1. What is the approximate density of healthy lung tissue?

(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

2. The accelerator component that injects electrons into the linear accelerator is:

(A) a klystron.
(B) an electron gun.
(C) a high-voltage power supply.
(D) a bending magnet.
(E) a thyratron.

3. The equivalent square of a rectangular field of dimensions X x Y is:

(A) the square root of 4 x X x Y.
(B) 2 x (X + Y).
(C) 2 x X x Y.
(D) (4 x X x Y) / (X + Y).
(E) 2 x (X x Y) / (X + Y).

4. Which of the following problems may be encountered in the use of diagnostic CT data in radiation therapy treatment planning?

(1) Vertical and horizontal scales may differ, resulting in image distortion.
(2) Small scan ring size may result in side cut-off of patient contours.
(3) The position of the patient in the scanner may <u>not</u> duplicate the therapy setup.
(4) Cross-sectional CT images can provide inaccurate tissue heterogeneity corrections if the data do not correlate with the CT tables in the treatment planning computer.

(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. Radiation damage to the fetus resulting in severe birth defects would most often occur when radiation was delivered at which time post-fertilization?

(A) 0 - 2 weeks
(B) 3 - 12 weeks
(C) 13 - 24 weeks
(D) 23 - 32 weeks
(E) 33 - 40 weeks

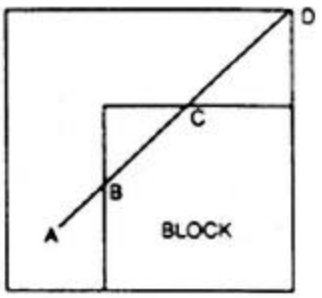
6. A patient is to be given a 4600 cGy midplane dose in 23 fractions by parallel opposed fields to the mediastinum. The dose to the spinal cord each fraction is 209 cGy. If a spinal cord block is added to the posterior field only, the dose to the spinal cord each fraction is 94 cGy. The spinal cord dose through the treatment course is limited to 4000 cGy. How many fractions must the posterior cord block be inserted?

(A) 3 fractions
(B) 4 fractions
(C) 5 fractions
(D) 6 fractions
(E) 7 fractions

7. The decay constant for a radioactive source that has a half-life of 60 days is:

(A) 0.012.
(B) 0.170.
(C) 0.662.
(D) 1.250.
(E) 6.580.

8.



The scatter-air ratio (SAR) for point A on line AD shown in the diagram, is:

(A) SAR(AD) x SAR(AC) x SAR(AB).
(B) SAR(AD) - SAR(AC) - SAR(AB).
(C) SAR(AD) - SAR(AC) + SAR(AB).
(D) SAR(AD) - ((SAR(AC)/2) - (SAR(AB)/2)).
(E) SAR(AD) x SAR(AB) + SAR(AC).

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9. The function of a maze to a megavoltage treatment room is to:

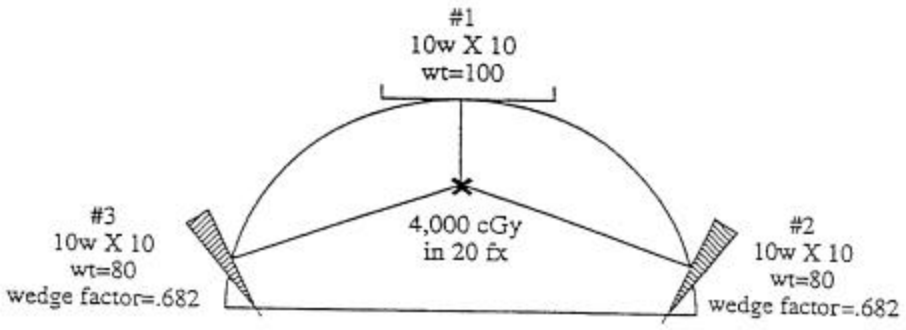
(A) prevent neutron contamination at high energies.
(B) keep operators as remote from the machine as possible.
(C) attenuate photons originating from the head of the linear accelerator.
(D) separate the primary and scattered components of the beam.
(E) minimize radiation levels at the door.

10. A single field megavoltage treatment plan displays the effects of which of the following?

(1) penumbra
(2) flattening filter
(3) patient contour
(4) field normalization

(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.

11.



On the tenth treatment, the wedge shown for field #2 was left out. What is the total tumor dose given that day?

(A) 200 cGy
(B) 229 cGy
(C) 258 cGy
(D) 264 cGy
(E) 297 cGy

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12. According to the American Association of Physicists in Medicine (AAPM) standards (TG40), when performing periodic linear accelerator quality assurance procedures, which of the following is the acceptable tolerance for light/radiation field coincidence?

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

13. The standard Clarkson technique for irregular field calculations corrects the scatter component for which of the following?

(1) patient contour
(2) inhomogeneities
(3) blocks
(4) lateral electron equilibrium

(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.

14. Morbidity that may be seen in the radiation treatment of lung cancer includes which of the following?

(1) pneumonitis
(2) esophagitis
(3) pericarditis
(4) transverse myelitis

(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.

15. The anatomic location of the seminal vesicles is:

(A) inferior to the prostate and angled anteriorly near the bladder.
(B) inferior to the prostate and angled posteriorly near the rectum.
(C) superior to the prostate and angled anteriorly near the bladder.
(D) superior to the prostate and angled posteriorly near the rectum.
(E) surrounding the proximal urethra.

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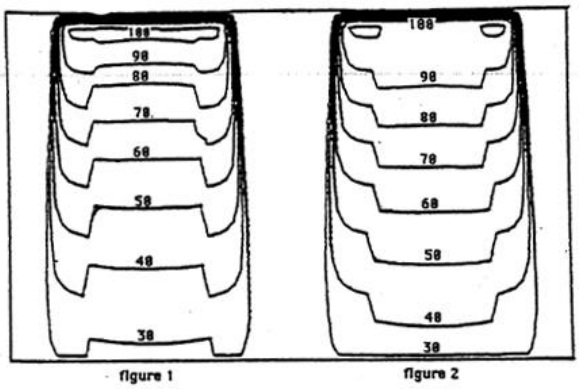

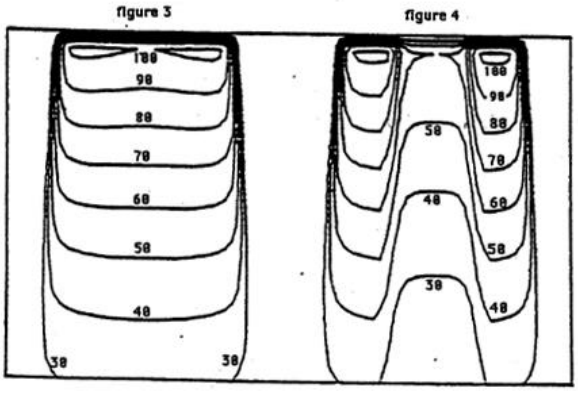

16. Figure 1 shown above represents a single-field isodose distribution as the beam traverses through:

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

17. A simulation is performed for an isocentric treatment on a linear accelerator, source-to-axis distance (SAD) 100 cm, field size 12 cm x 15 cm at the isocenter. Treatment is given using an isocentric Cobalt-60 treatment unit, SAD 80 cm. The field size to be used is:

(A) 9.6 cm x 12.0 cm.
(B) 10.0 cm x 12.5 cm.
(C) 12.0 cm x 15.0 cm.
(D) 15.0 cm x 18.8 cm.
(E) 18.8 cm x 23.4 cm.

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18. The dose to which of these areas would be of dosimetric concern when using an electron beam for total skin irradiation?

(1) soles of the feet
(2) finger nails
(3) scalp
(4) lungs

(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.

19. For a 4-field box technique, which of the following will deliver the lowest dose to the femoral heads?

(A) 100 source-to-surface distance (SSD), equal d_{max} dose to all fields
(B) 100 source-to-surface distance (SSD), equal target dose to all fields
(C) 100 source-to-axis distance (SAD), equal air dose to all fields
(D) 100 source-to-axis distance (SAD), equal target dose to all fields
(E) 100 source-to-axis distance (SAD), equal monitor unit setting for all fields

20. Which of the following statements is/are true concerning a 3-dimensional (3D) pencil beam calculation algorithm?

(1) It does <u>not</u> consider the effects of scatter to and from heterogeneities, irregular surfaces, or irregularly blocked fields.
(2) It divides the broad beam into many small thin beams that can have their own intensity and lateral scatter spread.
(3) It uses an equivalent pathlength calculation that converts any heterogeneity into homogeneous water medium through an attenuation equivalent thickness coefficient.
(4) It allows each pencil beam to be individually manipulated to make the calculation more sensitive to changes in patient anatomy in all three dimensions.

(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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21. Assuming the surgeon has left clips in the tumor bed following an excision of a left breast tumor and an axillary dissection, the electron boost volume and depth may be accurately localized by:

(1) obtaining a CT scan to show the location of the clips.
(2) outlining the excision scar with lead wire and measuring the chest wall distance on tangential simulator films.
(3) taking orthogonal films and plotting the location of the clips on the patient contour.
(4) measuring the depths from the clips to the skin and the chest wall using tangential simulator films.

(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.

22. According to the American Association of Physicists in Medicine (AAPM) Task Group Report 40, the constancy of dose per monitor unit for photon beams of a linear accelerator should be checked:

(A) daily.
(B) once a week.
(C) once a month.
(D) every three months.
(E) every six months.

23. The spinal cord is approaching tolerance from opposing lateral 6 MV fields to the neck and a cord block will be placed. In evaluating the resulting calculations from the computer, it is noticed that 20% more monitor units are required for the same midplane dose. The medical dosimetrist should do which of the following?

(1) Check whether the block is too close to the calculation point.
(2) Advise the therapists of the change.
(3) Verify by hand that the calculation is correct.
(4) Plan oblique fields off the cord.

(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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24. Conventional record and verify systems have made it possible to perform daily computer confirmation of which of the following?

(1) patient position
(2) treatment area
(3) isocenter location
(4) collimator angle and field size

(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.

25. An individual receives a dose of 0.1 cGy from a gamma source and 0.05 cGy from neutrons . The dose equivalent from both radiation sources is:

(A) 0.1 mSv.
(B) 1.0 mSv.
(C) 1.5 mSv.
(D) 11.0 mSv.
(E) 30.0 mSv.

26. An increase in which of the following factors results in an increase in the percent depth dose (PDD) of a megavoltage beam?

(1) beam energy
(2) source-to-skin distance
(3) field size
(4) dose rate

(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.

27. Isodose distributions for a 10 cm x 10 cm^2 6 MV X-ray field in which only half of the beam intersects the phantom differ markedly from isodose distributions in which the entire beam intersects the phantom due to differences in:

(A) off-axis beam hardening.
(B) lateral scatter.
(C) output factor.
(D) primary intensity.
(E) profile coefficients.

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28. Bolus is often used in electron beam therapy to do which of the following?

(1) flatten out an irregular surface
(2) increase the surface dose
(3) reduce the penetration of the electrons in parts of the field
(4) reduce the amount of scatter due to inhomogeneities

(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 surface dose rate of a Strontium-90 (Sr-90) eye applicator was 4.5 cGy/second on May 15. If a patient is to be treated 2 years later on May 15, what is the treatment time if 1000 cGy is prescribed? (The half-life of Sr-90 is 28 years.)

(A) 202 seconds
(B) 214 seconds
(C) 222 seconds
(D) 233 seconds
(E) 242 seconds

30. An optimized plan consists of three fields weighted 1.0 : 0.5 : 0.5 at the isocenter. The plan was normalized to the isocenter and the radiation oncologist prescribed 4500 cGy in 25 fractions to the 95% isodose line. What daily doses are required to produce a new dose distribution that shows the prescribed dose?

(A) 90 : 45 : 45
(B) 90 : 60 : 60
(C) 95 : 47 : 47
(D) 102 : 51 : 51
(E) 120 : 30 : 30

31. A simulation film is taken at 130 cm source-to-film distance for making blocks to be used on a linear accelerator with a source-to-axis distance (SAD) of 100 cm and a source-to-tray distance of 65 cm. The treatment is rescheduled for a linear accelerator with an SAD of 80 cm and a source-to-tray distance of 52 cm. The block may be accurately produced if the source-to-film distance on the cutting apparatus is set to:

(A) 100.0 cm.
(B) 104.0 cm.
(C) 110.0 cm.
(D) 125.0 cm.
(E) 162.5 cm.

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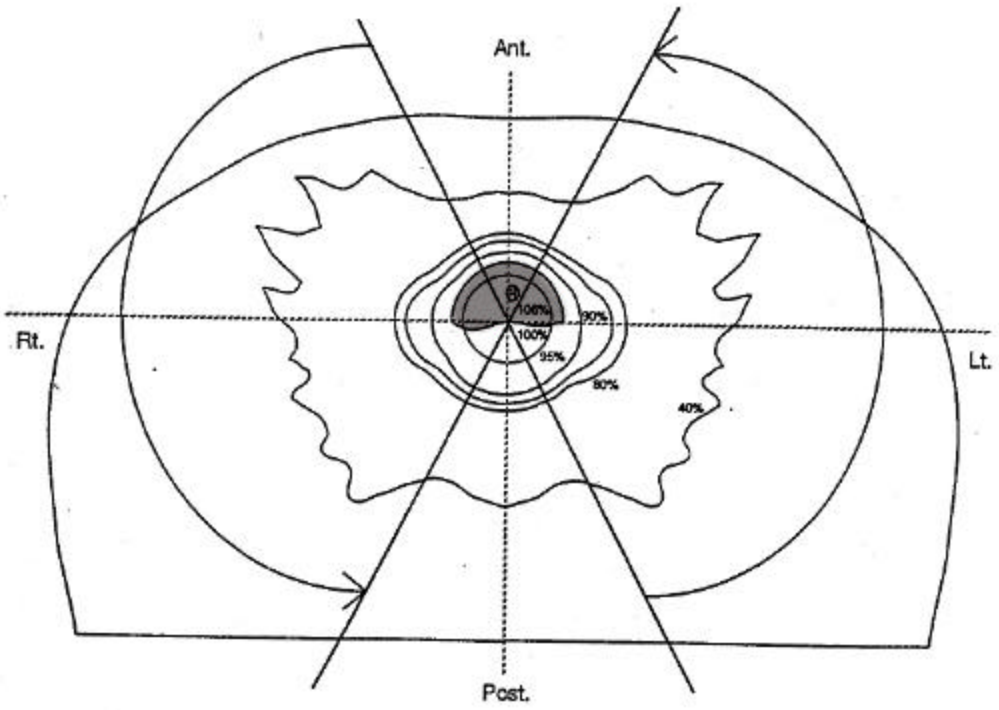
32.



The isodose distribution shown for 120 degree bilateral arc treatment of the prostate could be improved by:

(1) past pointing the isocenter posteriorly.
(2) past pointing the isocenter anteriorly.
(3) the addition of wedges.
(4) use of smaller arcs.

(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.

33. What is the approximate density of muscle?

(A) 0.65 g/cc
(B) 0.95 g/cc
(C) 1.00 g/cc
(D) 1.03 g/cc
(E) 1.65 g/cc

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34. Which of the following is the accelerator component that supplies pulses of high-power radiofrequency microwave energy to accelerate injected electrons?

(A) klystron
(B) electron gun
(C) high-voltage power supply
(D) bending magnet
(E) thyratron

35. Which of the following represents the ratio of the scatter dose at a given point in the phantom to a dose in free space at the same point?

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