

**MULTIPLE CHOICE**

1. Sectional images are obtained from all of the following *except*:
  - a. tomography.
  - b. transverse axial tomography.
  - c. conventional radiography.
  - d. computed tomography (CT).

ANS: C

Conventional radiography cannot obtain sectional images.

REF: p. 2

2. Which acronym has been established by the Radiological Society of North America (RSNA) and the accepted term for use within the radiologic community and major American radiology journals?
  - a. CAT
  - b. CT
  - c. CTAT
  - d. RT

ANS: B

The term CT was established by the RSNA in its major journal *Radiology*. In addition, the *American Journal of Roentgenology* accepted this term, which has now gained widespread acceptance within the radiologic community.

REF: p. 3

3. Data acquisition refers to:
  - a. collecting X-ray transmission readings from the patient.
  - b. subjecting data to computer processing.
  - c. changing the data before they are displayed on a monitor.
  - d. storing the data collected from the patient onto magnetic tapes or disks.

ANS: A

The term data acquisition refers to the collection of X-ray transmission measurements from the patient.

REF: p. 3

4. Which term describes the systematic motion of the X-ray tube as it rotates around the patient to collect X-ray transmission readings?
  - a. Sampling
  - b. Data processing
  - c. Scanning
  - d. Generation

ANS: C

This process of translate-rotate-stop-rotate, referred to as scanning, is repeated 180 times.

REF: p. 4

5. Which of the following refers to modifying CT data to make the images more useful to the observer?
  - a. Image manipulation
  - b. Image reconstruction
  - c. Data collection
  - d. Pattern recognition

ANS: A

Images can be modified through image manipulation to make them more useful to the observer.

REF: p. 4

6. Who developed the first clinically useful CT scanner?
  - a. Cormack
  - b. Roentgen
  - c. Hounsfield
  - d. Siemens Medical Systems

ANS: C

Dr. Hounsfield's research resulted in the development of a clinically useful CT scanner for imaging the brain.

REF: p. 7

7. Which company pioneered the development of the first clinically useful CT scanner?
- General Electric
  - Siemens
  - Elscent
  - EMI

ANS: D

In 1971, the first clinical prototype CT brain scanner (EMI Mark I) was installed at Atkinson-Morley's Hospital.

REF: p. 7

8. The radiation used by Hounsfield in his original experiments was:
- gamma rays.
  - X-rays.
  - beta particles.
  - electrons.

ANS: A

The radiation used was from an americium gamma source coupled to a crystal detector.

REF: p. 6

9. What contribution did Cormack make to the development of clinical CT?
- He developed Britain's first business computer
  - He developed programs to calculate doses to patients
  - He developed the solutions to the mathematical problems in CT
  - He performed a practical reconstruction of an image of the sun

ANS: C

Professor Cormack developed solutions to the mathematical problems in CT.

REF: p. 8

10. Who developed the first whole-body CT scanner?
- Ledley
  - Kuhl
  - Cormack and Hounsfield
  - Oldendorf

ANS: A

In 1974, Dr. Robert Ledley, a professor of radiology, physiology, and biophysics at Georgetown University, developed the first whole-body CT scanner.

REF: p. 8

11. Which type of high-speed CT scanner was first introduced to image the cardiovascular system without artifacts caused by motion of the heart?
- Single-slice CT scanner
  - Electron-beam CT (EBCT) scanner
  - Dual-source CT (DSCT) scanner
  - EMI Mark I CT scanner

ANS: B

In the mid-1980s, a high-speed CT scanner was introduced that used electron-beam technology, a result of work by Dr. Douglas Boyd and colleagues during the late 1970s at the University of California at San Francisco. The scanner was invented to image the cardiovascular system without artifacts caused by motion. This scanner was referred to as the *EBCT scanner*.

REF: p. 8 | p. 9

12. When a large set of transmission measurements is collected from the patient at different locations and is used to build up an image of internal anatomy, it is referred to as:
- tomography.
  - image reconstruction from projections.
  - pattern recognition.
  - digital image processing.

ANS: B

Image reconstruction from projections had its theoretical roots in 1917 when the Austrian mathematician Radon proved it possible to reconstruct or build up an image of a two- (2D) or three-dimensional (3D) object from a large number of its projections from different directions.

REF: p. 2

13. The following developments in CT were introduced during the period between 1973 and 1983 *except*:

- a. image quality improvements.
- b. quality control (QC).
- c. detectors.
- d. Multislice CT (MSCT).

ANS: D

In 1998 a new generation of CT scanners was introduced at the RSNA meeting in Chicago. These scanners are called *MSCT scanners* because they are based on the use of multidetector technology to scan four or more slices per revolution of the X-ray tube and detectors

REF: p. 11

14. Which of the following is best used to describe patient dose in CT?

- a. CT dose index (CTDI) and multiple-scan average dose (MSAD)
- b. Isometric curves
- c. Exposure doses
- d. Collective doses

ANS: A

Dose descriptors include the single-scan dose profile, multiple-scan dose profile, CTDI, MSAD, and isodose curves.

REF: p. 14

15. Which form of imaging primarily uses DSCT scanners?

- a. Virtual colonoscopy
- b. Cardiac imaging
- c. Biopsy procedures
- d. Pulmonary imaging

ANS: B

DSCT scanners feature two X-ray tubes and two detectors specifically intended for imaging cardiac patients in a very short time.

REF: p. 12 | p. 13

16. All these elements can be used during data acquisition to reduce patient dose *except*:

- a. combined applications.
- b. ultrafast ceramic (UFC) detectors.
- c. decreased pitch.
- d. online dose modulation.

ANS: C

One scheme uses three elements to keep the patient dose to a minimum during data acquisition: combined applications to reduce exposure, new UFC detectors, online dose modulation.

REF: p. 14

17. The detectors convert the attenuation data into \_\_\_\_\_ signals.

- a. digital
- b. electrical
- c. light
- d. mechanical

ANS: B

The detectors convert the X-ray photons (attenuation data) into electrical signals or analog signals.

REF: p. 5

18. The mathematical techniques used by the computer to reconstruct the CT image are known as:

- a. computer programs.
- b. image reconstruction algorithms.
- c. manipulation of images.
- d. pattern recognition.

ANS: B

After enough transmission measurements have been collected by the detectors, they are sent to the computer for processing. The computer uses special mathematical techniques to reconstruct the CT image in a finite number of steps called image reconstruction algorithms.

REF: p. 4

19. In CT,

- a. a computer is used to reconstruct images of sectional anatomy.
- b. a computer is used to calculate radiation dose to the patient.
- c. a computer is not required because the physicist calculates the image, which the computer then prints out.
- d. special detectors are used to reconstruct sectional images.

ANS: A

CT overcomes limitations in detail and clarity by using image reconstruction from projections to produce sharp, clear images of cross-sectional anatomy.

REF: p. 2

20. What form of archiving has proven most popular among CT departments?

- a. Film-based recording
- b. Optical card
- c. Picture archiving and communication system
- d. Magnetic tapes

ANS: C

CT departments now operate in a picture archiving and communications systems environment that allows the flow of CT data and images among devices and people not only in the radiology department but throughout the hospital as well.

REF: p. 5

#### TRUE/FALSE

1. The original term used to describe imaging of a specific layer or section of the body was transverse axial tomography.

ANS: F

Traced back to the early 1920s, when a number of investigators were developing methods to image a specific layer or section of the body. At that time, terms such as “body section radiography” and “stratigraphy” (from *stratum*, meaning “layer”) were used to describe the technique. It wasn’t until 1937 when the technique referred to as transverse axial tomography was developed.

REF: p. 2

2. Ambrose received the Nobel Prize in 1979 with Hounsfield.

ANS: F

In 1979, Hounsfield shared the Nobel Prize in medicine and physiology with Allan MacLeod Cormack.

REF: p. 7

3. In the original experiments in CT, the apparatus took 9 hours to scan the object.

ANS: F

Due to the low radiation output, the apparatus took about 9 days to scan the object. The computer needed 2.5 hours to process the 28,000 measurements collected by the detector. Because this procedure was too long, various modifications were made and the gamma radiation source was replaced by a powerful X-ray tube. The results of these experiments were more accurate, but it took 1 day to produce a picture.

REF: p. 6

4. The first clinical prototype CT scanner was used to scan a woman patient with a suspected brain lesion.

ANS: T

In 1972, the first patient was scanned by this machine. This patient was a woman with a suspected brain lesion, and the picture showed clearly in detail a dark circular cyst in the brain.

REF: p. 7

5. The first CT scanners’ X-ray tube and detector movement was described as translate-rotate-stop-rotate because they moved in a straight line across the patient.

ANS: T

The first brain CT scanner used a data acquisition scheme where the X-ray tube and detectors moved in a straight line, or translated, across the patient’s head, collecting a number of transmission measurements as they moved from left to right. This process of translate-rotate-stop-rotate, referred to as *scanning*, is repeated over 180 degrees.

REF: p. 4

6. DSCT scanners feature two X-ray tubes and two detector arrays and were designed with the intention of imaging active bleeding in trauma patients in a short period of time.

ANS: F

DSCT scanner features two X-ray tubes and two detectors specifically intended for imaging cardiac patients in a very short time.

REF: p. 12 | p. 13

7. Isodose curves are a dose descriptor used in reporting radiation doses in CT.

ANS: T

Dose descriptors include the single-scan dose profile, multiple-scan dose profile, CTDI, MSAD, and isodose curves.

REF: p. 14

8. 3D algorithms, or rendering techniques, transform the transaxial CT data into simulated 3D images.

ANS: T

These algorithms, or rendering techniques, transform the transaxial CT data into simulated 3D images.

REF: p. 18

9. QC tests in CT meet only quantitative criteria to indicate the scanner is in working condition.

ANS: F  
As with any medical imaging system, CT scanners are subject to QC procedures and tests. These QC tests must meet both quantitative and qualitative criteria, which indicate that the scanner is in perfect working condition. Testing system performance is vital to maintain optimal image quality and minimize the production of image artifacts.

REF: p. 15

10. CT has been applied to the study of internal log defects and Egyptian mummies.

ANS: T  
CT can be used for both the study of internal log defects and the study of Egyptian mummies.

REF: p. 15 | p. 16

11. CT fluoroscopy is a clinical tool allowing the reconstruction and display of images in real time with variable frame rates.

ANS: T  
CT fluoroscopy allows for the reconstruction and display of images in real time with variable frame rates. In 1996, the U.S. FDA approved real-time CT fluoroscopy as a clinical tool for use in radiology.

REF: p. 17

12. Determining tissue types in CT slices is referred to as volume formation.

ANS: F  
Volume formation involves stacking images to form a volume with some preprocessing. Classification refers to determining the tissue types in the slices.

REF: p. 18

13. Gas-ionization detectors (xenon gas) are used in the majority of commercial CT scanners today.

ANS: F  
Detectors fall into two categories, namely, solid-state detectors (scintillation detectors) and gas-ionization detectors (xenon gas). While the xenon gas detectors have become obsolete, scintillation detectors have evolved.

REF: p. 21

14. ALARA is an acronym for as low as reasonably achievable.

ANS: T  
The International Commission on Radiological Protection advocates the use of the as low as reasonably achievable (ALARA) philosophy when considering dose reduction to patients.

REF: p. 21

15. Processing images by computer is referred to as digital image processing.

ANS: T  
Digital image processing involves the use of a digital computer to process and manipulate digital images.

REF: p. 22

**MATCHING**

*Please match the following CT concepts. All answer selections will be used just once.*

- a. Determine tissue types in CT slices
- b. Algorithms
- c. CT dose descriptor
- d. Converting electrical signals into digital data
- e. Surface-based rendering

- 1. 3D technique
- 2. 3D classification
- 3. Image reconstruction
- 4. Analog to digital converter
- 5. MSAD

- |           |                    |
|-----------|--------------------|
| 1. ANS: E | REF: p. 18         |
| 2. ANS: A | REF: p. 18         |
| 3. ANS: B | REF: p. 4          |
| 4. ANS: D | REF: p. 22   p. 23 |
| 5. ANS: C | REF: p. 14         |