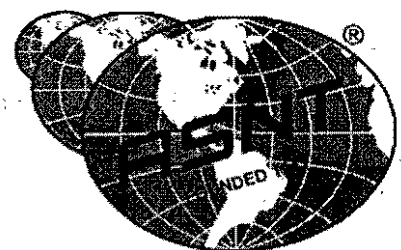


Questions and Answers

Levels I, II, and III

Radiographic Testing Method

*Supplement to
Recommended Practice
No. SNT-TC-1A
Book A*



**The American Society
for Nondestructive Testing, Inc.**



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Published by
The American Society for Nondestructive Testing, Inc.
1711 Arlingate Lane
PO Box 28518
Columbus, OH 43228-0518

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ISBN 0-931403-45-6

Printed in the United States of America

first printing 1980
second printing 11/87
third printing 03/88
fourth printing 09/89
fifth printing 04/90
sixth printing 12/91
seventh printing with revision 04/96
eighth printing 05/99
ninth printing 03/05

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Recommended Training References

Radiographic Testing Method

The following references were used in formulating the questions contained in this book.

- A.* McMaster, R.C., ed. *Nondestructive Testing Handbook*, first edition. Columbus, OH: The American Society for Nondestructive Testing, Inc. 1959. Sections 13-26 (pgs. 13.1-26.18).
- B.* McGonnagle, Warren J. *Nondestructive Testing*, second edition. New York: Gordon & Breach. 1977.
- C.* *Annual Book of ASTM Standards*, Volume 03.03, *Nondestructive Testing*. "Standard Guide for Radiographic Testing," Standard ASTM E 94. "Standard Method for Controlling Quality of Radiographic Testing," Standard ASTM E 142, and "Standard Practice for Design, Manufacture, and Material Grouping Classification of Hole-Type Image Quality Indicators (IQI) Used for Radiology," Standard ASTM E 1025. Philadelphia, PA: American Society for Testing and Materials. Latest edition.
(Reference numbers after the questions contain the standard number in them. Example: C.E94.)
- D. Richardson, Harry D. *NDT Radiography Training Manual*. Wilmington, DE. E. I. du Pont de Nemours and Co. 1968, reprint.
- E.* *Radiographic Testing: Classroom Training Handbook (CT-6 6)*. San Diego, CA: General Dynamics/Convair Division. 1967. (Now published by The American Society for Nondestructive Testing, Inc.)
- F.* *Radiography in Modern Industry*, fourth edition. Rochester, NY: Eastman Kodak Co. 1980.
- G.* *Metals Handbook*, eighth edition, *Nondestructive Inspection and Quality Control*, Volume 11. Metals Park, OH: American Society for Metals. 1976.
- H.* Halmshaw, R. *Industrial Radiology Techniques*. New York: Springer-Verlag. 1971.

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Each question found in this book contains letter(s) and page number(s) in bold type and sometimes chapter or section number(s) immediately following the answers. For example,

35. In comparison with lower-voltage radiographs, high-energy radiographs show:
- a. greater contrast
 - b. greater latitude
 - c. greater amounts of scatter radiation relative to primary beam intensity
 - d. none of the above

A.23.4-5

In this example, the letter "A" refers to Reference A in the list provided above. The number "23" refers to the section or chapter number in Reference A and the "4-5" is the page range in Reference A where the answer to the question can be found.

Historical References

- Clark, G. L. *Applied X-Rays*. New York: McGraw-Hill. 1955.
- Clauser, H. R. *Practical Radiography for Industry*. New York: Rheinhold Publishing Corporation. 1952.
- Crowther, J. A. *Handbook of Industrial Radiography*. London: Edward Arnold and Co. 1949.
- Sproull, W. T. *X-Rays in Practice*. New York: McGraw-Hill. 1946.
- St. John, A., and H. R. Isenburger. *Industrial Radiology*. New York: John Wiley & Sons. 1943.
- Wiltshire, W. J. *A Further Handbook of Industrial Radiography*. London: Edward Arnold and Co. 1957.

Reference Usage List Radiographic Testing Method

Reference A: Total = 255

Level I (67)
Level II (88)
Level III (100)

Reference B: Total = 9

Level I (2)
Level II (1)
Level III (6)

Reference C: Total = 16

Level I (3)
Level II (3)
Level III (10)

Reference D: Total = 60

Level I (12)
Level II (12)
Level III (36)

Reference E: Total = 46

Level I (9)
Level II (13)
Level III (24)

Reference F: Total = 197

Level I (51)
Level II (48)
Level III (98)

Reference G: Total = 23

Level I (1)
Level II (0)
Level III (22)

Reference H: Total = 22

Level I (0)
Level II (0)
Level III (22)



Level I Questions

Radiographic Testing Method

1. Although there may be other reasons for using calcium tungstate screens in industrial radiography, they are most usually used to:
 - a. improve definition and resolution in radiographic images
 - b. improve contrast in radiographic images
 - c. decrease exposure time
 - d. make films respond to multimillion volt radiation

F.36
2. An excellent radiograph is obtained under given conditions of exposure with the film located at a distance of 91 cm (36 in.) from the target of the X-ray tube. If the film is now placed only 46 cm (18 in.) from the target, and all exposure conditions except time are held constant, the new exposure time will be:
 - a. unchanged
 - b. longer by approximately 80 percent
 - c. shorter by approximately 55 percent
 - d. only about 25 percent as long as the original exposure time

F.47
3. An excellent radiograph is obtained under given exposure conditions with a tube current of 5 mA and an exposure time of 12 minutes. If other conditions are not changed, what exposure time would be required if the X-ray tube current could be raised to 10 mA?
 - a. 24 minutes
 - b. 12 minutes
 - c. 6 minutes
 - d. 3 minutes

F.49
4. In film radiography, penetrameters are usually placed:
 - a. between the intensifying screen and the film
 - b. on the source side of the test object
 - c. on the film side of the test object
 - d. between the operator and the radiation source

A.13.31
5. When radiographing to the 2-2T quality level, an ASTM penetrameter for 13 mm (0.5 in.) thick 2024 aluminium alloy has a thickness of:
 - a. 13 mm (0.5 in.)
 - b. 5×10^{-3} m (2 mils)
 - c. 13×10^{-3} m (5 mils)
 - d. 25×10^{-3} m (10 mils)

C.E142-77
6. The penetrating ability of an X-ray beam is governed by:
 - a. kilovoltage
 - b. time
 - c. milliamperage
 - d. source-to-film distance

A.20.15
7. Co-60 used in nondestructive testing emits:
 - a. alpha particles
 - b. neutrons
 - c. gamma rays
 - d. X-rays

A.15.14
8. A densitometer is an instrument for measuring:
 - a. X-ray intensity
 - b. film density
 - c. density of a material
 - d. tube current

A.20.32
9. Three liquids which are essential to process an exposed film properly are:
 - a. stop bath, acetic acid, and water
 - b. developer, stop bath, and H_2O_2
 - c. developer, fixer, and water
 - d. acetic acid, fixer, and stop bath

A.21.1

Radiographic Testing Method, Level I

10. The two most common causes for excessively high-density radiographs are:
- a. insufficient washing and overdevelopment
 - b. contaminated fixer and insufficient washing
 - c. overexposure and contaminated fixer
 - d. overexposure and overdevelopment
- A.21.18**
11. The time required for one-half of the atoms in a particular sample of radioactive material to disintegrate is called:
- a. the inverse square law
 - b. a curie
 - c. a half-life
 - d. the exposure time
- A.15.1, 15.5**
12. What does the term R/h refer to when speaking of intensity?
- a. radiation limits for humans
 - b. roentgens per hour
 - c. X-rays per hour
 - d. radiation in hydrogen
- A.15.5**
13. The ability to detect a small discontinuity or flaw is called:
- a. radiographic contrast
 - b. radiographic sensitivity
 - c. radiographic density
 - d. radiographic resolution
- A.15.30**
14. Movement, geometry, and screen contact are three factors that affect radiographic:
- a. contrast
 - b. unsharpness
 - c. reticulation
 - d. density
- A.15.33**
15. The difference between the densities of two areas of a radiograph is called:
- a. radiographic contrast
 - b. subject contrast
 - c. film contrast
 - d. definition
- F.67**
16. The most widely used unit of measurement for measuring the rate at which the output of a gamma ray source decays is the:
- a. curie
 - b. roentgen
 - c. half-life
 - d. MeV
- A.13.12-13**
17. Exposure to X-rays or gamma rays:
- a. may have a cumulative effect which must be considered
 - b. will be beneficial since they build up an immunity to radiation poisoning
 - c. will have no effect on human beings
 - d. will have only a short-term effect on human tissues
- A.26.3**
18. Which dose would be dangerous, if not fatal, if applied to the entire body in a short period of time?
- a. 1.5-15 R ($4-38 \times 10^{-4}$ C/kg)
 - b. 25-70 R
 - c. 200-800 R
 - d. all of the above doses would most likely be fatal
- A.26.2**
19. When doing gamma ray radiography with high-intensity emitters, the sources are best handled:
- a. directly by personnel equipped with special protective clothing
 - b. by remote handling equipment
 - c. directly by personnel with special protective clothing except when radiographs are being made
 - d. by the same methods used for low-intensity emitters
- A.15.22**
20. If a film is placed in a developer solution and allowed to develop without any agitation:
- a. the radiograph will not show proper contrast
 - b. it will be impossible to fix the radiograph permanently
 - c. there will be a general "fogging" condition over the entire radiograph
 - d. there will be a tendency for areas to affect each other
- F.83**
21. The selection of the proper type of film to be used for the X-ray examination of a particular part depends on:
- a. the thickness of the part
 - b. the material of the specimen
 - c. the voltage range of the available X-ray machine
 - d. all of the above
- F.75**

22. A Co-60 source has a half-life of:
- 1.2 years
 - 6 months
 - 5.3 years
 - 75 days
- A.15.14**
23. X-ray tube current is controlled by:
- the current passing through the filament
 - the distance from the cathode to the anode
 - the type of material used in the target
 - the voltage and waveform applied to the X-ray tube
- A.14.6; F.9**
24. The voltage and waveform applied to the X-ray tube by a high-voltage transformer primarily determines the:
- quantity of radiation
 - duration of exposure
 - penetrating ability
 - X-ray beam divergence
- A.14.6**
25. Lead foil in direct contact with X-ray film:
- intensifies the scatter radiation more than the primary radiation
 - decreases the contrast of the radiographic image
 - intensifies the primary radiation more than the scatter radiation
 - should not be used when gamma rays are emitted by the source of radiation
- F.32**
26. Fluorescent intensifying screens are usually mounted in pairs in rigid holders called:
- film racks
 - cassettes
 - emulsifiers
 - diaphragms
- F.37**
27. Radiographic sensitivity, in the context of the minimum detectable flaw size, depends on:
- graininess of the film
 - the unsharpness of the flaw image in the film
 - the contrast of the flaw image on the film
 - all of the above
- A.15.32**
28. In order to decrease geometric unsharpness:
- radiation should proceed from as small a focal spot as other considerations will allow
 - radiation should proceed from as large a focal spot as other considerations will allow
 - the film should be as far as possible from the object being radiographed
 - the distance from the anode to the material examined should be as small as is practical
- F.20**
29. As the kilovoltage applied to the X-ray tube is raised:
- X-rays of longer wavelength and more penetrating power are produced
 - X-rays of shorter wavelength and more penetrating power are produced
 - X-rays of shorter wavelength and less penetrating power are produced
 - X-rays of longer wavelength and less penetrating power are produced
- A.20.4**
30. In order to increase the intensity of X-radiation:
- the tube current should be increased
 - the tube current should be decreased
 - the test specimen should be moved farther from the film
 - a lower kilovoltage should be applied to the tube
- A.20.3; F.9**
31. Primary radiation which strikes a film holder or cassette through a thin portion of the specimen will cause scattering into the shadows of the adjacent thicker portions producing an effect called:
- radiation imaging
 - spotting
 - undercut
 - unsharpness
- A.20.19; F.39**
32. Scattered radiation caused by any material, such as a wall or floor, on the film side of the specimen is referred to as:
- primary scattering
 - undercut
 - reflected scattering
 - backscattered radiation
- F.39-40**
33. Which of the following materials is suitable for use in vessels or pails and used to mix processing solutions?
- stainless steel
 - aluminum
 - galvanized iron
 - tin

Radiographic Testing Method, Level I

34. Of the following, which would be especially sensitive to injury by excessive exposure to X- or gamma rays?
- blood
 - lens of the eye
 - internal organs
 - all of the above
- F.142**
35. X-ray exposure may be due to:
- the direct beam from the X-ray tube target
 - scatter radiation arising from objects in the direct beam
 - both a and b
 - both a and b plus residual radiation that exists for the first few minutes after the X-ray machine has been returned to the "off" position.
- F.142**
36. A general rule often employed for determining the kilovoltage to be used when X-raying a part is that:
- the kilovoltage should be as high as other factors will permit
 - the kilovoltage should be as low as other factors will permit
 - the kilovoltage is always a fixed value and cannot be changed
 - the kilovoltage is not an important variable and can be changed over a wide range without affecting the radiograph
- F.29**
37. If a piece of lead 13 mm (0.5 in.) thick is placed in the path of a beam of radiation emanating from Co-60, it will reduce the dose rate at a given location by:
- one-third
 - one-quarter
 - one-half
 - three-quarters
- A.26.9**
38. Excessive exposure of film to light prior to development of the film will most likely result in:
- a foggy film
 - poor definition
 - streaks
 - yellow stain
- F.148**
39. Reticulation resulting in a puckered or net-like film surface is probably caused by:
- crimping film after exposure
 - sudden extreme temperature change while processing
 - water or developer on unprocessed film
 - excessive object-to-film distance
- F.150**
40. Frilling or loosening of the emulsion from the base of the film is most likely caused by:
- water or developer on unprocessed film
 - low temperature of processing solutions
 - developer solution contamination
 - warm or exhausted fixer solution
- F.151**
41. If an exposure time of 60 seconds was necessary using a 1.2 m (4 ft) source-to-film distance for a particular exposure, what time would be necessary if a 0.6 m (2 ft) source-to-film distance is used and all other variables remain the same?
- 120 s
 - 30 s
 - 15 s
 - 240 s
- F.47**
42. One of the general rules concerning the application of geometric principles of shadow formation to radiography is:
- the X-rays should proceed from as large a focal spot as other considerations will allow
 - the film should be as far as possible from the object being radiographed
 - the distance between the anode and the material examined should always be as great as possible
 - all of the above
- F.20**
43. As a check on the adequacy of the radiographic technique, it is customary to place a standard test piece on the source side of the specimen. This standard test piece is called a:
- reference plate
 - lead screen
 - penetrameter
 - illuminator
- A.20.36; F.69**
44. The duration of an exposure is usually controlled by:
- controlling the milliamperage
 - a timer
 - controlling the source-to-film distance
 - a choke coil in the filament transformer
- A.14.6**
45. A penetrameter is used to indicate the:
- size of discontinuities in a part
 - density of the film
 - amount of film contrast
 - quality of the radiographic technique
- F.73**



46. A fluorescent intensifying screen will:
- transform X-ray energy into visible or ultraviolet light
 - result in reticulation
 - decrease the graininess of the image when using gamma rays
 - increase the definition in a radiograph
- A.16.16**
47. The three main steps in processing a radiograph are:
- developing, frilling, and fixation
 - developing, fixation, and washing
 - exposure, developing, and fixation
 - developing, reticulating, and fixation
- A.16.18**
48. Kilovoltage, exposure time, and source-to-film distance are three of the most important X-ray exposure factors that can be controlled. A fourth such exposure factor is:
- focal point size
 - temperature
 - filament-to-focal spot distance
 - milliamperage
- A.20.15**
49. When the minute silver grains on which the X-ray film image is formed group together in relatively large masses, they produce a visual impression called:
- air bells
 - graininess
 - reticulation
 - frilling
- F.132**
50. Static marks, which are black tree-like or circular marks on a radiograph, are often caused by:
- film being bent when inserted in a cassette or holder
 - foreign material or dirt imbedded in screens
 - scratches on lead foil screens
 - improper film handling techniques
- F.148**
51. The purpose of agitating an X-ray film during development is to:
- protect the film from excessive pressure
 - renew the developer at the surface of the film
 - disperse unexposed silver grains on the film surface
 - prevent reticulation
- A.21.5**
52. When manually processing films, the purpose for sharply tapping hangers two or three times after the films have been lowered into the developer is to:
- disperse unexposed silver grains on the film surface
 - prevent frilling
 - dislodge any air bubbles clinging to emulsion
 - do all of the above
- A.21.5**
53. The activity of the developer solution is maintained stable by:
- constantly agitating it
 - maintaining processing solutions within the recommended temperature range
 - avoiding contamination from the wash bath
 - adding replenisher
- A.21.6**
54. The purpose of fixation is:
- to remove all the undeveloped silver salts of the emulsion
 - to leave the developed silver as a permanent image
 - to harden the gelatin
 - all of the above
- A.21.7**
55. For best results when manually processing film, solutions should be maintained within a temperature range of:
- 18 to 24 °C (65 to 75 °F)
 - 65 to 75 °C (149 to 167 °F)
 - 24 to 29 °C (75 to 85 °F)
 - 75 to 85 °C (167 to 185 °F)
- A.21.4-5**
56. Water spots on films can be minimized by:
- the rapid drying of wet film
 - using a wetting agent solution
 - using a fresh fixer solution
 - cascading water during the rinse cycle
- A.21.9**
57. The small area in the X-ray tube from which the radiation emanates is called the:
- diaphragm
 - focal spot
 - focusing cup
 - cathode
- F.9-10**

Radiographic Testing Method, Level I

58. The radiation quality of a gamma ray source is:
- determined by the size of the focal spot
 - determined by the isotope involved
 - varied by the operator
 - greater in Ir-192 than in Co-60
- F.14**
59. The most common material used to provide protection against X-rays is:
- high-density brick
 - an alloy of 70 percent steel and 30 percent copper
 - tungsten
 - lead
- F.143**
60. A curie is the equivalent of:
- 0.001 mCi
 - 1 000 mCi
 - 1 000 MCi
 - 100 MCi
- D.22**
61. With a given exposure time and kilovoltage, a properly exposed radiograph is obtained with a 6 mA-minutes exposure at the distance of 51 cm (20 in.). It is desired to increase the sharpness of detail in the image by increasing the source-to-film distance to 102 cm (40 in.). The correct milliamperage-minutes exposure to obtain the desired radiographic density at the increased distance is:
- 12 mA-minutes
 - 24 mA-minutes
 - 3 mA-minutes
 - 1.7 mA-minutes
- F.47**
62. Very short wavelength electromagnetic radiation produced when electrons travelling at high speeds collide with matter is called:
- X-radiation
 - beta radiation
 - gamma radiation
 - none of the above
- F.9**
63. The exposure of personnel to X- and gamma radiation can be measured or monitored by means of:
- film badges
 - dosimeters
 - radiation exposure survey meters
 - all of the above
- B.204**
64. Assuming that a good radiograph is obtained at a setting of 10 mA in 40 s, how much time will be necessary to obtain one equivalent radiograph if the milliamperage is changed to 5 mA (all other conditions remaining constant)?
- 20 s
 - 10 s
 - 80 s
 - 160 s
- F.47**
65. A graph showing the relation between material thickness, kilovoltage, and exposure is called:
- a bar chart
 - an exposure chart
 - a characteristic curve
 - an H&D curve
- F.51**
66. A graph which expresses the relationship between the logarithm of the exposure applied to a photographic material and the resulting photographic density is called:
- a bar chart
 - an exposure chart
 - the characteristic curve
 - a logarithmic chart
- F.53**
67. Short wavelength electromagnetic radiation produced during the disintegration of nuclei of radioactive substances is called:
- X-radiation
 - gamma radiation
 - scatter radiation
 - backscatter radiation
- F.14**
68. A photographic image recorded by the passage of X- or gamma rays through a specimen onto a film is called a:
- fluoroscopic image
 - radiograph
 - isotopic reproduction
 - none of the above
- A.20.1**
69. The normal development time for manually processing X-ray film is:
- 12-18 minutes in processing solutions at 24 °C (75 °F)
 - 3-8 minutes in processing solutions at 16 °C (60 °F)
 - 12-18 minutes in processing solutions at 68 °C (154 °F)
 - 5-8 minutes in processing solutions at 20 °C (68 °F)
- A.21.4**

70. In order to achieve uniformity of development over the area of an X-ray film during manual processing:
- the film should be placed in a dryer after being developed
 - the developer should be agitated by using mechanical stirrers or circulating pumps
 - the film should be agitated while in the developer
 - the film should be transferred directly from the developer to the fixer

A.21.5

71. When referring to a "2T" or "4T" hole in the ASTM penetrometer, the T refers to the:
- part thickness
 - penetrometer thickness
 - time of exposure
 - time for developing

A.20.37

72. A sheet of lead with an opening cut in the shape of the part to be radiographed may be used to decrease the effect of scattered radiation which undercuts the specimens. Such a device is called a:
- mask
 - filter
 - backscatter absorber
 - lead foil screen

F.40

73. Two X-ray machines operating at the same nominal kilovoltage and milliamperage settings:
- will produce the same intensities and qualities of radiation
 - will produce the same intensities but may produce different qualities of radiation
 - will produce the same qualities but may produce different intensities of radiation
 - may give not only different intensities but also different qualities of radiation

D.106

74. Fluoroscopy differs from radiography in that:
- fluoroscopy uses a much lower kilovoltage than radiography
 - fluoroscopy is much more sensitive than radiography
 - the X-ray image is observed visually on a fluorescent screen rather than recorded on a film
 - fluoroscopy permits examination of thicker parts than does radiography

F.113

75. An advantage of the pocket dosimeter type of ionization chamber used to monitor radiation received by personnel is:
- it provides a permanent record of accumulated dosage
 - it provides an immediate indication of dosage
 - it is the most sensitive detector available
 - all of the above are advantages

A.26.4; D.41

76. The density difference between two selected portions of a radiograph is known as:
- unsharpness
 - radiographic contrast
 - specific activity
 - subject density

A.15.35, 20.24; F.67

77. One requirement for keeping fluorescent screens in good condition is that they must:
- be cleaned with a lint-free cloth each time they are used
 - not be exposed to intense ultraviolet radiation
 - be mounted in a rigid container at all times
 - not be exposed to caustic fumes

A.16.15

78. In making an isotope exposure in an unshielded area, you find the dose rate 1.8 m (6 ft) from the source is 1 200 mR/h. What would be the dose rate at 7.3 m (24 ft)?
- 75 mR/h
 - 100 mR/h
 - 200 mR/h
 - 300 mR/h

A.15.6

79. The intensity of X- or gamma radiation is measured in:
- roentgens
 - ergs
 - roentgens per unit of time
 - H&D units

A.15.5; D.28

80. When producing radiographs, if the kilovoltage is increased, the:
- subject contrast decreases
 - film contrast decreases
 - subject contrast increases
 - film contrast increases

A.20.35

Radiographic Testing Method, Level I

81. The accidental movement of the specimen or film during exposure or the use of a focus-film distance that is too small will:
- a. produce a radiograph with poor contrast
 - b. make it impossible to detect large discontinuities
 - c. result in unsharpness of the radiograph
 - d. result in a fogged radiograph
- A.15.33**
82. A properly exposed radiograph that is developed in a developer solution at a temperature of 14 °C (58 °F) for 5 minutes will probably be:
- a. overdeveloped
 - b. underdeveloped
 - c. fogged
 - d. damaged by frilling
- A.21.4**
83. A good radiograph is obtained using a milliamperage of 15 mA and an exposure time of 0.5 minutes. What exposure time will be necessary to produce an equivalent radiograph if the milliamperage is changed to milliamperes and all other conditions remain the same?
- a. 4.5 minutes
 - b. 1.5 minutes
 - c. 3 minutes
 - d. 0.5 minutes
- A.20.13**
84. Lead screens in contact with the film during exposure:
- a. increase the photographic action on the film largely by reason of the electron emission and partly by the secondary X-rays generated in the lead
 - b. absorb the shorter wavelength scattered radiation more than the long wavelength primary radiation
 - c. intensify the photographic effect of the scatter radiation more than that of the primary radiation
 - d. none of the above
- A.20.25**
85. The sharpness of the outline in the image of the radiograph is a measure of:
- a. subject contrast
 - b. radiographic definition
 - c. radiographic contrast
 - d. film contrast
- A.20.35**
86. An unshielded isotope source gives a dosage rate of 900 mR/h at 3 m (10 ft). What would the unshielded dosage rate be at 9 m (30 ft)?
- a. 300 mR/hr
 - b. 600 mR/hr
 - c. 100 mR/hr
 - d. 2 700 mR/hr
- A.15.6**
87. Which has the shortest wavelengths?
- a. visible light
 - b. microwaves
 - c. 100 kV peak X-rays
 - d. infrared radiation
- A.13.9; F.7**
88. Beta particles are:
- a. neutrons
 - b. protons
 - c. electrons
 - d. positrons
- A.13.1**
89. A radioactive source with an activity of 1 Ci has:
- a. 1 000 disintegrations per second taking place
 - b. 1 000 000 disintegrations per second taking place
 - c. 1 000 000 000 disintegrations per second taking place
 - d. 3.7×10^{10} disintegrations per second taking place
- A.13.13**
90. The formula for determining permissible accumulated personnel dose is:
- a. $12 (N - 18)$
 - b. $18 (5 + N)$
 - c. $5 (N - 18)$
 - d. $12 (N + 18)$
- D:56**
91. The metal that forms the image on an X-ray film is:
- a. tin
 - b. silver
 - c. tungsten
 - d. iron
- F.135**
92. Unexposed boxes of X-ray film should be stored:
- a. flat
 - b. on edge or end
 - c. in a pile
 - d. it does not matter
- F.79**

93. The lead symbol "B" is attached to the back of the film holder to determine:
- sensitivity
 - whether excessive backscatter is present
 - radiographic contrast
 - density
- C.E94**
94. Penetrators for _____ are considered Group I Materials and do not need to have an identification notch.
- inconel
 - nickel
 - stainless steel
 - aluminum bronze
- C.E142**
95. The purpose of a dated decay curve is to:
- determine the source size at any time
 - calculate shielding requirements
 - determine the source strength (activity) at any time
 - mark the date and length of time for each exposure
- E.6-18**
96. Why is Co-60 used as a radiation source for medium-weight metals of thickness ranges from 38 to 229 mm (1.5 to 9 in.)?
- because of its short half-life
 - because of the limited amount of shielding required
 - because of its penetrating ability
 - none of the above
- A.15.14; F.15**
97. The cause for poor image definition could be:
- too short source-to-film distance
 - screens and film not in close contact
 - film graininess
 - all of the above
- E.3-15; F.148**
98. During manual film processing, the purpose of the stop bath is to:
- change the exposed silver salts to black metallic silver
 - neutralize the developer and stop the developing process
 - eliminate most water spots and streaks
 - none of the above
- F.85**
99. A thin metallic sheet (brass, copper, aluminum, etc.) placed at the source to reduce effects of softer radiation is known as:
- an intensifying screen
 - a filter
 - an electron inducer
 - a focusing cup
- B.118; E.6-7; F.42**
100. The reason a "shim" is used in radiographic setup is to:
- improve the penetrometer image
 - reduce diffraction
 - simulate weld reinforcement
 - intensify the image
- E.6-13; G.140**
101. The focal spot size of an X-ray machine must be known in order to determine the:
- geometric unsharpness value
 - kilovolt peak output
 - milliamperage settings
 - exposure time
- E.3-6; F.21**
102. A section with a significant increase in thickness variation is required to be shown on a single radiograph within a desired film density range. This may be accomplished by:
- increasing kilovoltage
 - using a coarser grain film
 - both a and b
 - neither a nor b
- F.30**
103. The density of a radiograph image refers to the:
- thickness of the film
 - thickness of the specimen
 - weight of the film
 - degree of film blackening
- A.20.3; F.51**
104. A beam of radiation consisting of a single wavelength is known as:
- characteristic radiation
 - fluoroscopic radiation
 - monochromatic radiation
 - microscopic radiation
- A.13.9**

Radiographic Testing Method, Level I

105. The image of the required penetrameter and hole on the radiograph indicates that the radiograph has the required:

- a. contrast
- b. definition
- c. sensitivity
- d. latitude

E.6-10; F.69

106. The primary parts of an atom are:

- a. proton, neutrino, electron
- b. proton, electron, gamma ray
- c. photon, electron, neutron
- d. proton, electron, neutron

E.2-13

107. X-rays and gamma rays always travel in:

- a. pairs
- b. orbital spheres
- c. straight lines
- d. none of the above

E.2-7

108. A large source size can be compensated for by:

- a. increasing the source-to-specimen distance
- b. addition of lead screens
- c. increasing the specimen-to-film distance
- d. increasing penumbra

E.6-25

109. Radiation arising directly from the target of an X-ray tube or an accelerator, or from a radioactive source, is usually referred to as:

- a. secondary radiation
- b. primary radiation
- c. backscatter
- d. inherent radiation

A.13.29

110. The extent to which X-rays can be successfully utilized in nondestructive testing is largely dependent upon:

- a. the intensity of the X-rays generated
- b. their wavelengths
- c. the dimensions of the area from which they are emitted
- d. the duration of their emission
- e. all of the above

A.14.1

111. To produce X-rays, electrons are accelerated to a high velocity by an electrical field and then suddenly stopped by a collision with a solid body. This body is called a:

- a. cathode
- b. filament
- c. target
- d. generator

112. The best X-ray efficiency is produced when the target material has a:

- a. low atomic number
- b. high atomic number
- c. low hardness
- d. high hardness

A.14.3

113. What is sometimes used to change the alternating current from the high voltage transformer to direct current for the purpose of increasing the X-ray machine output?

- a. rectifier
- b. cathode X-ray tubes
- c. gas X-ray tube
- d. vacuum X-ray tube

A.14.6

114. In X-radiography, the ability to penetrate the test object is governed by:

- a. source-to-film distance
- b. time
- c. kilovoltage
- d. milliamperage

F.24

115. Which of the following types of radiation is emitted by Co-60 and used in nondestructive testing?

- a. neutrons
- b. gamma rays
- c. X-rays
- d. alpha particles

F.14

116. The term used to describe the loss of excess energy by the nucleus of radioactive atoms is called:

- a. decay (disintegration)
- b. ionization
- c. scintillation
- d. activation

A.15.1; D.22

117. X-rays, gamma rays, and alpha particles all have one thing in common; they are all:

- a. particulate radiations
- b. electromagnetic radiations
- c. microwave radiations
- d. ionizing radiations

D.25

121. Approximately what percent of the original radioactivity is left after 6 half-lives?

- a. 0.005
- b. 10
- c. 33.3
- d. 2

A.13.12; D.22

118. The term used to express the number of curies of radioactivity per gram or ounce of source weight is:

- a. decay
- b. emissivity
- c. specific activity
- d. source output

A.15.5; D.81; F.15

122. The velocity of all electromagnetic radiation is:

- a. 186 000 miles per second
- b. 18 600 miles per second
- c. 186 000 miles per second
- d. 1 860 miles per second

A.13.8; D.10

119. Atoms, molecules, and various subatomic particles that carry either a positive or negative electrical charge are called:

- a. photoelectrons
- b. photons
- c. ions
- d. compounds

A.5.16; D.25

123. The radiation intensity of a radioisotope:

- a. increases with time
- b. decreases with time
- c. is not affected as time elapses
- d. none of the above

A.15.5

120. Gamma and X-radiation interact with matter and may be absorbed by:

- a. photoelectric absorption
- b. Compton scattering
- c. pair production
- d. all of the above

A.13.18; D.27

Level I Answers

Radiographic Testing Method

1. c	32. d	63. d	94. c
2. d	33. a	64. c	95. c
3. c	34. d	65. b	96. c
4. b	35. c	66. c	97. d
5. d	36. b	67. b	98. b
6. a	37. c	68. b	99. b
7. c	38. a	69. d	100. c
8. b	39. b	70. c	101. a
9. c	40. d	71. b	102. a
10. d	41. c	72. a	103. d
11. c	42. c	73. d	104. c
12. b	43. c	74. c	105. c
13. b	44. b	75. b	106. d
14. b	45. d	76. b	107. c
15. a	46. a	77. b	108. a
16. a	47. b	78. a	109. b
17. a	48. d	79. c	110. e
18. c	49. b	80. a	111. c
19. b	50. d	81. c	112. b
20. d	51. b	82. b	113. a
21. d	52. c	83. b	114. c
22. c	53. d	84. a	115. b
23. a	54. d	85. b	116. a
24. c	55. a	86. c	117. d
25. c	56. b	87. c	118. c
26. b	57. b	88. c	119. c
27. d	58. b	89. d	120. d
28. a	59. d	90. c	121. d
29. b	60. b	91. b	122. a
30. a	61. b	92. b	123. b
31. c	62. a	93. b	

Level II Questions

Radiographic Testing Method

1. Low voltage X-ray tubes are generally fitted with windows made of:
 - a. plastic
 - b. beryllium
 - c. glass
 - d. lead

A.14.12
2. A monochromatic X-ray beam is:
 - a. a narrow beam used to produce high-contrast radiographs
 - b. also referred to as a heterogeneous X-ray beam
 - c. a beam containing only characteristic X-radiation
 - d. a beam consisting of a single wavelength

D.15
3. The general method of producing X-rays involves the sudden deceleration of high velocity electrons in a solid body called a:
 - a. focus cup
 - b. filament
 - c. target
 - d. cathode

A.14.1
4. If it were necessary to radiograph a 18 cm (7 in.) thick steel product, which of the following gamma ray sources would most likely be used?
 - a. Co-60
 - b. Tm-170
 - c. Ir-192
 - d. Cs-137

F.17
5. A Co-60 gamma ray source has an approximate practical thickness limit of:
 - a. 63 mm (2.5 in.) of steel or its equivalent
 - b. 102 mm (4 in.) of steel or its equivalent
 - c. 23 cm (9 in.) of steel or its equivalent
 - d. 28 cm (11 in.) of steel or its equivalent

F.17
6. The absorption of gamma rays from a given source when passing through matter depends on the:
 - a. atomic number, density, and thickness of the matter
 - b. Young's modulus value of the matter
 - c. Poisson's ratio value of the matter
 - d. specific activity value of the source

D.149; F.26
7. The fact that gases, when bombarded by radiation, ionize and become electrical conductors make them useful in:
 - a. X-ray transformers
 - b. X-ray tubes
 - c. masks
 - d. radiation detection equipment

A.16.1
8. The velocity of electrons striking the target in an X-ray tube is a function of the:
 - a. atomic number of the cathode material
 - b. atomic number of the filament material
 - c. voltage difference between the cathode and anode
 - d. current flow in the rectifier circuit

D.14
9. The uneven distribution of developed grains within the emulsion of a processed X-ray film causes the subjective impression of:
 - a. graininess
 - b. streaks
 - c. spots
 - d. white scum

A.16.21

Radiographic Testing Method, Level II

Note: If questions 10 or 11 are used on a test, the examinee should be furnished with semilogarithmic coordinate paper.

10. Co-60 is reported to have a half-life of 5.3 years. By how much should exposure time be increased (over that used initially to produce excellent radiographs when the Co-60 source was new) when the source is two years old?
- no change in exposure time is needed
 - exposure time should be about 11 percent longer
 - exposure time should be about 31 percent longer
 - exposure time should be about 62 to 100 percent longer
- A.15.5**
11. A source of Ir-192, whose half-life is 75 days, provides an optimum exposure of a given test object today in a period of 20 minutes. Five months from now, what exposure time would be required for the same radiographic density, under similar exposure conditions?
- 10 minutes
 - 20 minutes
 - 1 hour and 20 minutes
 - 6 hours
- A.15.5; E.2-19**
12. Of the following, the source providing the most penetrating radiation is:
- Co-60
 - 220 kVp X-ray tube
 - 15 MeV X-ray betatron
 - electrons from Ir-192
- A.14.19**
13. The gamma ray intensity at 30 cm (1 ft) from a 37 GBq (1 Ci) source of radioactive Co-60 is nearest to:
- 15 roentgens per hour
 - 1 000 roentgens per hour
 - 1 roentgen per minute
 - 10 milliroentgens per day
- A.15.13; D.36**
14. The focal spot in an X-ray tube:
- is inclined at an angle of 30° from the normal to the tube axis
 - is maintained at a high negative voltage during operations
 - should be as large as possible to ensure a narrow beam of primary radiation
 - should be as small as possible without unduly shortening the life of the tube
- F.9-10**
15. In an X-ray tube, the filament and focusing cup are the two essential parts of the:
- anode
 - cathode
 - rectifier
 - X-ray transformer
- F.9**
16. The quantity of radiation which will produce, by means of ionization, one electrostatic unit of electricity in 0.001293 g of dry air is known as a:
- millicurie
 - gamma
 - roentgen
 - curie
- F.15**
17. The specific activity of an isotopic source is usually measured in:
- million electron volts (MeV)
 - curies per gram (Ci/g)
 - roentgens per hour (R/h)
 - counts per minute (cpm)
- A.15.5; E.2-19**
18. Which of the following isotopes has the longest half-life?
- Tm-170
 - Co-60
 - Ir-192
 - Cs-137
- A.15.13; E.3-16**
19. The primary form of energy conversion when electrons strike a target in an X-ray tube results in the production of:
- primary X-rays
 - secondary X-rays
 - short wavelength X-rays
 - heat
- E.3-6**
20. The slope of a straight line joining two points of specified densities on a characteristic curve of a film is known as the:
- speed of the curve
 - latitude
 - average gradient
 - density
- F.126**

21. An X-ray film having wide latitude also has, by definition:
- poor definition
 - low contrast
 - high speed
 - none of the above
- F.67-69**
22. The purpose for circulating oil in some types of X-ray tubes is to:
- lubricate moving parts
 - absorb secondary radiation
 - decrease the need for high current
 - dissipate heat
- A.14.33**
23. An X-ray tube with a small focal spot is considered better than one with a large focal spot when it is desired to obtain:
- greater penetrating power
 - better definition
 - less contrast
 - greater film density
- F.18-22**
24. One method of reducing radiographic contrast is to:
- increase the distance between the radiation source and the object
 - decrease the distance between the object and the film
 - decrease the wavelength of the radiation used
 - increase development time within manufacturer's recommendations
- F.29**
25. Thin sheets of lead foil in intimate contact with X-ray film during exposure increase film density because they:
- fluoresce and emit visible light which helps expose the film
 - absorb the scattered radiation
 - prevent backscattered radiation from fogging the film
 - emit electrons when exposed to X- and gamma radiation which help darken the film
- A.16.24**
26. X-ray tubes are often enclosed in a shockproof casing in order to:
- dissipate heat
 - protect the operator from high-voltage shock
 - shield the tube from secondary radiation
 - increase the efficiency of the rectifier
- E.5.24**
27. An X-ray tube is rated for a maximum of 250 kVp. This tube may be operated at a maximum of:
- 250 000 V peak voltage
 - 250 kV effective voltage
 - 250 000 000 V rms voltage
 - 250 kV average voltage
- A.14.12**
28. A voltage selector consisting of an iron core transformer with a single winding having a series of taps at various points on the winding is called:
- a high-voltage transformer
 - a filament transformer
 - an autotransformer
 - a power transformer
- F.10-11**
29. In X-ray radiography, alternating current must be changed to pulsating direct current in order to satisfy the need for unidirectional current. This change may be accomplished by:
- transformers
 - rectifiers
 - anodes
 - cathodes
- F.11**
30. When radiographing to the 2-2T quality level, an ASTM penetrameter for 63 mm (2.5 in.) steel has a thickness of:
- 13 mm (0.5 in.)
 - 64 μ m (2.5 mils)
 - 127 μ m (5 mils)
 - 1270 μ m (50 mils)
- C.E94**
31. Valve tubes are used in X-ray equipment to:
- provide necessary rectification
 - activate and deactivate the X-ray tube
 - heat the filaments in the X-ray tube
 - adjust the size of the target
- A.14.6; B.96-97**
32. A good Co-60 radiograph is made on a 76 mm (3 in.) steel casting using an exposure time of 10 minutes and a source-to-film distance of 91 cm (36 in.). If it is necessary to change the source-to-film distance to 61 cm (24 in.), what exposure time would produce a similar radiograph if all other conditions remain the same?
- 1.6 minutes
 - 4.4 minutes
 - 6.4 minutes
 - 8.8 minutes