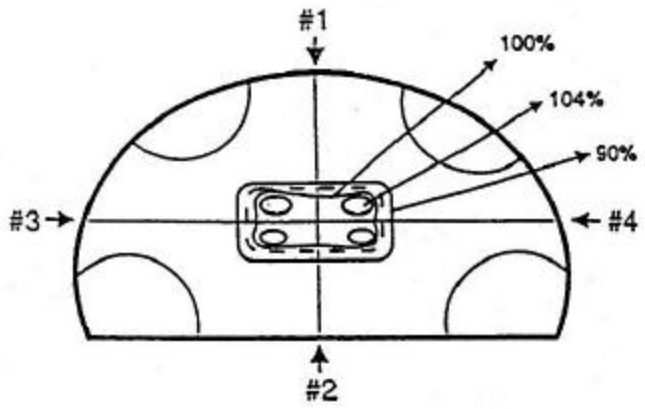
8.



The 104% isodose lines at the four corners of the target shown are due to the:

(A) inhomogeneity of the femur.
(B) scatter from the femur.
(C) horns of the beams.
(D) weights of the lateral beams.
(E) use of a wrong algorithm.

9. Clinical applications of multileaf collimators (MLC) include which of the following?

(1) shaping of static fields as a replacement for cerrobend blocks
(2) dynamic field shaping as a function of gantry rotation
(3) modulating beam intensity by dynamic multileaf collimation (MLC)
(4) field shaping without penumbra

(A) (1), (2), and (3) only are correct.
(B) (1) and (3) only are correct.
(C) (2) and (4) only are correct.
(D) (4) only is correct.
(E) All are correct.

10. A patient is treated to the left chest wall with electron arc therapy. In order to sharpen the distribution at the medial and lateral field borders, the medical dosimetrist should:

(A) place the isocenter at the skin surface.
(B) shape the field with a cerrobend electron insert in the cone.
(C) choose the highest electron beam energy available.
(D) use a field size larger than the target defined by the physician.
(E) shape the field on the skin surface with lead strips.

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11. For X rays generated at less than 250 kVp, there is a substantial increase of dose inside bone because of an increase in which of the following?

(A) electron density relative to soft tissue
(B) number of secondary photons from Compton interactions
(C) electron fluence arising from photoelectric absorption
(D) backscatter effect at the bone/soft tissue interface
(E) percentage of low-energy photons in the beam

12. According to the American Association of Physicists in Medicine (AAPM) standards (TG40), when periodic linear accelerator quality assurance procedures are performed, which of the following is the acceptable tolerance for field size indicators?

(A) ± 0.5 mm
(B) ± 1.0 mm
(C) ± 2.0 mm
(D) ± 3.0 mm
(E) ± 4.0 mm

13. When an enface electron beam is used for chest wall irradiation, which of the following describes the dose at the interface between the chest wall and lung?

(A) decreased due to reduced scatter from the lung
(B) decreased due to irregular surface contour effects
(C) increased due to an increase in the electron fluence
(D) increased due to a larger angle of electron scatter
(E) unchanged from that in a homogeneous phantom

14. An averaged ionization chamber reading for a 10 cm x 10 cm^2 electron applicator is 98.5 and an averaged ionization chamber reading for an electron cut-out in a 6 cm x 10 cm^2 applicator is 92.4. What is the monitor unit setting if 200 cGy is prescribed to 90% and the 6 cm x 10 cm^2 cut-out is utilized? (The output factor for 10 cm x 10 cm^2 is 1 cGy/MU.)

(A) 208 MU
(B) 217 MU
(C) 222 MU
(D) 237 MU
(E) 244 MU

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15. Parent and daughter radioactive isotopes are said to be in secular equilibrium when they:

(A) are equal in atomic weight.
(B) have the same half-life.
(C) have a constant ratio of activity.
(D) emit equivalent gamma energies.
(E) have the same average life.

16. A beam degrader/spoiler is used in a photon beam for total body irradiation (TBI) in order to:

(1) decrease beam energy.
(2) effectively hold lung transmission blocks close to the patient.
(3) decrease background radiation.
(4) increase the surface dose to the patient.

(A) (1), (2), and (3) only are correct.
(B) (1) and (3) only are correct.
(C) (2) and (4) only are correct.
(D) (4) only is correct.
(E) All are correct.

17. Two adjacent posterior fields are to be used to treat the spine. A 4 MV (80 source-to-axis distance (SAD)) unit is used, but it is decided to treat the patient at 100 source-to-surface distance (SSD). The collimator setting size is 32 cm long for the first field, and the collimator setting size is 16 cm long for the second field. The skin gap required to match the two fields at a depth of 5 cm is:

(A) 1.0 cm.
(B) 1.2 cm.
(C) 1.5 cm.
(D) 1.7 cm.
(E) 2.0 cm.

18. To make inhomogeneity corrections in treatment plans based on CT derived anatomical information, the dosimetrist:

(A) converts CT numbers to Hounsfield units.
(B) determines the absorption equivalents.
(C) converts to equivalent path lengths.
(D) determines electron densities.
(E) determines mass attenuation coefficients.

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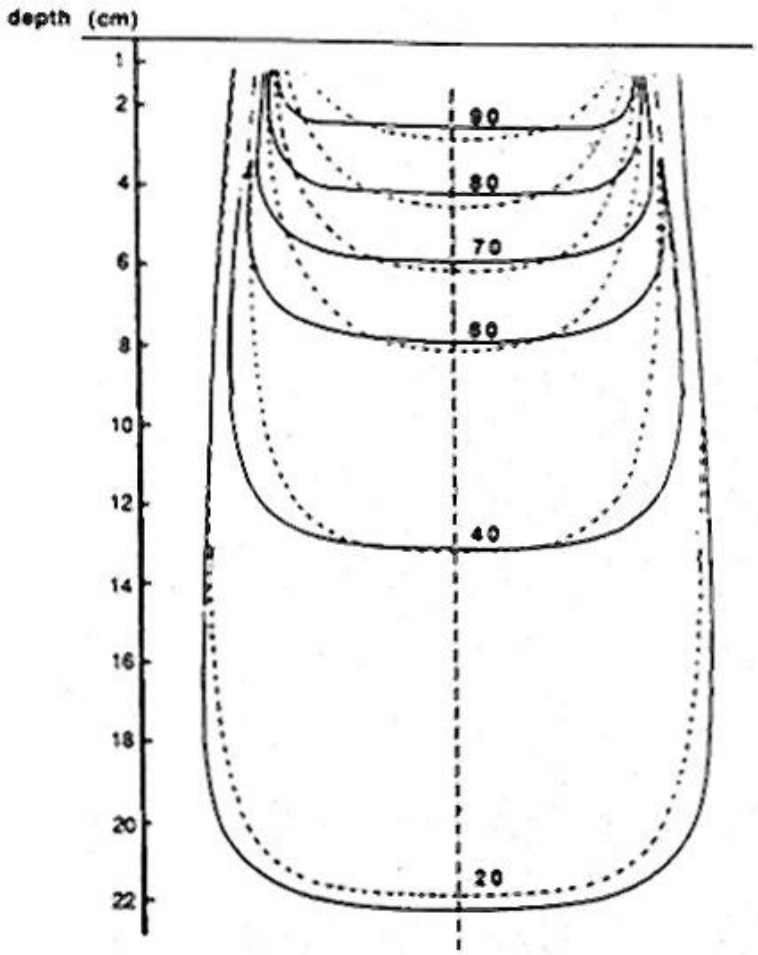
19.



The isodose curves shown on the diagram demonstrate the effect of source size on isodose distribution by illustrating:

(1) dashed curves resulting from smaller source size.
(2) solid curves resulting from smaller source size.
(3) solid curves showing greater penumbra.
(4) dashed curves showing greater penumbra.

(A) (1), (2), and (3) only are correct.
(B) (1) and (3) only are correct.
(C) (2) and (4) only are correct.
(D) (4) only is correct.
(E) All are correct.

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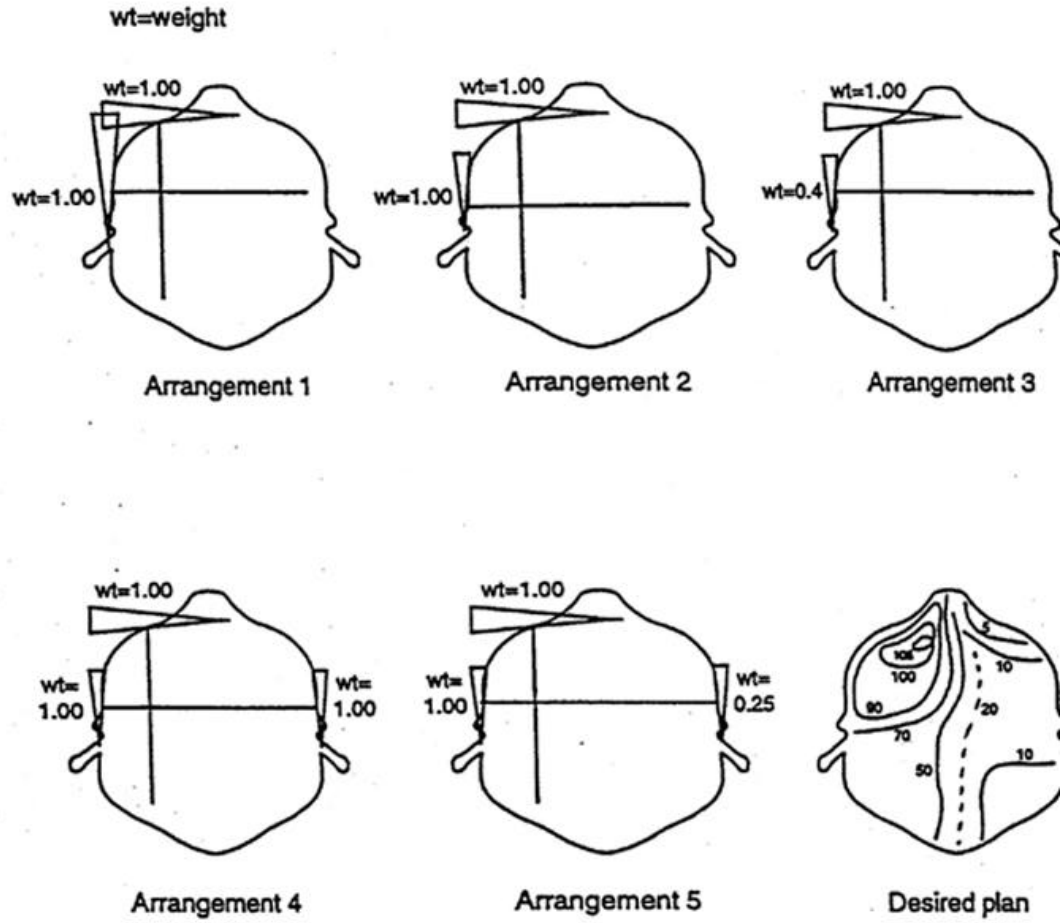
20. Below are five beam arrangements. Which one would yield the desired plan?



(A) arrangement 1
(B) arrangement 2
(C) arrangement 3
(D) arrangement 4
(E) arrangement 5

21. According to the National Council on Radiation Protection and Measurements (NCRP) guidelines (#116), the annual equivalent dose limit for the hands of an occupational worker in 1 year is:

(A) 5 mSv (0.5 rem).
(B) 15 mSv (1.5 rem).
(C) 50 mSv (5.0 rem).
(D) 150 mSv (15.0 rem).
(E) 500 mSv (50.0 rem).

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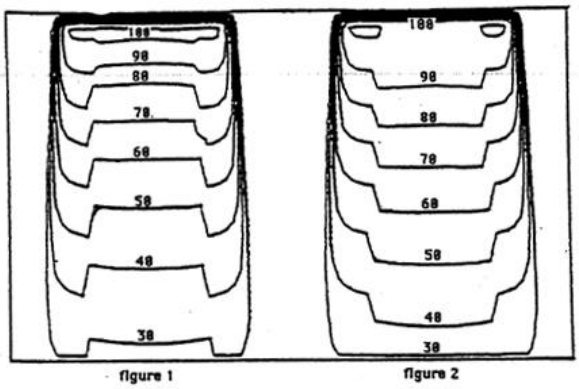

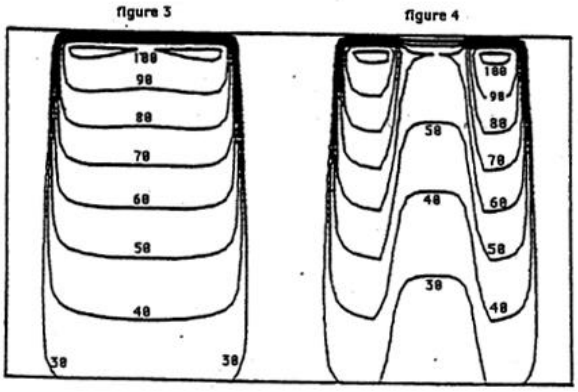

22. Figure 3 shown above represents a single-field isodose distribution as the beam traverses through:

(A) bone.
(B) full thickness block.
(C) soft tissue only.
(D) partial transmission block.
(E) lung.

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23. A simulation is done for a treatment to be given isocentrically, source-axis distance 80 cm, and with a field size of 5 cm x 12.5 cm. The image of the field size on the radiograph measures 6 cm x 15 cm. What is the actual size of an object placed on the patient's surface, 72 cm from the source, if the image of the object on the radiograph measures 4 cm?

(A) 5.3 cm
(B) 4.0 cm
(C) 3.4 cm
(D) 3.3 cm
(E) 3.0 cm

24. A four-field isocentric isodose plan normalized to 100% at the isocenter shows the entire target volume encompassed by the 97% isodose line. The target volume is to receive 65 Gy; however, it is required that the dose be prescribed at the isocenter. The dose prescription should be written for:

(A) 65 Gy to the target volume.
(B) 65 Gy to the isocenter.
(C) 65 Gy to the 97% isodose volume.
(D) 67 Gy to the isocenter.
(E) 67 Gy to the 97% isodose volume.

25. High dose rate (HDR) remote afterloading can be used to treat which of the following sites?

(1) nasopharynx
(2) lung
(3) esophagus
(4) cervix

(A) (1), (2), and (3) only are correct.
(B) (1) and (3) only are correct.
(C) (2) and (4) only are correct.
(D) (4) only is correct.
(E) All are correct.

26. Film badges used for personnel monitoring contain filters that are used to:

(A) reduce the dose from low-energy radiations.
(B) provide information concerning beam quality.
(C) store the absorbed energy for subsequent measurement.
(D) increase film resolution.
(E) filter out naturally occurring radiation.

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27. Which of the following clinical machines produce(s) photon beams?

(1) betatron
(2) linear accelerator
(3) microtron
(4) cyclotron

(A) (1), (2), and (3) only are correct.
(B) (1) and (3) only are correct.
(C) (2) and (4) only are correct.
(D) (4) only is correct.
(E) All are correct.

28. A patient is normally treated with 18 MV photons on a linear accelerator that has a target-to-tray distance of 61.4 cm. The machine breaks down and the patient is moved to a 6 MV linear accelerator that has a target-to-tray distance of 57.8 cm. To ensure that the patient is properly treated, the medical dosimetrist should consider doing which of the following?

(1) recalculating the monitor units
(2) recognizing that the isodose distribution may need to reflect this treatment
(3) recutting the customized field-defining blocks
(4) using new field sizes if the treatment source-to-surface distance (SSD) is the same

(A) (1), (2), and (3) only are correct.
(B) (1) and (3) only are correct.
(C) (2) and (4) only are correct.
(D) (4) only is correct.
(E) All are correct.

29. The most important prognostic factor in breast cancer is the:

(A) size of the tumor.
(B) age of the patient.
(C) status of the axillary nodes.
(D) quadrant of origin within the breast.
(E) menopausal status.

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30. A dose of 30 Gy in 10 fractions to a depth of 7 cm from a 6 MV single posterior field using an isocentric technique at 100 cm source-to-axis distance (SAD). The patient was incorrectly treated five times at 100 cm source-to-surface distance (SSD). The approximate dose at 7 cm after five fractions is:

(A) 11.6 Gy.
(B) 13.1 Gy.
(C) 13.8 Gy.
(D) 15.0 Gy.
(E) 16.3 Gy.

31. Prior to the administration of a brachytherapy remote afterloading treatment, the following is/are required:

(1) preparation of a signed written directive.
(2) verification of the patient's identity by more than one method.
(3) independent confirmation of treatment time.
(4) redundant check of input parameters.

(A) (1), (2), and (3) only are correct.
(B) (1) and (3) only are correct.
(C) (2) and (4) only are correct.
(D) (4) only is correct.
(E) All are correct.

32. Tissue-air ratio (TAR) is dependent on:

(1) beam energy.
(2) depth.
(3) field size.
(4) source-to-surface surface distance (SSD).

(A) (1), (2), and (3) only are correct.
(B) (1) and (3) only are correct.
(C) (2) and (4) only are correct.
(D) (4) only is correct.
(E) All are correct.

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33. Multileaf collimators (MLC) are advantageous over conventional field shaping devices because:

(1) there is no danger of injury to the patient or therapist from a falling block.
(2) they eliminate toxicity concerns resulting from fabrication and handling of lead and cadmium alloy blocks.
(3) they save block fabrication costs, storage space, and the effort of lifting and mounting heavy blocks.
(4) immediate modification of the field aperture can be made if the portal image reveals inaccuracy.

(A) (1), (2), and (3) only are correct.
(B) (1) and (3) only are correct.
(C) (2) and (4) only are correct.
(D) (4) only is correct.
(E) All are correct.

34. Electron beam output factors are corrected for air gaps by using which of the following?

(A) elongation depth
(B) energy coefficient
(C) equivalent thickness
(D) virtual source distance
(E) electron range

35. Which of the following represents the ratio of the dose at a given point in a phantom to the dose at the same point at depth of maximum in the phantom?

(A) scatter-air ratio (SAR)
(B) off-axis ratio
(C) tissue-phantom ratio (TPR)
(D) tissue-air ratio (TAR)
(E) tissue-maximum ratio (TMR)

END OF TEST

ANSWER KEY

1. D
2. B
3. B
4. A
5. D
6. E
7. D
8. C
9. A
10. E
11. C
12. C
13. A
14. D
15. C
16. D
17. C
18. D
19. C
20. C
21. E
22. C
23. E
24. D
25. E
26. B
27. A
28. A
29. C
30. B
31. E
32. A
33. E
34. D
35. E