

# ASNT QUESTIONS & ANSWERS BOOK

Third Edition

## Radiographic Testing Method

Levels I, II and III Review Questions  
Book A



ASNT  
QUESTIONS & ANSWERS  
BOOK

Third Edition

# Radiographic Testing Method

Levels I, II and III Review Questions - Book A



The American Society for  
Nondestructive Testing, Inc.



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Third Edition  
first printing 12/14  
e-book 12/14

Errata, if available for this printing, may be obtained from ASNT's website, [www.asnt.org](http://www.asnt.org). E-books contain all corrections and updates, including the latest errata.

ISBN: 978-1-57117-335-5 (print)  
ISBN: 978-1-57117-336-2 (e-book)

Printed in the United States of America

Published by:  
The American Society for Nondestructive Testing, Inc.  
1711 Arlingate Lane  
Columbus, OH 43228-0518  
[www.asnt.org](http://www.asnt.org)

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ASNT Mission Statement:  
ASNT exists to create a safer world by promoting the profession and technologies of nondestructive testing.

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# ACKNOWLEDGMENTS

The American Society for Nondestructive Testing, Inc. is grateful for the volunteer contributions, technical expertise, knowledge and dedication of the following individuals who have helped make this work possible.

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# INTRODUCTION

## Purpose

This book was previously published as *Supplement to Recommended Practice SNT-TC-1A (Q&A Book): Radiographic Testing*. This is an update of previous editions prepared by members of ASNT's Penetrating Radiation Committee.

As with other books in the ASNT Questions & Answers series, this book is intended to provide candidates studying for qualifying examinations with sample Level I, II, and III questions. The questions are similar to the types of questions one might encounter on a certification examination and should be used for review and for practice examinations only.

Though this book is intended to cover the body of knowledge in *ANSI/ASNT CP-105: ASNT Standard Topical Outlines for Qualification of Nondestructive Testing Personnel* (2011), it is not intended to comprehensively cover all possible technical issues that may appear on a certification exam.

## What Is New

The main changes between the second and third editions are that the references have been updated, many questions have been updated, and every question is multiple choice with four unique answers to more closely match the ASNT exam format.

## Additional Information

Because ASNT is an International System of Units (SI) publisher, throughout the text both SI and imperial units are used. Level I and Level II questions use imperial units first. Level III questions use SI units first. For simplicity, many equations in this book use 25 mm equals 1 in. Where SI units are not used in the original text of a standard or code, conversions to SI units were not made.

All figures are from ASNT sources unless otherwise indicated.

# REFERENCES

## Recommended References

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

### Reference A

Bossi, R.H., F.A. Iddings, and G.C. Wheeler, tech. eds., P.O. Moore, ed., *Nondestructive Testing Handbook*, third edition: Volume 4, *Radiographic Testing*. Columbus, OH: American Society for Nondestructive Testing, Inc. 2002.

### Reference B

Staton, J. *Radiographic Testing Classroom Training Book (PTP Series)*. Columbus, OH: American Society for Nondestructive Testing, Inc. 2005.

### Reference C

*ASNT Level III Study Guide: Radiographic Testing Method*. Columbus, OH: American Society for Nondestructive Testing, Inc. 2014.

### Reference D

McCain, D., *ASNT Study Guide: Industrial Radiography Radiation Safety*. Columbus, OH: American Society for Nondestructive Testing, Inc. 2009.

### Reference E

*Radiography in Modern Industry*, fourth edition. Rochester, NY: Eastman Kodak Co. <http://www.kodak.com/eknec/documents/87/0900688a802b3c87/Radiography-in-Modern-Industry.pdf>. 1980.

### Reference F

*Annual Book of ASTM Standards*, Volume 03.03, *Nondestructive Testing*. "Standard Guide for Radiographic Examination," Standard ASTM E 94, 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. Example: FE94.)

### Reference G

Becker, W.T. and R.J. Shipley. *Metals Handbook*, ninth edition, *Nondestructive Inspection and Quality Control*, Volume 11. Metals Park, OH: American Society for Metals. 2002.

## Additional References

The following references are listed in *CP-105-2011* as recommended references but were not used in building this book. These references may be useful for additional study of the radiographic testing method.

*Materials and Processes for NDT Technology*. Columbus, OH: American Society for Nondestructive Testing, Inc. 1981.

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*Welding Inspection Handbook*. Miami, FL: American Welding Society. Latest edition.

## Reference Codes

Each question in this book is followed by letter(s) and page number(s) indicating the specific recommended reference where the answer may be found. For example:

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

A.44, 74-75

In this example, the letter “A” refers to Reference A in the list above and 44, 74-75 are the specific pages in Reference A where the answer to the question is located.

## Reference Usage

### Reference A Total = 210

Level I (48)  
Level II (80)  
Level III (82)

### Reference B Total = 27

Level I (6)  
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Level III (13)

### Reference C Total = 33

Level I (5)  
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### Reference D Total = 11

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### Reference E Total = 168

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### Reference F Total = 15

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Level III (9)

### Reference G Total = 5

Level I (0)  
Level II (5)  
Level III (0)





# LEVEL I

## Review Questions

1. Although there may be other reasons for using calcium tungstate screens in industrial radiography, they are most often 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.

E.9
2. An excellent radiograph is obtained under given conditions of exposure with the film located at a distance of 36 in. (914.4 mm) from the target of the X-ray tube. If the film is now placed only 18 in. (457.2 mm) 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%.
  - c. shorter by approximately 55%.
  - d. only about 25% as long as the original exposure time.

E.47
3. An excellent radiograph is obtained under given exposure conditions with a tube current of 5 mA and an exposure time of 12 min. 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 min
  - b. 12 min
  - c. 6 min
  - d. 3 min

E.49
4. In film radiography, image quality indicators (IQIs) 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.458
5. When radiographing to the 2-2T quality level, an ASTM IQI for 0.5 in. (12.7 mm) thick 2024 aluminum alloy has a thickness of:
  - a. 0.5 in. (12.7 mm)
  - b. 0.002 in. (0.051 mm)
  - c. 0.005 in. (0.127 mm)
  - d. 0.010 in. (0.254 mm)

F.E1025
6. The penetrating ability of an X-ray beam is governed by:
  - a. kilovoltage.
  - b. time.
  - c. milliamperage.
  - d. source-to-film distance.

A.142
7. Co-60 used in nondestructive testing emits:
  - a. alpha particles.
  - b. neutrons.
  - c. gamma rays.
  - d. X-rays.

A.44, 74-75
8. A densitometer is an instrument for measuring:
  - a. X-ray intensity.
  - b. film density.
  - c. density of a material.
  - d. tube current.

A.165
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<sub>2</sub>O<sub>2</sub>.
  - c. developer, fixer, and water.
  - d. acetic acid, fixer, and stop bath.

A.230
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.141, 242



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.
12. What does R/h refer to?
  - a. Radiation limits for humans.
  - b. Roentgen per hour.
  - c. X-rays per hour.
  - d. Radiation in hydrogen.
13. The ability to detect a small detail is called radiographic:
  - a. contrast.
  - b. sensitivity.
  - c. density.
  - d. resolution.
14. The term used to express the number of curies (becquerels) of radioactivity per ounce or gram of source weight is:
  - a. decay.
  - b. emissivity.
  - c. specific activity.
  - d. source output.
15. The unit of measurement used for the output of a gamma-ray source is the:
  - a. curie (becquerel).
  - b. roentgen (sievert).
  - c. half-life.
  - d. MeV.
16. 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.
17. Which dose would be most dangerous, if not fatal, if applied to the entire body in a short period of time?
  - a. 0-25 R (0-250 mSv).
  - b. 25-100 R (250-1000 mSv).
  - c. 400-600 R (4000-6000 mSv).
  - d. 600 R or more (6000 mSv or more).
18. 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.
19. If a film is placed in a developer solution and allowed to develop without any agitation:
  - a. the radiograph may 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. uneven development or streaking could occur.
20. 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. quality of radiograph or exposure time.
21. A Co-60 source has a half-life of:
  - a. 1.2 years.
  - b. 6 months.
  - c. 5.27 years.
  - d. 74.3 days.
22. X-ray tube current is controlled by the:
  - a. current passing through the filament.
  - b. distance from the cathode to the anode.
  - c. type of material used in the target.
  - d. voltage and waveform applied to the X-ray tube.

C.23; D.18

A.42

D.83

A.151, 170

A.455

A.31, 42

D.1

A.80

E.81, 108

E.72

A.74

B.31; C.13

23. 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.
- E.30
24. Lead intensifying screens are usually mounted in pairs in rigid holders called:
- film racks.
  - cassettes.
  - emulsifiers.
  - diaphragms.
- E.39
25. 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.
- A.60, 144
26. 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.141
27. 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.141-142
28. Primary radiation that strikes a film holder or cassette through a thin portion of the specimen causes scattering into the shadows of the adjacent thicker portions, producing an effect called:
- radiation imaging.
  - spotting.
  - undercut.
  - unsharpness.
- E.50
29. 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.
- E.50-51
30. Which of the following materials is suitable for use in containers used to mix processing solutions?
- Stainless steel.
  - Aluminum.
  - Galvanized iron.
  - Tin.
- E.104
31. Of the following, which would be *especially* sensitive to injury by excessive exposure to X-rays or gamma rays?
- White blood cells.
  - Blood vessel cells.
  - Immature red blood cells.
  - Digestive system lining cells.
- D.16
32. Film overexposure from X-ray radiography may be caused by:
- lower kilovoltage radiations in the direct beam from the X-ray tube target.
  - scatter radiation arising from objects in the direct beam.
  - residual radiation that exists for the first few minutes after the X-ray machine has been returned to the "off" position.
  - high-speed films.
- E.195-196, 209

33. A general rule often employed for determining the kilovoltage to be used when radiographing 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.
- E.34
34. If a piece of lead 0.5 in. (12.7 mm) 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.132
35. Excessive exposure of film to light prior to development of the film will most likely result in:
- a foggy film.
  - improved definition.
  - streaks.
  - yellow stain.
- E.132-133
36. Reticulation resulting in a puckered or net-like film surface is probably caused by:
- crimping film after exposure.
  - sudden extreme temperature change while processing in the developer.
  - water or developer on unprocessed film.
  - excessive object-to-film distance.
- A.244
37. 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.
- E.107
38. If an exposure time of 60 s was necessary using a 4 ft (1.2 m) source-to-film distance for a particular exposure, what time would be necessary if a 2 ft (0.6 m) source-to-film distance is used and all other variables remain the same?
- 120 s
  - 30 s
  - 15 s
  - 240 s
- E.31
39. 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.
  - as far as the shape of the specimen will allow, the plane of the maximum interest should be perpendicular to the plane of the film.
- E.22-23
40. 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.
  - a lead screen.
  - an image quality indicator (IQI).
  - an illuminator.
- A.172, 187
41. An IQI is used to indicate the:
- size of discontinuities in a part.
  - density of the film.
  - amount of film contrast.
  - sensitivity of the radiographic technique.
- E.90
42. A fluorescent intensifying screen will:
- emit light that may lessen the necessary exposure.
  - result in reticulation.
  - decrease the graininess of the image when using gamma rays.
  - increase the definition in a radiograph.

E.33, 45



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43. 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.230
44. 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.150
45. 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.
- E.60
46. 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 embedded in screens.
  - scratches on lead foil screens.
  - improper film handling techniques.
- E.98
47. 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.233
48. When manually processing films, the purpose for abruptly tapping the hangers against the side of the tank 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 the emulsion.
  - secure uniformity of development over the whole area of the film.
- A.205
49. The activity of the developer solution is stabilized by:
- constantly agitating it.
  - heating processing solutions.
  - avoiding contamination from the wash bath.
  - adding replenisher.
- A.242
50. The purpose of fixation is:
- to carry away and diffuse fixer from the film.
  - to leave the developed silver as a permanent image.
  - to deactivate the development.
  - to transform the exposed silver halide crystal to metallic crystal.
- A.230
51. 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.205
52. The small area in the X-ray tube from which the radiation emanates is called the:
- diaphragm.
  - focal spot.
  - focusing cup.
  - cathode.
- A.60

53. 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.
- E.14
54. The radiation intensity of a radioisotope:
- increases with time.
  - decreases with time.
  - is not affected as time elapses.
  - increases with tube current mA.
- A.42, 456
55. A curie is the equivalent of:
- 37 Bq
  - 37 GBq
  - 37 000 000 TBq
  - 3 700 000
- A.30, 31
56. With a given exposure time and kilovoltage, a properly exposed radiograph is obtained with a 6 mA min exposure at the distance of 20 in. (508 mm). It is desired to increase the sharpness of detail in the image by increasing the source-to-film distance to 40 in. (1016 mm). The correct exposure to obtain the desired radiographic density at the increased distance is:
- 12 mA-min
  - 24 mA-min
  - 3 mA-min
  - 1.7 mA-min
- E.47
57. Very short wavelength electromagnetic radiation produced when electrons travelling at high speeds collide with matter is called:
- X-radiation.
  - beta radiation.
  - gamma radiation.
  - alpha radiation.
- E.10
58. The exposure of personnel to X-radiation and gamma radiation can be measured by means of:
- geiger-müller counters.
  - radiation detectors.
  - ionization chambers.
  - thermoluminescent dosimeters (TLDs).
- C.28
59. Assuming that a good radiograph is obtained at a setting of 10 mA in 40 s, how much time would 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
- E.47
60. A graph showing the relation between material thickness, kilovoltage, and exposure is called:
- a bar chart.
  - an exposure chart.
  - a characteristic curve.
  - a logarithmic chart.
- E.51
61. A graph that 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.
  - a characteristic curve.
  - a logarithmic chart.
- E.53
62. Short wavelength electromagnetic radiation produced during the disintegration of nuclei of radioactive substances is called:
- X-radiation.
  - gamma radiation.
  - scatter radiation.
  - backscatter radiation.
- E.14

63. A photographic image recorded by the passage of X-rays or gamma rays through a specimen onto a film is called a(n):
- fluoroscopic image.
  - radiograph.
  - isotopic reproduction.
  - photofluorograph.
- E.7
64. 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.
- E.109
65. When referring to a 2T or 4T hole in the ASTM IQI, the T refers to the:
- part thickness.
  - plaque thickness.
  - time of exposure.
  - time for developing.
- A.458, 485
66. 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 specimen. Such a device is called a:
- mask.
  - filter.
  - backscatter absorber.
  - lead foil screen.
- E.52
67. 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.
- A.166
68. 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.
- E.161
69. 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.
  - it should be charged and set to zero prior to the beginning of the shift.
- D.26
70. The density difference between two selected portions of a radiograph is known as:
- unsharpness.
  - radiographic contrast.
  - specific activity.
  - subject density.
- A.150
71. X-rays, gamma rays, and alpha particles all have one thing in common; they are all:
- particulate radiations.
  - electromagnetic radiations.
  - microwave radiations.
  - ionizing radiations.
- A.90, 664
72. When producing radiographs, if the kilovoltage is increased, the:
- subject contrast decreases.
  - film contrast decreases.
  - subject contrast increases.
  - film contrast increases.
- A.131, 170

73. The accidental movement of the specimen or film during exposure or the use of a focus-film distance that is too small will:
- produce a radiograph with poor contrast.
  - make it impossible to detect large discontinuities.
  - result in unsharpness of the radiograph.
  - result in a fogged radiograph.
- A.43
- E.142
74. Lead screens in intimate contact with the film during exposure:
- reduce exposure time and improve radiographic quality.
  - absorb the shorter wavelength scattered radiation more than the long wavelength primary radiation.
  - intensify the photographic effect of the scatter radiation more than that of the primary radiation.
  - cause film overexposure.
- A.671
- A.159
75. The sharpness of the outline in the image of the radiograph is a measure of:
- subject contrast.
  - radiographic definition.
  - radiographic contrast.
  - film contrast.
- E.79
- A.170
76. An unshielded isotope source gives a dosage rate of 900 mR/h at 10 ft (9000  $\mu$ Sv/h at 3 m). What would the unshielded dosage rate be at 30 ft (9 m)?
- 300 mR/h (3000  $\mu$ Sv/h)
  - 600 mR/h (6000  $\mu$ Sv/h)
  - 100 mR/h (1000  $\mu$ Sv/h)
  - 2700 mR/h (27 000  $\mu$ Sv/h)
- F.E94
- A.44
77. Which has the shortest wavelength?
- Visible light.
  - Microwaves.
  - 100 kV peak X-rays.
  - Infrared radiation.
- F.E1025
- E.7
78. Beta particles are:
- neutrons.
  - electrons.
  - positrons.
  - protons.
79. The velocity of all electromagnetic radiation is:
- 186 000 miles per second (299 338 km per second).
  - 18 600 miles per second (29 934 km per second).
  - 186 000 miles per minute (299 338 km per minute).
  - 1860 miles per second (2993 km per second).
80. Unexposed boxes of X-ray film should be stored:
- flat.
  - on edge or end.
  - in a pile.
  - in any arrangement.
81. The lead symbol B is attached to the back of the film holder to determine:
- sensitivity.
  - whether excessive backscatter is present.
  - radiographic contrast.
  - density.
82. Image quality indicators for \_\_\_\_\_ are considered Group I Materials and do not need to have an identification notch.
- high-temperature nickel-chromium alloy
  - nickel
  - stainless steel
  - aluminum bronze

83. 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.
- B.97
84. Why is Co-60 used as a radiation source for medium-weight metals of thickness ranges from 1.5 to 9 in. (38.1 to 228.6 mm)?
- Because of its short half-life.
  - Because of the limited amount of shielding required.
  - Because of its penetrating ability.
  - Because of its weight and ease of handling.
- A.75; B.13-14, 48
85. The cause for poor image definition could be:
- too short source-to-film distance.
  - screens and film in close contact.
  - fine-grain film.
  - smaller source size/effective focal spot.
- A.170
86. 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.
  - remove all of the undeveloped silver salt of the emulsion.
- E.85
87. A thin, metallic sheet (brass, copper, lead, etc.) placed at the source to reduce the effects of softer radiation is known as:
- an intensifying screen.
  - a filter.
  - an electron inducer.
  - a focusing cup.
- A.155-156
88. The reason a shim is used in a radiographic setup is to:
- improve the IQI image.
  - reduce diffraction.
  - simulate weld thickness.
  - intensify the image.
- A.488
89. 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.164
90. Which of the following is *not* a common method of absorption of X-radiation and gamma radiation during their interaction with matter?
- Photoelectric absorption.
  - Compton effect.
  - Pair production.
  - Rayleigh scattering.
- A.91
91. The image of the appropriate IQI and hole on the radiograph indicates that the radiograph has the required:
- contrast.
  - definition.
  - sensitivity.
  - latitude.
- B.87
92. The primary parts of an atom are:
- proton, neutrino, and electron.
  - proton, electron, and gamma ray.
  - photon, electron, and neutron.
  - proton, electron, and neutron.
- C.1
93. X-rays and gamma rays travel in:
- pairs.
  - orbital spheres.
  - straight lines.
  - curved lines.
- B.15

94. A large source size can be compensated for by:
- increasing the source-to-specimen distance.
  - adding lead screens.
  - increasing the specimen-to-film distance.
  - increasing the penumbra.

B.14, 99-100; C.39-40

95. Radiation arising directly from the target of an X-ray tube or an accelerator, or from a radioactive source, is usually referred to as:
- secondary radiation.
  - primary radiation.
  - backscatter.
  - inherent radiation.

A.668

96. 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:
- cathode.
  - filament.
  - target.
  - generator.

A.56, 59

97. The best X-ray efficiency is produced when the target material has a:
- low atomic number.
  - high atomic number.
  - low hardness.
  - high hardness.

E.11

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

- Rectifier.
- Cathode X-ray tubes.
- Gas X-ray tube.
- Vacuum X-ray tube.

E.12-13

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

- source-to-film distance.
- time.
- kilovoltage.
- milliamperage.

E.36

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

- Neutrons.
- Gamma rays.
- X-rays.
- Alpha particles.

A.44

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

- decay (disintegration).
- ionization.
- scintillation.
- activation.

A.42

### Answers

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

# LEVEL II

## Review Questions

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

A.62-63; G.306
2. The projected area of the target of an X-ray tube is called the:
  - a. focal spot.
  - b. focus.
  - c. effective focal spot.
  - d. geometric unsharpness.

E.8
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.62
4. If it were necessary to radiograph a 7 in. (177.8 mm) 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

A.74-75
5. A Co-60 gamma-ray source has an approximate practical thickness limit of:
  - a. 2.5 in. (63.5 mm) of steel or its equivalent.
  - b. 4 in. (101.6 mm) of steel or its equivalent.
  - c. 8 in. (203.2 mm) of steel or its equivalent.
  - d. 11 in. (279.4 mm) of steel or its equivalent.

A.75
6. The absorption of gamma rays from a given source when passing through matter depends on:
  - a. the 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. the specific activity value of the source.

A.48-51, 57
7. The fact that gases, when bombarded by radiation, ionize and become electrically conductive makes them useful in:
  - a. X-ray transformers.
  - b. X-ray tubes.
  - c. masks.
  - d. radiation detection equipment.

A.90
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.

E.11