Brachytherapy Practice Problems EXTRA

1. 100 mCi decays to 12.5 mCi in ___ days, if the half-life is 17d.
   a. 170
   b. 136
   c. 85
   d. 51
   e. 25

2. A radionuclide has a half-life of 74 d. The activity after 370 days is 10mCi. The initial activity was ___ mCi.
   a. 160
   b. 240
   c. 320
   d. 560
   e. 640

3. The exposure rate in air at 1 meter from a 10 Ci HDR Ir-192 source is ____ mR/min. (I' = 4.7 Rcm²/mCi-h)
   a. 11
   b. 52
   c. 78
   d. 109
   e. 226

4. For point sources of all of the following radionuclides used in Brachytherapy the dose rate vs. depth curve closely follows the inverse square function, between one and five cm, except for:
   a. Gold 198
   b. Iridium 192
   c. Cesium 137
   d. Iodine 125
   e. Radium 226

5. The initial dose rate at a reference point in a permanent prostate seed implant is 27 cGy per hour. The half-life is 17 days. The total dose from the implant delivered at the reference point is ______ cGy.
   a. 15,860
   b. 16,200
   c. 16,550
   d. 16,940
   e. 17,320

6. The transport index on a package of radioactive material indicates:
   a. The number of similar packages the carrier can transport together.
   b. The dose rate at 1 m from the surface.
   c. The dose rate at 1 cm from the surface.
   d. The activity of the source in the Bq.
7. When Pd 103 seeds are used instead of I 125 seeds for permanent prostate implants, all of the following are true except:
   a. The half-life is shorter.
   b. The anisotropy correction is not required.
   c. The photon energy is lower.
   d. The initial dose rate is higher.

Match the radioisotope with its clinical use and properties. (Answers can be used more than once or not at all).

8. _____ Has a gamma energy of 0.66 MeV
9. _____ Emits 27 and 35 keV photons
10. _____ Has the greatest HVL in Pb
11. _____ Emits alphas
12. _____ Is a pure beta emitter
   a. Radium 226
   b. Phosphorus 32
   c. Iodine 125
   d. Iridium 192
   e. Cesium 137

13. In Brachytherapy, HDR is superior to conventional LDR for all of the following reasons, except:
   a. Reduced need for hospital stay.
   b. Reduced radiation exposure to staff, under normal operating conditions.
   c. Simplifies source inventory and calibration, as only one source is used.
   d. Dose distribution can be optimized.
   e. Reduced risk of normal tissue complications.

14. Strontium-90 emits 2.2 MeV betas. Their range in air is about _____. (The density of air is 0.00129 gm/cm³).
   a. 50 cm
   b. 1 m
   c. 10 m
   d. 20 m
   e. 50 m

15. The number of TVL’s of shielding required in the wall of a high dose rate afterloader room depend on all of the following factors except the:
   a. Radionuclide
   b. Workload
   c. Minimum distance from source to wall
   d. Wall material
   e. Maximum activity of the source

16. The number of HVL’s required to reduce the exposure rate from a radionuclide from 64 mR/hr to 2mR/hr is:
   a. 6
   b. 5
   c. 4
   d. 3
   e. Depends on the radionuclide
17. If the exposure rate at 1 m from a Brachytherapy patient is 50 mR/hr, the exposure rate at 20 cm (assuming a point source) is _____ mR/hr.
   a. 100
   b. 250
   c. 1250
   d. Depends on the radionuclide

18. The instrument best suited for finding a dropped iodine 125 seed is a(n):
   a. Thimble Farmer chamber
   b. Geiger counter
   c. Thermoluminescent dosimeter
   d. Diode
   e. Ionization survey meter

19. After 10 half-lives, the activity (A) of a radionuclide is reduced to approximately:
   a. A/10
   b. $Ae^{1/10}$
   c. A/1000
   d. Zero

20. A batch of Iodine 125 seeds is ordered so that the activity will be 0.48 mCi/seed on the day of the prostate implant. If the seeds arrive five days before the implant, the expected activity on receipt is _____ mCi/seed.
   a. 0.45
   b. 0.51
   c. 0.55
   d. 0.57
   e. 0.59

21. The dose distribution in tissue up to 5 cm from an Iridium 192 seed closely follows the inverse square law because:
   a. No other factors are involved
   b. Up to 5 cm, tissue attenuation is always negligible
   c. For this photon energy, tissue attenuation is negligible
   d. Scatter dose buildup and attenuation approximately cancel each other out
   e. Dose from betas emitted by the source cancels the attenuation

22. To calculate the dose rate at a given distance from a patient with a temporary seed implant, all of the following information is required except:
   a. Radionuclide
   b. Half-life
   c. Distance from sources
   d. Source strength

23. A preplan is performed for an Iodine 125 implant: 100 seeds are required and 115 are ordered. If the procedure has to be delayed for 7 days, and the same batch of seeds and is used, the number of seeds now required would be ______.
   a. 92
   b. 98
   c. 102
   d. 108
   e. 116
24. If a permanent seed implant has a half-life of 17 days if, after how many days will 75% of the total dose have been delivered?
   a. 34 days
   b. 25 days
   c. 17 days
   d. 13 days
   e. 4 days

25. After receiving a batch of loose Iodine 125 seeds for a prostate implant, the AAPM task group 40 report and most state regulations require all of the following to be performed except:
   a. At least 50% of the seeds should have their activity independently verified by the user
   b. Seeds assayed for activity by the user should have a mean activity within +/-3% of the manufacturer’s stated activity
   c. After loading the seeds into cartridges and removing them for sterilization, the preparation area and surrounding area should be surveyed for dropped or improperly shielded sources
   d. Cartridges prepared for sterilization should be clearly labeled with the radionuclide, date, and activity

26. A Brachytherapy source transport container has a dose rate of 18 mR/hr at 20 cm from its center. At what distance from the center will the dose rate fall to 2 mR/hr?
   a. 180 cm
   b. 120 cm
   c. 80 cm
   d. 60 cm
   e. 40 cm

27. An HDR treatment takes 366 seconds on the first treatment day. If the source is Ir-192 (half-life 74 days), the treatment time exactly one week later will be ____ sec.
   a. 343
   b. 355
   c. 372
   d. 387
   e. 391

Match the photon energy with the radionuclide:
28. Cesium 137 _____ a. 30 keV average
29. Iodine 125 _____ b. 141 keV
30. Iridium 192 _____ c. 380 keV average
31. Cobalt 60 _____ d. 662 keV
   e. 1.25 MeV average

32. Historically, Cesium-137 activity has been expressed in terms of mg-Ra-eq because:
   a. The activity in millicuries is difficult to determine
   b. The gamma-ray energy is the same
   c. Patterson-Parker tables designed for radium could be used
   d. Shielding requirements are the same for 1 mg radium and 1 mg-Ra-eq Cesium-137
   e. All of the above
33. If the half-life of Palladium-103 is 17 days, a consignment of seeds will decay to _____ % of their initial activity after one week.
   a. 97  
   b. 83  
   c. 75  
   d. 41  
   e. 25

34. The air kerma strength of an HDR Iridium-192 source is 40,000 cGy h\(^{-1}\) cm\(^2\). The dose received in 1 minute at 1 m from the unshielded source would be _____ cGy.
   a. 4.0  
   b. 2.4  
   c. 0.67  
   d. 0.24  
   e. 0.067

35. The rapid fall-off of dose with distance around a Cesium-137 source in tissue is mainly due to:
   a. Tissue attenuation  
   b. The inverse square law  
   c. The short range of the betas  
   d. The short range of the alphas  
   e. Attenuation in the source encapsulation

36. The prescribed dose for a prostate implant using Palladium-103 is usually lower than for Iodine-125 implants because Palladium-103:
   a. Delivers the dose in a shorter time  
   b. Requires less initial activity  
   c. Has a lower initial dose rate in the prostate  
   d. Poses a greater radiation hazard to staff and family members

37. The total dose from a permanent seed implant is 1600 cGy. The half-life is 17 days. The total dose delivered in the first 34 days is _____ cGy.
   a. 1400  
   b. 1200  
   c. 800  
   d. 400  
   e. 40

38. A patient has a brachytherapy insertion lasting 36 hours. In the adjacent waiting room the maximum dose rate is 1.9 mR/hr. The required action for this room is:
   a. To post a “radiation area” sign on the door  
   b. To place lead shields against the wall to reduce the dose rate  
   c. To allow only personnel with film badges in the room  
   d. To vacate the room until the sources have been removed  
   e. No precautions are required

39. Regarding the radioactive package labeling, which is false?
   a. Yellow III has a higher dose rate at 1 m than Yellow II  
   b. Yellow II has a higher dose rate at 1 m than White I  
   c. The transport index (TI) is the dose rate on the surface of the package  
   d. The type of label implies a maximum dose rate on the surface and at 1 m
40. Unused Iodine-125 seeds must be stored for a minimum of ___ before being discarded.
    a. 10 months
    b. 5 years
    c. 10 half lives
    d. 20 half lives
    e. They can never be discarded by the user, but must be returned to the manufacturer

41. An HDR treatment with interstitial catheters is delivered daily for five days. Checks done before each fraction should show that all of the following are constant except:
    a. The distance from the indexer to the first dwell position
    b. The product of source strength and dwell time
    c. The position of the catheters in the patient
    d. The total treatment time

Match the radioisotope with its clinical use and properties. (Answers can be used more than once.)
42. Has half-life of 74 days
    a. Ra-226
43. Is a pure beta emitter
    b. P-32
44. Emits 27 and 35 KeV photons
    c. I-125
d. Ir-192
e. Cs-137

45. The dose rate in cGy/hr in air at 1 m from a radioactive source is closest, numerically, to the source strength expressed in:
    a. mCi
    b. Ci
    c. GBq
    d. Air kerma rate
    e. Mg Ra eq

46. 240 mgRaeq of Iridium seeds are placed in a shipping container with radius of 10 cm. How many tenth value layers of shielding must be placed around the sources to reduce the exposure rate on the surface of the container to less than 2 mR/hr? (The exposure rate constant of radium= 8.25 R.cm^2/mg.h)
    a. 0
    b. 1
    c. 2
    d. 4
    e. 8

47. An anisotropy correction is used in I-125 seed Brachytherapy calculations to account for:
    a. Absorption in adjacent seeds
    b. Decay of activity between the date of source calibration and the date of implantation
    c. Reduction in average dose rate due to self-absorption along the seed axis
    d. Conversion between different units of activity

48. A patient who had an Iodine-125 seed implant three years ago is admitted for a TURP. The activity implanted was 25 mCi. Which of the following is true?
    a. Radiographs should not be attempted, as radiation from the seeds would fog the film
    b. The Physician performing the TURP would need to wear a lead apron
    c. The TURP should not be attempted because of the exposure hazard to OR staff
    d. No special radiation safety precautions are necessary to protect the staff
49. A physician needs to loan a 10 mCi source of Y-90 to a colleague in a different hospital for an experiment. Which of the following is an acceptable method of transport?
   a. The Physician can hand carry the source, if correctly labeled, and take public transport
   b. The source must be packaged according to DOT regulations and can then be taken by a graduate student on a bus
   c. The source can be hand carried by the Physician, with no label, provided the distance is less than 2 miles
   d. The source must be packaged according to the DOT regulations, appropriately labeled, and can be sent by a commercial carrier

50. After removing a temporary implant of iridium seeds from a patient, the Physician should immediately:
   a. Called the radiation safety officer to request that a room survey be performed within 24 hours
   b. Monitor the patient and bedding for remaining sources with a sensitive detector
   c. Order radiographs to detect any remaining sources
   d. Count each of the sources to verify that all sources inserted are present
   e. None of the above are necessary

51. A resident checking on an inpatient with a Cesium-137 insertion wishes to reduce his/her exposure. Which of the following would be the most effective?
   a. Reducing time spent with the patient by half
   b. Wearing a lead apron
   c. Using a lead shield of thickness one HVL
   d. Doubling the distance from the patient
   e. All of the above have about an equal effect