MULTIPLE CHOICE

1. Because electron potential energy is greater the farther away a bound electron is from the nucleus, what results from an outer shell electron falling into an inner shell vacancy?
   a. The size of the nucleus increases.
   b. The atomic weight of the element increases.
   c. The binding energy of the outer shell electron decreases.
   d. Electromagnetic energy is released.
   e. The nucleus emits a proton.

   ANS: D

2. How much energy is released when a K-characteristic x-ray is emitted from a given element?
   a. The difference in binding energy between a K-shell electron and an L-shell electron.
   b. Energy equal to the kVp.
   c. The sum of the energies of the K-shell electron and the L-shell electron.
   d. Energy equal to the potential energy of the K-shell electron.
   e. No energy.

   ANS: A

3. Select the entire energy range that represents diagnostic x-rays.
   a. 70 kilo-electron volts (keV) to 90 keV
   b. 40 keV to 125 keV
   c. 40 keV to 150 keV
   d. 70 keV to 150 keV
   e. 125 keV to 300 keV

   ANS: C

4. A scattered x-ray is an x-ray that _____.
   a. has changed direction with a resulting increase in frequency and decrease in wavelength
   b. has changed direction with no subsequent change in frequency or wavelength
   c. has changed direction with an increase in both frequency and wavelength
   d. leaks out of the x-ray tube housing
   e. changes direction with a resulting increase in wavelength and decrease in frequency

   ANS: E

5. Select the relationship of wavelength to frequency in an electromagnetic waveform.
   a. Directly proportional
   b. Inversely proportional
   c. No relationship

   ANS: B

6. Which statement is true of the anode heel effect?
   a. The intensity of the x-ray beam is greater on the anode side of the tube.
   b. The heel effect is more evident when using the small focal spot.
   c. The heel effect is less evident at longer focal film distances.
   d. The heel effect is more evident with smaller exposure areas.
   e. Filtration minimizes the heel effect.

   ANS: C

7. Which of the following is a variable aperture beam-limiting device?
   a. Aperture diaphragm
   b. Cone
   c. Cylinder
   d. Collimator
   e. None of the above

   ANS: D

8. Which one of the following controls the initiation of electron flow from cathode to anode?
   a. Rotor switch
   b. mA control knob
   c. Timer
   d. Line voltage compensator
   e. Exposure switch

   ANS: E

9. Choose the electrical requirements necessary to operate a 300/125 x-ray machine that is hard-wired into a chiropractic office in the United States.
   a. 110 volts; 100 amps; 60 Hz; AC
   b. 110 volts; 60 amps; 60 Hz; AC
   c. 220 volts; 20 amps; 60 Hz; DC
   d. 220 volts; 100 amps; 60 Hz; AC
   e. 220 volts; 100 amps; 60 Hz; DC

   ANS: D

10. A lateral cervical spine view is taken at a 40-inch FFD using 70 kVp, 100 mAs, and .2 second. If the FFD were changed to 60 inches, which of the following techniques would produce the same exposure to the film as the original?
    a. 100 mA, .5 second, 70 kVp
    b. 300 mA, .15 second, 70 kVp
    c. 300 mA, .1 second, 70 kVp
    d. 200 mA, .044 second, 70 kVp
    e. 100m A, .088 second, 70 kVp

    ANS: B

11. According to federal standards, a 90-kVp beam requires which of the following measurements to be the equivalent of aluminum of total filtration to minimize soft radiation exposure to patients?
    a. 1.0 mm
    b. 1.5 mm
    c. 2.0 mm
    d. 2.5 mm
    e. 3.0 mm

    ANS: D

12. Which type of generator will produce the greatest effective tube current when identical exposure factors are used?
    a. Single-phase, half-wave rectified
    b. Single-phase, full-wave rectified
    c. Three-phase, six-pulse
    d. Three-phase, twelve-pulse
    e. 100 KHz high frequency

    ANS: E

13. What is the function of the high voltage circuit within the x-ray tube?
    a. To drive electrons from cathode to anode
    b. To select filament size
    c. To create a space charge for x-ray production
    d. To rectify filament current
    e. To activate the rotor

    ANS: A

14. Why is rectification of AC to DC important to the operation of the x-ray tube?
    a. To reduce the heel effect
    b. To help maintain a small effective focal spot
    c. To save on electricity
    d. To protect the cathode side of the tube from electron bombardment
    e. To reduce the electrical load on the anode

    ANS: D

15. The penetration of the x-ray beam is increased under which condition?
    a. As kVp is decreased
    b. As kVp is increased
    c. As mA is decreased
    d. As mA is increased
    e. As time is increased

    ANS: B

16. Which of the following combinations would produce the smallest effective focal spot?
    a. Using the large filament with a small anode angle
    b. Using the small filament with a small anode angle
    c. Using a small filament with a large anode angle
    d. Using a large filament with a large anode angle
    e. Using a small filament and no focusing cup

    ANS: B

17. Which of the following control console selectors determines focal spot selection?
    a. kVp
    b. Rotor
    c. mA
    d. Timer
    e. Line voltage compensator

    ANS: C

18. Where does controlled thermionic emission physically take place?
    a. Anode
    b. Focusing cup
    c. Rotor
    d. Stator
    e. Cathode filament

    ANS: E

19. Select the advantage automatic exposure control (AEC) has over other methods of determining x-ray exposure time.
    a. Requires less exposure time than other methods to produce the same radiographic results.
    b. Results in less patient dose from soft radiation.
    c. Accounts for variations in patient density in determining appropriate exposure time.
    d. Requires no clinical knowledge of the role of mA and kVp.
    e. Demonstrates no dramatic advantage over manual methods of determining exposure time.

    ANS: C

20. Which component part is designed specifically to prevent leakage radiation?
    a. Tube housing
    b. Glass x-ray tube
    c. Collimator
    d. Added filtration
    e. Transformer assembly

    ANS: A

21. What would result if a focusing cup were not employed in an x-ray tube?
    a. The heel effect would be decreased.
    b. Electrical loading of the anode would be increased.
    c. Effective focal spot sizes would be considerably larger.
    d. X-rays would be impossible to focus.
    e. Nothing would change.

    ANS: C

22. What advantage does a rotating anode tube have over a stationary anode tube?
    a. The voltage never drops to zero.
    b. A rotating anode produces a higher-quality beam.
    c. Voltage from the entire sine wave may be used.
    d. A rotating anode is capable of a greater electrical load.
    e. X-rays are more easily dispersed with a rotating anode.

    ANS: D

23. Select the tube functions that are initiated by the rotor switch.
    a. Anode rotation; line-voltage compensation
    b. Changing AC to DC; x-ray exposure
    c. Anode rotation; collimation
    d. Filament current; anode rotation
    e. Anode rotation; x-ray exposure

    ANS: D

24. When screen film is used as the image receptor, which one of the following is true?
    a. As speed increases, detail improves.
    b. As speed increases, noise (graininess) increases.
    c. As noise increases, detail improves.
    d. As speed increases, quantum mottle decreases.
    e. Speed has no effect on detail.

    ANS: B

25. Identify the active ingredient in film emulsion that renders the film sensitive to light.
    a. Gelatin
    b. Calcium tungstate
    c. Barium platinocyanide
    d. Silver bromide
    e. Lanthanum oxysulfide

    ANS: D

26. If 40 mAs are needed to produce an adequate exposure for a given projection using a 200-speed imaging system, how many mAs would be needed if the speed were changed to 800?
    a. 10
    b. 20
    c. 80
    d. 120
    e. 160

    ANS: A

27. Collimating an exposure field to the film size or less has what result on image contrast compared to no collimation (wide-open field)?
    a. An increase
    b. A decrease
    c. No change

    ANS: A

28. A radiograph demonstrates uneven exposure across the film laterally (side-to-side). What is the most likely cause of this manifestation?
    a. Heel effect
    b. Line-focus principle
    c. Collimator cutoff
    d. Grid cutoff
    e. Split screens

    ANS: D

29. The primary purpose for using a radiographic grid is to _____.
    a. reduce the amount of scatter radiation generated in the patient
    b. increase radiographic contrast
    c. reduce patient dose
    d. eliminate penumbra
    e. reduce air-gap magnification

    ANS: B

30. What represents the tube distance whereby x-ray beam divergence is perfectly accommodated by the grid?
    a. Grid radius
    b. Grid ratio
    c. Focal range
    d. Grid cutoff
    e. Grid frequency

    ANS: A

31. Of the following grid specifications, which one is most significant in determining contrast improvement?
    a. Grid ratio
    b. Grid frequency
    c. Grid radius
    d. Focal range
    e. Grid alignment

    ANS: A

32. Under which circumstance will using a grid be most effective?
    a. When performing all extremity radiography
    b. When using less than 70 kVp
    c. When the patient part measures greater than 10 cm
    d. When using very fast (1200-speed), rare earth-imaging systems
    e. When radiographic contrast is not a concern

    ANS: C

33. Under which of the following conditions will production of scatter radiation increase?
    a. Low kVp, high mAs
    b. Small body part size
    c. Long FFD
    d. Large exposure field size
    e. Recumbent radiography (compared to upright)

    ANS: D

34. Select the property of an intensifying screen that helps reduce patient dose.
    a. Protects the radiographic film from light exposure
    b. Prevents scatter from fogging the film
    c. Increases image detail
    d. Converts the energy of x-rays to visible light
    e. Intensifies the absorption of scatter radiation

    ANS: D

35. Rare earth-intensifying screens are superior to calcium tungstate screens in that rare earth screens are characterized by which of the following?
    a. They are less expensive.
    b. They require less radiation, resulting in shorter exposure time.
    c. They eliminate distortion.
    d. They have a built-in scatter control mechanism.
    e. They produce less penumbra.

    ANS: B

36. Which is true when using a high-mA, low-kVp technique?
    a. There will be an increase in the photoelectric effect.
    b. There will be an increase in Compton's effect.
    c. There will be a decrease in patient dose.
    d. Radiographs will display lower contrast (more gray).
    e. The x-ray beam will be more penetrating.

    ANS: A

37. How are Bremsstrahlung x-rays produced?
    a. A target electron is displaced and replaced.
    b. A target electron is excited.
    c. A target electron is absorbed.
    d. A projectile electron is absorbed.
    e. A projectile electron loses kinetic energy.

    ANS: E

38. Which interaction results from a high-speed electron knocking out an inner-shell electron, an outer-shell electron falling into the inner shell vacancy, and an x-ray photon being emitted?
    a. Compton
    b. Photoelectric
    c. Characteristic
    d. Classical scatter
    e. Bremsstrahlung

    ANS: C

39. Under which condition would it be best to simply use the 15% rule for kVp?
    a. The optimum kVp is used, and the film is overexposed.
    b. The film is blurred.
    c. The density is adequate, but the contrast is poor.
    d. The image is underexposed, and bone is difficult to see.
    e. There is never a condition for this use.

    ANS: D

40. Apply the 30% rule to a film that was underexposed using 100 mA, .4 second, and 75 kVp. Which answer is correct?
    a. 200 mA, .26 second, 75 kVp
    b. 100 mA, .8 second, 75 kVp
    c. 100 mA, .28 second, 75 kVp
    d. 100 mA, .4 second, 97 kVp
    e. 300 mA, .09 second, 75 kVp

    ANS: A

41. Which of the following series arranges patient densities in order of most radiolucent to most radiopaque?
    a. Bone, muscle, fat, gas
    b. Gas, muscle, fat, bone
    c. Bone, fat, muscle, gas
    d. Gas, fat, muscle, bone
    e. Bone, metal, muscle, gas

    ANS: D

42. A patient has a lateral scoliosis of the lumbar spine. In taking the lateral lumbar radiograph, what should be done to minimize projectional distortion?
    a. Take a recumbent radiograph.
    b. Decrease exposure time and increase milliamperage.
    c. Direct the x-ray beam into the convexity of the curvature.
    d. Direct the x-ray beam into the concavity of the curvature.
    e. Increase the FFD to use more of the central portion of the x-ray beam.

    ANS: D

43. Under which circumstance will recorded detail be greatest?
    a. Long FFD/short object-film distance (OFD)
    b. Short FFD/long OFD
    c. Long FFD/long OFD
    d. Short FFD/short OFD
    e. None of the above

    ANS: A

44. Select the technique that would produce a film with the highest contrast on an AP lumbo-pelvic projection.
    a. 300 mA, .05 second, at 90 kVp
    b. 300 mA, .15 second, at 75 kVp
    c. 300 mA, .1 second, at 80 kVp
    d. 300 mA, .06 second at 85 kVp
    e. 300 mA, .03 second, at 100 kVp

    ANS: B

45. Noise factors like fog, quantum mottle, and inherent film graininess have the greatest effect on which of the following?
    a. Magnification distortion
    b. Recorded detail
    c. Geometric distortion
    d. Penumbra
    e. Visibility of detail

    ANS: E

46. Wide exposure latitude is a benefit of which system of radiographic technique?
    a. Fixed mAs/variable kVp
    b. Fixed mAs/fixed kVp
    c. Variable mAs/low kVp
    d. Variable mAs/fixed (optimum) kVp
    e. All of the above

    ANS: D

47. What does "the maximum kVp capable of consistently producing diagnostically acceptable radiographs" define?
    a. Optimum mAs technique
    b. Variable kVp technique
    c. Optimum kVp technique
    d. Low kVp technique
    e. High mAs technique

    ANS: C

48. Which condition would best control for postexposure fog from safelight in an average-sized darkroom (6- x 8-foot) using blue or green sensitive film?
    a. Using a single 7.5-watt red safelight (direct) at least 4 feet away from the film handling area
    b. Using several 7.5-watt red safelights strategically placed beyond 4 feet from the film handling area
    c. Using a 15-watt red safelight (direct) at least 4 feet away from the film handling area
    d. Using a 7.5-watt orange safelight (direct) at least 4 feet from the film handling area
    e. Using a 15-watt orange safelight and employing an indirect method

    ANS: A

49. Which statement best describes the function of the developer?
    a. The developer clears the film of unexposed silver.
    b. The developer shrinks and hardens the emulsion.
    c. The developer provides archival quality to the film.
    d. The developer converts the latent image into the manifest image.
    e. The developer stops the reduction process.

    ANS: D

50. Which compound is responsible for making film black upon processing?
    a. Activator
    b. Clearing agent
    c. Restrainer
    d. Reducing agent
    e. Acidifier

    ANS: D

51. Select the most noticeable film changes resulting from variable developer temperatures beyond the norm.
    a. Processing artifacts
    b. Density changes
    c. Contrast changes
    d. Image distortion changes
    e. Wet films

    ANS: B

52. What happens to film density as the reducing agents in the developer are depleted?
    a. Film density is increased.
    b. Film density is decreased.
    c. No change occurs.

    ANS: B

53. Select the safest time in which to x-ray a female of childbearing potential in the lumbo-pelvic region where the risk of exposing a fetus is lowest.
    a. 10 days after the onset of menses
    b. 10 days before the onset of menses
    c. 10 days before ovulation
    d. The first 10 days of pregnancy
    e. 10 days after menses ceases

    ANS: A

54. Which one of the following adheres to the ALARA concept?
    a. Long exposure times
    b. Gonad shielding
    c. Short FFD
    d. Split-screen technology
    e. High mAs, low kVp technique

    ANS: B

55. Under which condition would it be reasonable to not use gonad shielding?
    a. The patient requests it, and it will not compromise the examination.
    b. The gonads are in the primary field of exposure.
    c. The examination will be compromised by using the shielding.
    d. The gonads are within 5 cm of the primary exposure field.
    e. There are no good reasons not to use gonad shielding.

    ANS: C

56. Which in the following types of radiation has the highest photon energy?
    a. Radio wave
    b. Microwave
    c. Infrared
    d. Ultraviolet
    e. X-ray

    ANS: E

57. Which in the following units of radiation measure is most important for radiation protection reporting of occupational exposure?
    a. Roentgen
    b. Rad
    c. Rem
    d. Gray
    e. Curie

    ANS: C

58. What percent of the kinetic energy of high-speed electrons striking the anode in an x-ray tube is converted to produce x-rays?
    a. 1%
    b. 5%
    c. 25%
    d. 50%
    e. 100%

    ANS: A

59. Heating the tungsten filament in the cathode of an x-ray tube boils off electrons in a process called _____.
    a. space charge
    b. thermionic emission
    c. electromagnetic induction
    d. focusing
    e. incandescence

    ANS: B

60. The disk, stem, and rotor make up which component of the x-ray tube?
    a. Cathode
    b. Anode
    c. Stator
    d. Expansion bellows
    e. Transformer

    ANS: B

61. Which of the following would decrease both the actual and effective focal spots?
    a. Increasing anode angle
    b. Decreasing anode angle
    c. Increasing filament size
    d. Decreasing filament size
    e. Rotating the anode

    ANS: D

62. What is the total thickness equivalent of aluminum required on an x-ray tube to reduce patient exposure to very low energy x-rays?
    a. 0.5 mm
    b. 1.0 mm
    c. 1.5 mm
    d. 2.0 mm
    e. 2.5 mm

    ANS: E

63. Which type of x-ray generator would produce the greatest patient dose of lower energy soft x-rays?
    a. Single phase 1 pulse
    b. Single phase 2 pulse
    c. Three-phase 6 pulse
    d. Three-phase 12 pulse
    e. High-frequency

    ANS: A

64. Which of the following would produce the greatest film density?
    a. 4 mA X 2 seconds
    b. 10 mA X 2.5 seconds
    c. 15 mA X 1.0 seconds
    d. 20 mA X 0.5 seconds
    e. 25 mA X 1.0 seconds

    ANS: B

65. Which of the following timing devices decreases the need for repeat radiographs by adjusting for patient density and reducing human error in exposure calculation?
    a. Synchronous
    b. Electronic
    c. mAs
    d. Mechanical
    e. AEC

    ANS: E

66. X-ray quality, or penetrating power, is directly proportionate to _____.
    a. mAs
    b. kVp
    c. exposure time
    d. anode heal effect
    e. distance

    ANS: B

67. What new mAs setting would be needed to maintain the same film density achieved with a technique of 4 mAs at 40 inches focus-to-film distance (FFD), if FFD is increased to 80 inches?
    a. 2
    b. 8
    c. 16
    d. 20
    e. 24

    ANS: C

68. What type of radiation is responsible for the majority of x-rays produced in a diagnostic x-ray beam?
    a. Characteristic
    b. Bremsstrahlung
    c. Compton
    d. Classical
    e. Photoelectric

    ANS: B

69. What material in an x-ray grid is primarily responsible for reducing scattered x-rays?
    a. Lead
    b. Carbon fiber
    c. Aluminum
    d. Copper
    e. Polycarbonate

    ANS: A

70. Which of the following layers of an x-ray film contains silver crystals?
    a. Supercoating
    b. Emulsion
    c. Adhesive
    d. Base
    e. Protective

    ANS: B

71. What is the minimum change in mAs needed to make a perceptible difference in film density?
    a. 10%
    b. 15%
    c. 30%
    d. 50%
    e. 100%

    ANS: C

72. At what distance is a parallel grid likely to show the greatest amount of grid cut off?
    a. 20 inches
    b. 30 inches
    c. 40 inches
    d. 60 inches
    e. 80 inches

    ANS: E

73. Which of the following steps in chemical development of radiographs is most sensitive to time, temperature, and chemical concentration?
    a. Developing
    b. Rinsing
    c. Fixing
    d. Washing
    e. Drying

    ANS: A

74. Physical changes to radiographic film caused by exposure to light or x-ray that prior to developing are invisible to the naked eye are best described as the _____ image.
    a. Preexposed
    b. Gurney-Mott
    c. Underdeveloped
    d. Latent
    e. Invisible

    ANS: D

75. What layer of an intensifying screen is responsible for emitting light when energized by x-rays?
    a. Protective coating
    b. Phosphor
    c. Reflective
    d. Base
    e. Supercoating

    ANS: B

76. Which of the following is most responsible for altering radiographic contrast?
    a. mA
    b. Time
    c. Shielding
    d. Distance
    e. Peak kVp

    ANS: E

77. Which of the following would result in the least reduction in absorbed radiation dose by the patient?
    a. Decreasing time
    b. Increasing kVp from 80 to 81
    c. Decreasing mAs from 100 to 95
    d. Use of intensifying screen
    e. Non-grid technique

    ANS: C

78. The annual effective dose limit for occupational exposures to x-ray is _____ rem.
    a. 1
    b. 5
    c. 10
    d. 15
    e. 20

    ANS: B

79. Identify the type of radiographic noise produced in fast imaging systems, which results from too few x-ray photons interacting with the image receiver.
    a. Film graininess
    b. Quantum mottle
    c. Structural mottle
    d. Scatter radiation
    e. Shape distortion

    ANS: B