

## **Chapter 2: 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.

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

ANS: A

The filament is made of tungsten.

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, has a negative charge, keeping the negatively charged electrons from spreading apart.

4. \_\_\_\_\_ is the phenomenon that occurs around the filament during thermionic emission and prevents the further escape of electrons from the filament.
  - a. Saturation current
  - b. Space charge effect
  - c. mA rectification
  - d. 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.

5. The positive side of the x-ray tube is the:
  - a. anode.
  - b. cathode.
  - c. window.
  - d. stream of electrons.

ANS: A

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

6. The maximum speed the rotating anode will most likely achieve is \_\_\_\_\_ rpm.
- a. 3200
  - b. 5000
  - c. 10,000
  - d. 20,000

ANS: C

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

7. What is the base material of the rotating anode?
- a. Molybdenum
  - b. Tungsten
  - c. Rhenium
  - d. Beryllium

ANS: A

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

8. What is the anode target of a mammographic tube made of?
- a. Molybdenum
  - b. Tungsten
  - c. Rhenium
  - d. Beryllium

ANS: A

The anode target of a mammographic tube is made of molybdenum instead of tungsten, in order to produce lower energy x-rays.

9. What is the name of the exact area on the anode that is struck by the electron beam?
- a. Focal spot
  - b. Focal point
  - c. Target
  - d. Any of the above

ANS: A

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

10. 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.

11. 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, where the thickest part should be placed.

12. What is an acceptable level of leakage from the tube housing?
- a. 100 mR/hr measured 6 feet away
  - b. 10 mR/hr measured 1 foot away
  - c. 1000 R/hr measured at a distance of 4 meters
  - d. 100 mR/hr measured at a distance of 1 meter

ANS: D

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

13. 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?
- a. Photoelectric interaction
  - b. Bremsstrahlung interaction
  - c. Characteristic interaction
  - d. 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.

14. 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?
- a. Photoelectric interaction
  - b. Bremsstrahlung interaction
  - c. Characteristic interaction
  - d. 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.

15. \_\_\_\_\_ is the boiling off of electrons from the filament when current is applied.
- a. Saturation emission
  - b. Thermionic emission
  - c. Filament transport
  - d. 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.

16. What is the term used to describe the resistance to letting more electrons escape from a heated filament?
- a. Saturation emission
  - b. Space charge effect
  - c. Electrostatic attraction
  - d. Thermionic emission

ANS: B

The space charge effect involves the space charge (cloud of electrons with a strong negative charge) limiting the amount of additional electrons being emitted from the filament.

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

ANS: A

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

18. mA is a measure of \_\_\_\_\_ that flows from cathode to anode.
- a. filament current
  - b. tube current
  - c. space charge
  - d. thermionic emission

ANS: B

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

19. Increasing the kVp will do which of the following?
- a. Decrease the tube current.
  - b. Increase the speed of the electrons.
  - c. Increase the penetrability of the beam.
  - d. b and c

ANS: D

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.

20. The amount the voltage varies during an x-ray exposure is known as:
- a. kVp.
  - b. voltage ripple.
  - c. mA.
  - d. 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.

21. What is the focal spot size measured directly under the anode target?
- a. Actual focal spot
  - b. Target focal spot
  - c. Filament focal spot
  - d. 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.

22. The filtration of the x-ray beam results in:
- a. increased beam quantity.
  - b. increased beam quality.
  - c. lower average energy photons.
  - d. b and c

ANS: B

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.

23. Which of the following is not classified as inherent filtration?
- a. The oil in the transformer
  - b. The collimator mirror
  - c. The glass tube envelope
  - d. 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.

24. The amount of filtration required to reduce the exposure of the beam to half of its original intensity is defined as:
- a. wedge filtration.
  - b. HVL.
  - c. mAs compensator.
  - d. mA linearity.

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.

25. Which of the following types of filtration produces a more uniform density on the radiograph?
- a. Compensating
  - b. Half-value
  - c. Inherent
  - d. Spatial

ANS: A

Compensating filters are added filters that alter the beam intensity so images of non-uniform anatomic structures have more uniform density.