

Test Bank for Radiographic Imaging and Exposure 5th Fauber

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Chapter 02: The X-ray Beam

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MULTIPLE CHOICE

1. The _____ is the portion of the x-ray tube that contains the filament.
 - a. cathode
 - b. anode
 - c. rotor
 - d. rotating disk

ANS: A

The filament, the source of electrons during x-ray production, is located in the cathode.

REF: p.16

2. The cathode filament is made of:
 - a. tungsten.
 - b. rhenium.
 - c. molybdenum.
 - d. lead.
 - e. nickel.

ANS: A

The cathode filament is made of tungsten.

REF: p.16

3. The focusing cup:
 - a. surrounds the anode.
 - b. has a positive charge.
 - c. has a negative charge.
 - d. focuses the x-ray beam.

ANS: C

The focusing cup, surrounding the filament on three sides, has a negative charge, keeping the negatively charged electrons focused.

REF: p.16

4. In a dual-focus tube, how many filaments are energized at any one time during x-ray production?
 - a. One
 - b. Two
 - c. Four
 - d. An infinite number

ANS: A

Only one filament is energized at any one time during x-ray production.

REF: p.16

5. The focusing cup is made of:
- tungsten.
 - rhenium.
 - molybdenum.
 - lead.
 - nickel.

ANS: E

The focusing cup is made of nickel.

REF: p.16

6. _____ is the phenomenon that occurs around the filament during thermionic emission and prevents the further escape of electrons from the filament.
- Saturation current
 - Space charge effect
 - mA rectification
 - Line focus principle

ANS: B

The space charge effect limits the number of electrons in the space charge by preventing additional electrons from being boiled off the filament.

REF: p.24

7. The positive side of the x-ray tube is the:
- anode.
 - cathode.
 - window.
 - stream of electrons.

ANS: A

The anode is the positive side of the x-ray tube, and the cathode is the negative.

REF: p.17

8. The maximum speed the rotating anode will typically achieve is _____ rpm.
- 3200
 - 5000
 - 10,000
 - 20,000

ANS: C

Rotating anodes rotate at a set speed ranging from 3000 to 10,000 revolutions per minute (rpm).

REF: p.17

9. What is the base material of the anode disk?
- Molybdenum
 - Tungsten

- c. Rhenium
- d. Graphite
- e. A and B
- f. A and D

ANS: F

The base of the rotating anode disk is made of molybdenum with a graphite layer.

REF: p.17

10. What is the name of the fixed physical area on the anode target that is struck by the electron stream?
- a. Focal spot
 - b. Focal point
 - c. Focal range
 - d. Any of the above

ANS: A

The focal spot is the fixed physical area on the focal track of the anode target where electrons strike.

REF: p.18

11. What is the name of the device in a rotating anode x-ray tube that turns the rotor?
- a. Stator
 - b. Rotor
 - c. Focusing cup
 - d. Rheostat

ANS: A

Located outside the envelope of the x-ray tube, the stator is an electric motor that turns the rotor.

REF: p.18

12. Effective compensation for the anode heel effect would involve positioning:
- a. the thinnest portion of the part under the anode.
 - b. the thickest portion of the part under the anode.
 - c. the thinnest portion of the part under the cathode.
 - d. B and C.

ANS: A

The thinnest portion of a part should be placed under the anode, because the more intense x-rays are emitted toward the cathode end of the tube, where the thickest part should be placed.

REF: p.34

13. What is an acceptable level of leakage from the tube housing?
- a. 100 mR per hour, measured 6 feet away
 - b. 10 mR per hour, measured 1 foot away
 - c. 1000 R per hour, measured at a distance of 4 meters

d. 100 mR per hour, measured at a distance of 1 meter

ANS: D

The maximum amount of leakage radiation from an x-ray tube is 100 mR per hour when measured at a distance of 1 meter.

REF: p.20

14. Which of the following could be defined as the production of an x-ray photon by the electrostatic attraction between the incident electron and the nucleus of the tungsten atom?
- Photoelectric interaction
 - Bremsstrahlung interaction
 - Characteristic interaction
 - Pair production interaction

ANS: B

Production of an x-ray photon as a result of a slowing down of the incoming electron due to the electrostatic force of the nucleus is due to a bremsstrahlung interaction.

REF: p.20

15. Which of the following could be defined as the production of an x-ray photon by a collision between the incident electron and a K-shell electron of the tungsten atom?
- Photoelectric interaction
 - Bremsstrahlung interaction
 - Characteristic interaction
 - Pair production interaction

ANS: C

Characteristic interactions involve the incident electron colliding with a K-shell electron and ejecting it from orbit. X-rays are produced as a result.

REF: p.21

16. _____ is the boiling off of electrons from the filament when current is applied.
- Saturation emission
 - Thermionic emission
 - Filament transport
 - Proton emission

ANS: B

Thermionic emission is the emission of electrons (ion) as a result of heat (therm). The heating of the filament is due to the application of current.

REF: p.23

17. The actual flow of electrons from cathode to anode within the x-ray tube is known as:
- tube current.
 - filament current.
 - anode current.
 - A and C.

ANS: A

The tube current is the flow of electrons from cathode to anode within the tube.

REF: p.24

18. mA is a measure of _____ that flows from cathode to anode.
- filament current
 - tube current
 - space charge
 - thermionic emission

ANS: B

mA or milliampere, is the unit of measure for the amount of current flowing from cathode to anode within the x-ray tube.

REF: p.24

19. Increasing the kVp will do which of the following?
- Decrease the tube current.
 - Increase the speed of the electrons.
 - Increase the penetrability of the beam.
 - A and C.
 - B and C.

ANS: E

Increasing the kilovoltage (kVp) increases the speed of the electrons traveling between cathode and anode and results in an x-ray beam with greater penetrability.

REF: p.27

20. The amount the voltage varies during an x-ray exposure is known as:
- kVp.
 - voltage ripple.
 - mA.
 - tube current.

ANS: B

The amount of variation of the voltage during an x-ray exposure is voltage ripple; it can vary from 100% to less than 1%, depending on the type of generator being used.

REF: p.28

21. What focal spot size is measured directly under the anode target?
- Actual focal spot
 - Target focal spot
 - Filament focal spot
 - Effective focal spot

ANS: D

Based on the line focus principle, the effective focal spot size refers to the measurement of the focal spot from a point directly below the target.

REF: p.32

22. Filtration of the x-ray beam results in:
- increased beam quality.
 - increased beam quantity.
 - lower average energy photons.
 - A and C.

ANS: A

Beam filtration results in removing lower-energy x-ray photons, resulting in an x-ray beam with fewer photons but with a higher average energy.

REF: p.36

23. Which of the following is not classified as inherent filtration?
- The oil in the transformer
 - The collimator mirror
 - The tube envelope
 - The oil surrounding the tube

ANS: A

The oil in the transformer is not in the path of the x-ray beam, so it has no role in filtering the beam.

REF: p.35

24. The amount of filtration required to reduce the exposure of the beam to half of its original intensity is defined as:
- wedge filtration.
 - HVL.
 - mAs compensator.
 - TVL.

ANS: B

HVL, or half value layer, is the amount of filtration needed to reduce the intensity of the x-ray beam to half of its original.

REF: p.36

25. Which of the following types of filtration produce a more uniform exposure to the image receptor?
- Compensating
 - Half-value
 - Inherent
 - Spatial

ANS: A

Compensating filters are added filters that alter the beam intensity so images of nonuniform anatomic structures have more uniform brightness/density.

REF: p.36

26. In order to produce x-rays, electrons must be:

- a. suddenly decelerated.
- b. accelerated.
- c. liberated from the cathode filament.
- d. all of the above.

ANS: D

Electrons must be liberated from the cathode filament (thermionic emission), accelerated, and then decelerated very suddenly in order to produce x-rays.

REF: p.16

27. The device that nearly surrounds the filament is the:
- a. rotor.
 - b. focusing cup.
 - c. stator.
 - d. anode.

ANS: B

The focusing cup surrounds the filament with the exception of the side open to the anode.

REF: p.16

28. A dual-focus tube has two:
- a. cathode filaments.
 - b. anodes.
 - c. tubes.
 - d. none of the above.

ANS: A

A dual-focus x-ray tube has two cathode filaments: a large and a small one.

REF: p.16

29. The rotating target track is primarily made of:
- a. rhenium.
 - b. nickel.
 - c. tungsten.
 - d. copper.

ANS: C

The target track of a rotating anode is made up primarily of tungsten.

REF: p.17

30. The target angle of rotating targets typically ranges from:
- a. 1° to 5°.
 - b. 5° to 20°.
 - c. 30° to 50°.
 - d. 50° to 70°.

ANS: B

Rotating anode target angles usually range from 5° to 20°.

REF: p.17

31. Tungsten has a _____ atomic number and a _____ melting point.
- a. low; low
 - b. low; high
 - c. high; low
 - d. high; high

ANS: D

Tungsten has a high atomic number and a high melting point.

REF: p.17

32. The part of the x-ray tube that is connected to the target and causes it to turn is the:
- a. filament.
 - b. rotor.
 - c. stator.
 - d. base.

ANS: B

The rotor is physically connected to the target and causes it to turn.

REF: p.18

33. The advantage to having a focal track is that:
- a. the focal spot will be smaller.
 - b. the focal spot will be larger.
 - c. lower exposure factors can be used.
 - d. higher exposure factors can be used.

ANS: D

When the stream of electrons constantly has a new area of the target to hit, the result is that higher exposure factors can be used.

REF: p.18

34. _____ envelopes are more commonly used in today's x-ray tubes.
- a. Glass
 - b. Paper
 - c. Metal
 - d. Lead

ANS: C

Metal envelopes are more commonly found in today's x-ray tube, replacing glass envelopes.

REF: p.19

35. As compared to glass, which of the following is an advantage to having a metal envelope x-ray tube?
- a. Decrease in off-focus radiation
 - b. Increase in off-focus radiation
 - c. Increased deposits of tungsten on the inside surface of the envelope

d. A and C

ANS: A

The metal x-ray tube envelope results in less off-focus radiation being produced.

REF: p.20

36. Inside the x-ray tube envelope you will find:

- a. oil.
- b. air.
- c. A and B.
- d. none of the above.

ANS: D

The x-ray tube envelope has been evacuated, leaving a vacuum present.

REF: p.20

37. The speed the electrons inside the x-ray tube travel is:

- a. the speed of light.
- b. approximately one half the speed of light.
- c. dependent on the mAs set.
- d. dependent on the exposure time set.

ANS: B

The electrons in the tube current travel at approximately one half the speed of light.

REF: p.20

38. Diagnostic x-ray exposures range from:

- a. 15 to 40 kVp.
- b. 20 to 65 kVp.
- c. 30 to 150 kVp.
- d. 60 to 225 kVp.

ANS: C

The kVp in the diagnostic x-ray range varies from approximately 30 to 150.

REF: p.20

39. With a standard x-ray tube, _____% of the x-ray beam produced with 65 kVp is the result of bremsstrahlung interactions.

- a. 0
- b. 15
- c. 85
- d. 100

ANS: D

With a standard x-ray tube, 100% of the x-ray beam produced with 65 kVp is the result of bremsstrahlung interactions. The electrons must have at least 69.5 keV to produce characteristic radiation.

REF: p.20

40. With a standard x-ray tube, _____% of the x-ray beam produced with 90 kVp is the result of bremsstrahlung interactions.
- a. 0
 - b. 15
 - c. 85
 - d. 100

ANS: C

With a standard x-ray tube, 85% of the x-ray beam produced with 90 kVp is the result of bremsstrahlung interactions.

REF: p.20

41. With a standard x-ray tube, _____% of the x-ray beam produced with 65 kVp is the result of characteristic interactions.
- a. 0
 - b. 15
 - c. 85
 - d. 100

ANS: A

With a standard x-ray tube, 0% of the x-ray beam produced with 65 kVp is the result of characteristic interactions. The electrons must have at least 69.5 keV to produce characteristic radiation.

REF: p.21

42. With a standard x-ray tube, _____% of the x-ray beam produced with 90 kVp is the result of characteristic interactions.
- a. 0
 - b. 15
 - c. 85
 - d. 100

ANS: B

With a standard x-ray tube, 15% of the x-ray beam produced with 90 kVp is the result of characteristic interactions.

REF: p.21

43. X-ray photon energy is measured in:
- a. kVp.
 - b. mA.
 - c. angstroms.
 - d. keV.

ANS: D

X-ray photon energy is measured in keV.

REF: p.22

44. The wide range of energies in the x-ray beam is known as the:
- a. homoenergetic spectrum.
 - b. x-ray emission spectrum.
 - c. gamma ray emission spectrum.
 - d. x-ray transmission spectrum.

ANS: B

The x-ray beam is polyenergetic (has many energies) and consists of a wide range of energies known as the x-ray emission spectrum.

REF: p.22

45. The highest energy x-ray photons produced with a 100 kVp exposure will be:
- a. 50 keV.
 - b. 75 keV.
 - c. 100 keV.
 - d. 125 keV.

ANS: C

In that the p in kVp stands for peak, the highest energy produced with a 100 kVp exposure is 100 keV.

REF: p.22

46. When making an exposure, which of the following does not occur when just the rotor, or prep button, is activated?
- a. The anode begins to rotate.
 - b. Voltage is applied across the tube.
 - c. Current is applied to the filament.
 - d. A space charge is created.

ANS: B

Voltage is not applied across the tube until the exposure button has been pressed.

REF: p.24

47. Filament current is approximately:
- a. 0.5 to 2 mA
 - b. 3 to 5 mA
 - c. 0.5 to 2 A
 - d. 3 to 5 A

ANS: D

It takes about 3 to 5 A of current passing through the filament to produce enough thermionic emission to create a space charge.

REF: p.23

48. During x-ray production, the energy of the moving electrons is converted into:
- a. kinetic energy.
 - b. thermal energy.
 - c. electromagnetic energy.

- d. A and C.
- e. B and C.

ANS: E

The kinetic energy of the electrons is converted into thermal (heat) and electromagnetic (x-ray) energies.

REF: p.16

49. The quality of the x-ray beam indicates:
- a. the number of photons.
 - b. the ability of the photons to penetrate.
 - c. the quantity of radiation.
 - d. whether or not the photons were made well.

ANS: B

X-ray beam quality refers to the penetrability of the photons.

REF: p.26

50. Doubling mA results in:
- a. doubling the tube current.
 - b. doubling the quantity of x-ray photons.
 - c. doubling the thermionic emission.
 - d. all of the above.

ANS: D

Doubling the mA results in twice the thermionic emission, twice the tube current, and twice the number of x-ray photons produced.

REF: p.30

51. Decreasing the exposure time results in:
- a. fewer x-ray photons.
 - b. more x-ray photons.
 - c. higher photon energy.
 - d. lower photon energy.

ANS: A

Fewer x-ray photons are produced when the exposure time is shortened.

REF: p.30

52. How much is the mAs when 400 mA and 100 ms are used?
- a. 4 mAs
 - b. 40 mAs
 - c. 400 mAs
 - d. 4000 mAs

ANS: B

Since mAs is $\text{mA} \times \text{exposure time}$, $400 \text{ mA} \times 0.100 \text{ s}$ is equal to 40 mAs.

REF: p.30

53. When electrons strike the anode target, their kinetic energy is converted into ____% heat and ____% x-rays:
- a. 1; 99
 - b. 99; 1
 - c. 0; 100
 - d. 100; 0
 - e. 50; 50

ANS: B

Most of the electron kinetic energy in the tube current (>99%) is converted into heat, whereas less than 1% of it is converted into x-rays.

REF: p.24

54. The larger the anode angle, the:
- a. larger the actual focal spot.
 - b. smaller the actual focal spot.
 - c. larger the effective focal spot.
 - d. smaller the effective focal spot.

ANS: C

Based on the line focus principle, the larger the anode angle, the larger the effective focal spot.

REF: p.33

55. Due to the anode heel effect, the differences in intensities between the ends of the x-ray field can be as much as:
- a. 10%.
 - b. 25%.
 - c. 45%.
 - d. 60%.

ANS: C

The intensities between the anode and cathode ends of the x-ray field can vary as much as 45% due to the anode heel effect.

REF: p.34

56. Added tube filtration is typically made of:
- a. lead.
 - b. tungsten.
 - c. glass.
 - d. aluminum.

ANS: D

Added tube filtration is usually made of aluminum.

REF: p.35

57. X-ray tubes operating above 70 kVp must have total filtration of at least _____ of aluminum, or its equivalent.
- a. 0.5 mm
 - b. 1 mm
 - c. 2 mm
 - d. 2.5 mm

ANS: D

X-ray tubes operating above 70 kVp must have total filtration of at least 2.5 mm of aluminum, or its equivalent.

REF: p.35

58. As kVp increases, beam penetrability _____.
- a. increases
 - b. decreases
 - c. stays the same

ANS: A

As kVp increases, beam penetrability increases.

REF: p.27

59. The amount of heat produced from any given exposure is called a:
- a. heat unit.
 - b. three-phase generator.
 - c. focal track.
 - d. Hounsfield unit.

ANS: A

A heat unit is the amount of heat produced by any given x-ray exposure.

REF: p.37

60. How many HU are produced when using a three-phase x-ray unit, 400 mA, 200 ms, and 70 kVp?
- a. 5600 HU
 - b. 7560 HU
 - c. 5,600,000 HU
 - d. 7,560,000 HU

ANS: B

Heat units for a three-phase unit are equal to the $\text{kVp} \times \text{mA} \times \text{exposure time} \times 1.35$, which in this case equals $400 \times 0.2 \times 70 \times 1.35$, or 7560 HU.

REF: p.37

61. Setting identical exposure factors, which type of x-ray unit will produce the greatest heat?
- a. Single phase
 - b. Double phase
 - c. Three phase
 - d. High frequency

ANS: D

A high-frequency x-ray generator will produce the greatest heat.

REF: p.37

62. In order to produce 12 mAs, how long should the exposure time be when using 600 mA?
- 0.002 s
 - 0.02 s
 - 0.2 s
 - 2 s

ANS: B

Since mAs is equal to mA $\times$ exposure time, exposure time is equal to the mAs divided by the mA. In this example that would be 12 mAs divided by 600 mA or 0.02 s.

REF: p.31

63. Which of the following practices will extend the life of the x-ray tube?
- Use low mA and longer exposure time.
 - Warm up the tube as appropriate.
 - Hold down the rotor button for a long time, to keep the tube warmed up.
- 1 and 2 only
 - 1 and 3 only
 - 2 and 3 only
 - 1, 2, and 3

ANS: A

In order to have the tube last longer, it is recommended that lower mA, longer exposure time, and tube warm-up as appropriate be practiced. The rotor button should be depressed for as little time as possible.

REF: p.39

TRUE/FALSE

1. When an electron from the L-shell of the tungsten atom is ejected from its orbit by a projectile electron, high-energy x-ray photons are produced.

ANS: F

Very low-energy x-rays are produced when an L-shell electron is ejected from its orbit.

REF: p.21

2. The x-ray beam produced with 120 kVp will consist primarily of x-rays produced by bremsstrahlung interactions.

ANS: T

Approximately 85% of the x-ray beam produced at 120 kVp will consist of x-rays produced by bremsstrahlung interactions.

REF: p.20

3. Electrons can flow from cathode to anode or from anode to cathode during the x-ray exposure.

ANS: F

Electrons can only flow from cathode to anode during x-ray production.

REF: p.24