Chapter 10

1. Most of the primary x-ray beam consists of:

a. electrons

b. bremsstrahlung

c. characteristic x-rays

d. heat

e. remnant radiation

2. In the x-ray tube anode, a high-speed electron collides with an orbital electron in the *K-shell*

of a tungsten atom. This will ultimately produce:

a. a high-energy characteristic x-ray

b. a low-energy characteristic x-ray

c. a high-energy bremsstrahlung x-ray

d. a low-energy bremsstrahlung x-ray

3. An atom is said to be in an “excited state” when:

a. one or more protons are at a higher energy level than usual

b. one or more electrons are in higher energy levels than usual

c. neutrons in the nucleus are raised to a high energy level

d. all electrons are at their lowest energy level

e. the nucleus is unstable

4. When an x-ray technique calls for 74 kVp and 80 mAs, which of the following

*bremsstrahlung* x-rays will appear?

a. 12 kV

b. 69 kV

c. 74 kV

d. all of the above

e. none of the above

5. How efficient is an x-ray tube at producing x-rays?

a. 99.5%

b. 80%

c. 20%

d. 2%

e. 0.5%

6. In the x-ray tube anode disc, a high-speed electron from the filament may knock out an orbital

electron. The atom then fills the vacancy in this orbit by “pulling down” an electron from

a higher orbit into the vacant slot. An x-ray will be emitted when this electron drops into

an orbit nearer the nucleus *because*:

a. potential energy is lost

b. kinetic energy is lost by the electron slowing down in the lower orbit

c. internal energy is lost

d. the anode heats up, and a heated anode always emits x-rays

e. this change in the atom makes it radioactive

7. When a bremsstrahlung x-ray is produced:

a. a target electron is displaced

b. a target electron is excited

c. a projectile electron loses energy

d. a projectile electron is absorbed

8. Useful characteristic x-rays are produced in tungsten:

a. when a projectile electron interacts with an outer-shell electron

b. when a valence electron is removed

c. by excitation of a K-shell electron

d. by ionization of a K-shell electron

9. An L-shell electron (with binding energy of 26 kV) is removed from an atom with an M-shell

binding energy of 4 kV and an N-shell binding energy of 1 kV. If a free electron (from

outside the atom) fills the vacancy of the L shell, the characteristic x-ray produced will

have an energy of:

a. 4 kV

b. 22 kV

c. 25 kV

d. 26 kV

e. 30 kV

10. In a typical x-ray tube operated at 90 kVp, the most abundant x-ray produced would be:

a. 10 kV bremsstrahlung

b. 30 kV bremsstrahlung

c. 12 kV characteristic

d. 90 kV characteristic

11. Mammography x-ray tubes use target materials with much lower atomic numbers than

tungsten. The affect this has upon the x-ray beam produced is:

a. lower average energy and less beam intensity

b. lower average energy but greater beam intensity

c. no change in average energy, but less beam intensity

d. higher average energy, but less beam intensity

e. higher average energy and higher beam intensity

12. All of the following increase the average energy of the x-ray beam spectrum *except:*

a. increased atomic number of the target material

b. increased mAs

c. increased filtration

d. increased generator efficiency

13. In the x-ray tube, a projectile electron knocks out a K-shell electron having a binding energy

of 70 kV. Immediately after, an x-ray with 11 kV is emitted from this atom. The

incoming projectile electron must have been carrying of kinetic energy:

a. 11 kV

b. 59 kV

c. Less than 70 kV

d. More than 70 kV

14. Electrons are in the lowest energy state when they are in the:

a. L shell

b. M shell

c. N shell

d. K shell

15. The exact moment that x-rays are produced in an x-ray tube is when:

a. electrons from the filament approach the speed of light

b. electrons are accelerated by an applied potential difference

c. electrons are decelerated by collisions with tungsten and rhenium atoms in the anode

disc

d. electrons flow through the filament making it red hot

e. electrons flow down the anode shank behind the disc

16. In an x-ray tube anode, if a projectile electron from the filament passes near a tungsten

atom’s nucleus, it will:

a. replace any missing orbital electron

b. knock out an orbital electron - when the orbital vacancy is filled later, an x-ray will be

produced

c. be pulled into and combine with the nucleus, making it radioactive

d. be slowed down by nuclear attraction, change direction, and lose energy in the form of

an x-ray

e. accelerate toward the image receptor plate

17. An atom is said to be in its “ground state” when:

a. one or more protons are at a lower energy level than usual

b. one or more electrons are in lower energy levels than usual

c. neutrons in the nucleus are lowered to a high energy level

d. all electrons are at their lowest energy level

e. the nucleus is stable

18. The nuclear force which holds electrons in “orbit” around an atom is called:

a. valence force

b. binding energy

c. electrostatic energy

d. charge

e. gravity

19. In an atom, when an electron drops down from the L shell to the K shell:

a. a photon will be emitted

b. there is no observable effect

c. the nucleus gains energy

d. the nucleus loses energy

e. the atom (as a whole) gains energy

20. Characteristic x-rays are produced in tungsten at an energy of:

a. 1/3 of the peak energy (kVp)

b. ½ of the peak energy (kVp)

c. about 69 kilovolts (kV)

d. all the same energies as bremsstrahlung

e. the energy of the incoming projectile electrons

21. A spectrum graph of the x-ray beam just as it leaves the anode shows that at this time the

greatest number of x-rays in the beam occur at which energy level?

a. high energy x-rays which later get filtered out

b. high energy x-ray which reach the patient

c. low energy x-rays which later get filtered out

d. low energy x-rays which reach the patient

e. medium energy x-rays

22. The beam spectrum for *characteristic* x-rays principally depends on:

a. the set kVp

b. the set mA

c. the set mAs

d. the anode target material

e. the specific projectile electron energy

23. Which of the following primarily accounts for the reduced intensity of x-ray emission at low

energy?

a. the atomic number of the anode target material

b. the energy of the projectile electrons

c. filtration

d. the probability of projectile electrons passing very close to an atomic nucleus

24. When bremsstrahlung is emitted:

a. it results from the conversion of kinetic energy

b. it results from the conversion of potential energy

c. an inner shell electron is removed from a target atom

d. an outer shell electron is removed from a target atom

e. a target atom is ionized

25. For tungsten target material, when the kVp is increased from 60 to 80, and the mAs is

unchanged:

a. characteristic x-rays produced remains unchanged

b. bremsstrahlung x-rays produced remains unchanged

c. the number of projectile electrons from the filament is increased

d. the number of x-rays produced is increased

26. Which of the following electron transitions will result in the highest energy x-ray?

a. K to M

b. K to O

c. O to K

d. M to K

e. from outside the atom to K

27. Which of the following bremsstrahlung could be produced from a 67-kV projectile electron?

a. 14 kV

b. 55 kV

c. 67 kV

d. all of these

e. none of these

28. When 65 kVp is applied to a tungsten-target x-ray tube:

a. no projectile electrons will have less than 65 kV of energy

b. some projectile electrons may have 65 kV of energy

c. some projectile electrons may have 72 kV of energy

d. L shell x-rays cannot be produced

29. As the energy of projectile electrons is converted into bremsstrahlung x-ray photons in the x-

ray tube anode, according to the formula for kinetic energy, by far, most of the energy

imparted to the x-rays comes from the:

a. projectile electrons’ mass

b. projectile electrons’ speed

c. projectile electrons’ potential energy

d. target atoms’ binding energy

30. Which of the following refers to the movement of several electrons as they fall in sequence

from higher energy levels to fill vacancies in lower-energy shells:

1. Characteristic cascade
2. Bremsstrahlung series
3. Excitation
4. Ionization avalanche

31. Most of the energy from the electron stream is dispersed as when excited outer-shell

electrons in the atoms of the anode fall back into their orbits:

a. x-rays

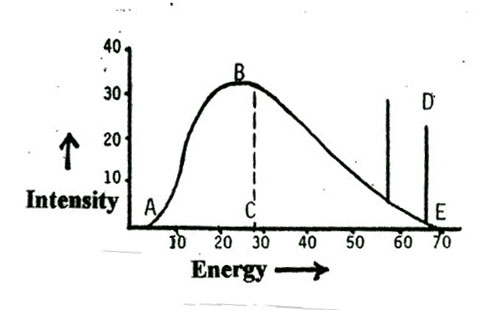
b. light

c. infrared rays

d. ultraviolet rays

e. gamma rays

For Questions #31 - #34, use the graph below:



32. In the x-ray beam spectrum graph above, the average voltage of the bremsstrahlung produced

is:

a. 5 kV

b. 28 kV

c. 32 kV

d. 67 kV

e. 70 kVp

33. In the x-ray beam spectrum graph above, point “E” would be indicative of the:

a. filtration

b. total mAs

c. average voltage

d. peak voltage (kVp)

e. maximum wavelength

34. In the x-ray beam spectrum graph above:

a. the kVp is 32

b. the mAs is 70

c. the minimum wavelength is 5

d. there is characteristic radiation ranging from 5 to 70 kV

e. there is characteristic radiation having 68 kV

35. In x-ray beam spectrum graph above, the left-to-right position of the curve at point

“A” would be associated with:

a. the kVp

b. the mAs

c. the average kV

d. the filtration

e. bremsstrahlung of minimum wavelength

36. The *average* photon energy of the x-ray beam graphed below is approximately:

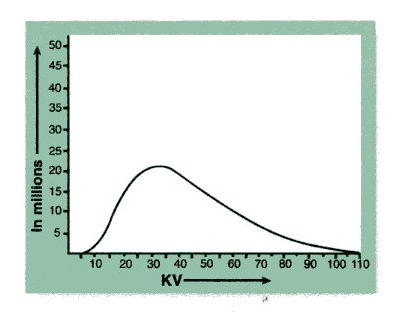
a. 22 kV

b. 28 kV

c. 37 kV

d. 50 kV

e. 60 kV



37. The graph below shows a change in the x-ray beam spectrum representing a change in:

a. filtration

b. milliamperage

c. kilovoltage

d. machine phase

e. exposure time

