Question Bank (Reference: SEE Question papers)

Medical Imaging Systems

Unit 1

1. What are X-rays and what are their properties? Explain the basis of diagnostic radiology with the help of a diagram.
2. How are X-rays produced? Explain the working of X-ray tube.
3. Distinguish between stationary anode X-ray tube and rotating anode X-ray tube. Explain with the help of a diagram.
4. Explain the working of an X-ray machine with the help of a block diagram.
5. What is the function of a collimator and grid in an X-ray machine? Explain with the help of a diagram.
6. What is the commonly used method for automatic exposure control in an X-ray machine? Describe with the help of a diagram.
7. Explain the working of an X-ray image intensifier system with the help of a block diagram. What is the special application of using X-ray image intensifier system?
8. What are the advantages of digital radiology? Explain the construction of a flat-panel X-ray detector.
9. With a block diagram explain Digital X-ray imaging systems
10. Analyse the different physical parameters for X-ray detectors

Unit 2: CT and Radionuclide Imaging:

1. Analyse technique of producing images in Computed tomography machines
2. Evaluate the iteration reconstruction method with an example
3. Explain radiation detectors used in radionuclide imaging
4. Discuss various generations of scanning arrangements
5. Explain interaction of nuclear particles with matter
6. Explain pulse height analyser with block diagram
7. Explain ionization collection detector with diagram
8. Explain gamma camera with diagram
9. Explain SPECT with schematic
10. Explain PET with schematic

Unit 3: Magnetic Resonance Imaging:

1. Explain (i) magnetic moment (ii) FID
2. Explain with basic diagram, NMR components
3. Explain spin-lattice relaxation and spin-spin relaxation
4. Explain image reconstruction methods used in NMR imaging
5. What is the significance of relaxation process in NMR imaging? Distinguish between T1 and T2 relaxation times
6. List the advantages and disadvantages of MR imaging systems
7. List out the biological effects of MR imaging modality
8. Explain Fourier transform of FID
9. Explain Frequency encoding
10. Explain Phase encoding

11. Explain any one method of pulse sequence in MR imaging
12. Explain for slice selection with schematic diagram
13. Illustrate how spatial position is encoded in terms of Frequency and Phase and how it is accomplished through the use of magnetic field gradients.
14. Analyse how long TR/TE gives T2-weighted and short TR/TE gives T1-weighted images

Unit 4: Ultrasound Imaging Systems

1. Write a note on interaction of ultrasound with tissue of human body.
2. Explain the principle of working of Ultrasound system
3. Briefly explain acoustic parameters of medium.
4. Explain Pulse echo system with a neat labeled diagram.
5. Write a note on transducer beam characteristics.
6. Explain the parameters that are important in optimizing transducers for various applications
7. Explain A-scan system with a block diagram.
8. Explain B- mode scanner with a neat-labeled diagram.
9. Briefly explain linear array scanner with the help of schematics.
10. Write a note on M mode system.
11. Write a note on portable ultrasound systems
12. Discuss the biological effect of ultrasound.
13. Illustrate how longitudinal mode of wave can be propagated in all types of media which can be used in medical applications
14. For a two-dimensional image, consider the scanning plane is the azimuth dimension whereas the elevation dimension is perpendicular to the azimuth scanning plane. Develop the shape of the region scanned for various array-element configurations.
15. Analyse the ultrasound flaw detectors normally employed in industry for non-destructive testing of metallic structures. Justify how this can be used for diagnostic purposes

Unit 5: Thermal Imaging Systems

1. Explain the working of thermo graphic unit with a neat labeled diagram.
2. Explain the principle of working and construction of pyroelectric vidicon camera.
3. With a schematic explain infrared imaging system.
4. Write a note on medical thermography.
5. Explain with a schematic diagram, digitization of thermogram
6. Explain the physics of thermography and augmented reality.
7. Write a note on quantitative medical thermography.
8. Write a note on thermo graphic equipment
9. Write a note on thermal camera
10. Illustrate how uncooled infrared technology is revolutionizing IR imaging by offering low-cost sensors with thermal sensitivity comparable to many high performance and complex cryogenically cooled infrared detectors.
11. Illustrate a system which can record a full scale (black to white) temperature difference of between 5 to l0°C.

12. Explain how to mitigate the problems encountered in clinical situations when it is difficult to distinguish small temperature differences.

Who is given credit for the discovery of X-ray?

- ○ Henri Becquerel
- ◉ Wilhelm Roentgen
- ○ Marie Curie
- ○ Pierre Curie

X-rays and Gamma rays have significant penetrating power due to their:

- ◉ Short wavelength
- ○ Medium wavelength
- ○ Long wavelength
- ○ Wide range of wavelengths

Collimators are used to:

- ◉ Reduce the radiation beam spread
- ○ Filter the radiation beam
- ○ Increase film latitude
- ○ Decrease film latitude

When penetrating radiation is directed at a material, the radiation intensity decreases:

- ◉ Decreases exponentially with increasing material thickness
- ○ Increase linearly with increasing material thickness
- ○ Decrease linearly with increasing material thickness
- ○ None of the above

Attenuation of radiation is due to:

- ○ Absorption
- ○ Scattering
- ○ Radioactive decay
- ◉ Both A and B

Bremsstrahlung production of X-rays produces radiation that is composed of:

- ○ A small number of very defined energies
- ◉ A continuous spectrum of energies over some range

- Radiation of only one energy
- None of the above

Computed tomography X-ray techniques allow the test component to be:

- Viewed in various cross-sectional slices
- Viewed from different angles
- Analyzed for chemical composition
- None of the above

The target of an X-ray tube is often made out of tungsten because:

- It has a high atomic mass which will result in more X-rays being generated due to atomic particle interactions
- It is an inexpensive material that is easy to machine
- It have very high thermal conductivity which makes it easy to cool
- None of the above

Exposure to ionizing radiation can be limited:

- With the use of shielding
- By increasing distance from the source
- By limiting the time exposed to the radiaiton
- All of the above

Higher energy radiation will have more:

- Speed
- Incident Intensity
- Penetrating power
- Both B and C

Which of the following crystals are not suited for x-ray grating?
a) Topaz
b) Lithium fluoride
c) Calcium fluoride
d) Sodium fluoride

Ans: d)Sodium Flouride

How can the resolution of the collimator be increased?

a) By reducing the separation between the metal plates of the collimator

b) By increasing the separation between the metal plates of the collimator

c) By increasing the number of metal plates

d) By decreasing the number of metal plates

View Answer

Answer: a
Explanation: The resolution of the collimator can be increased by reducing the separation between the metal plates of the collimator. Collimator has a series of closely spaced parallel metal plates.

Which of the following machines is often placed together with an X-Ray machine?

a) Endoscopy

b) Ultrasound

c) Fluoroscopy

d) C – Arm

View Answer

Answer: c
Explanation: Fluoroscopy is a process in which a radioactive dye is injected or ingested by the patient. The dye moves along the path in the body and emits radiation. Sometimes, X – Rays may have to fall on the dye to make it emit radiations. These radiations are collected to form images thus a fluoroscopic setup is often found together with an X-Ray setup.

The X-Ray is recorded on a plate coated with _____

a) Gold Halide

b) Silver Halide

c) Copper Halide

d) Iron Halide

View Answer

Answer: b
Explanation: The plate coated with Silver Halide, mostly silver bromide is used to image the X – Rays. Silver halides when exposed to X – Rays end up becoming black and so the images of the X – Rays are formed.

What does the ‘P’ in PET stand for?

a) Positron

b) Photon

c) Proton

d) P – orbital

View Answer

Answer: a
Explanation: PET stands for Positron Emission Tomography. In a PET process, there is a nuclear reaction causing emission of a positron. This positron comes in contact with an electron,

undergoes annihilation and gives out two gamma rays which are detected by the detector. On the gamma rays that are detected at the opposite ends are used to form an image. Rest are discarded as noise.

What does the ‘P’ in SPECT stand for?

a) Positron

b) Photon

c) Proton

d) P – orbital

View Answer

Answer: b
Explanation: SPECT stands for Single Emission Photon Tomography. In this process, the radioactive dyes give out photons which are detected by the detector and forms an image. The photon detector usually has Photo Multiplier Tubes (PMTs) that can amplify the received impulses from the photon and form an image.

What makes PET and SPECT so unique when it comes to nuclear imaging?

a) Do not require dyes

b) Do not require X – Rays

c) They show the metabolic functions

d) They give more details about the imaged organ/tissue

View Answer

Answer: c
Explanation: The dyes used in PET and SPECT are such that they become a part of the metabolic pathways and the transmitted radiations can help visualize the metabolic pathways. The machine that does the same work as PET and SPECT, i.e. visualizing the metabolic pathways is fMRI. However, since it does not use any dyes, it does not fall under nuclear imaging.

4. SPECT includes a _____ for imaging.

a) Gamma Camera

b) Silver Halide Film

c) Phosphorus Sheet

d) Lead Sheet

View Answer

Answer: a
Explanation: A gamma camera had detectors made of PMTs to help form an image. Since PET produces 2 photons/gamma rays, correlation of the image formed at the two ends is used to form a proper image. However, SPECT produces only 1 photon so if they need to be collected properly to form an image. Thus, a gamma camera, a camera specializing in capturing images by taking the impulses from the photons in used in SPECT.

The detector of PET is made of _____

a) Silver

b) Gadolinium

c) Tungsten

d) Lead

View Answer

Answer: b
Explanation: Bismuth germinate oxide (BGO), gadolinium oxyorthosilicate (GSO) or lutetium oxyorthosilicate detectors (LSO) are three materials that can be used to form the detectors for PET. They can record impulses from the gamma rays and convert them into electrical signals which are finally processed to form images.

6. As compared to PET, SPECT isotopes have _____ half life.

a) longer

b) shorter

c) equivalent

d) unstable

View Answer

Answer: a
Explanation: Since PET has 2 gamma rays, it uses the correlation of the images to form the final image. The process is also faster. However, with SPECT, there is only 1 gamma ray produced. The process is longer. Thus, for better imaging and allowing multiple imaging with a single shot of dye, SPECT radioisotopes need to have a longer half life.

The most preferred radioisotope element for SPECT is

a) Mo

b) W

c) Tc

d) Ba

View Answer

Answer: c
Explanation: Tc – 99m is activated Technetium which can be produced from Molybdenum. Tc – 99m has a half life of around 6hrs, is relatively easy to produce and can be flushed out of the body without causing much harm. It is also relatively stable and thus makes a good choice for SPECT scanning.

1. In X-ray spectrometers, the specimen or the sample is placed after which of the following components?

a) X-ray tube

b) Monochromator

c) Collimator

d) Detector

View Answer

Answer: a
Explanation: In X-ray spectrometers, the specimen or the sample is placed after the X-ray tube. The X-ray tube is the source of the X-ray.

2. Which of the following components are used to generate X-rays?

a) Meyer tube

b) West tube

c) Anger tube

d) Coolidge tube

View Answer

Answer: d
Explanation: Coolidge tube is used to generate X-rays. It the source of X-rays. Coolidge tube requires stabilised current and high voltage.

3. Using which of the following components is the generated x-rays focussed upon the specimen?

a) X-ray tube

b) Monochromator

c) Collimator

d) Detector

View Answer

Answer: c
Explanation: Collimator is used to focus the generated x-rays upon the specimen. The collimator is in between the specimen under analysis and the Coolidge tube.

4. The cathode in the Coolidge tube is made of which of the following elements?

a) Quartz

b) Iron

c) Tungsten

d) Barium

View Answer

Answer: c
Explanation: The cathode in the Coolidge tube is made of tungsten. The anode is made of copper.

5. The cathode in the Coolidge tube is kept in an inclined manner.

a) True

b) False

View Answer

Answer: b
Explanation: The anode in the Coolidge tube is kept in an inclined manner. The anode is made of copper.

6. Which of the following is not a target metal used in the Coolidge tube?

a) Rhodium

b) Cobalt

c) Gold

d) Silver

View Answer

Answer: c
Explanation: Gold is not used as a target metal in the Coolidge tube. The other target metals are copper, molybdenum and chromium.

7. How can the resolution of the collimator be increased?

a) By reducing the separation between the metal plates of the collimator

b) By increasing the separation between the metal plates of the collimator

c) By increasing the number of metal plates

d) By decreasing the number of metal plates

View Answer

Answer: a
Explanation: The resolution of the collimator can be increased by reducing the separation between the metal plates of the collimator. Collimator has a series of closely spaced parallel metal plates.

8.When x-rays emitted from molybdenum are allowed to pass through a zirconium filter, which of the following occurs?

a) It absorbs radiation of shorter wavelength

b) It absorbs radiation of longer wavelength

c) It allows radiation of shorter wavelength to pass through

d) It allows radiation in a particular band to pass through

View Answer

Answer: b
Explanation: When x-rays emitted from molybdenum are allowed to pass through a zirconium filter, it absorbs radiation of shorter wavelength. It allows radiation of a stronger wavelength to pass through.

9. When compared to filters, monochromators provide much signal to noise ratio.

a) True

b) False

View Answer

Answer: a
Explanation: When compared to filters, monochromators provide much signal to noise ratio. Monochromators are used for removal of unwanted wavelengths.

10. Which of the following crystals are not suited for x-ray grating?

a) Topaz

b) Lithium fluoride

c) Calcium fluoride

d) Sodium fluoride

View Answer

Answer: d
Explanation: The crystal which is not suited for x-ray grating is sodium fluoride. Other crystals which are suitable for x-ray grating are gypsum and sodium chloride.

Which statement is not true?

MRI can make images with many different contrasts.

MRI can provide anatomical, physiological, and functional information of our body in one single imaging system.

MRI generates only small amounts of ionizing radiation.

d) MRI and ultrasound are noninvasive medical imaging tools.

Ans: MRI generates only small amounts of ionizing radiation

The magnetic field causes protons to precess at a frequency proportional to the radio frequency energy.

O

X

Ans:X

MRI uses lower frequency range for imaging than optical imaging.

O

X

Ans: Yes

Which statement is not true?

MRI generates only small amounts of ionizing radiation.

MRI can make images with many different contrasts.

MRI can provide anatomical, physiological, and functional information of our body in one single imaging system.

MRI and ultrasound are noninvasive medical imaging tools.

Ans: A

Brian, who wears braces on his teeth, twisted his ankle. He wants to get MRI exam.

He will be surely safe to put his leg into the MRI scanner, as long as his head does not go inside the MRI bore.

O

X

Ans: X

Which statement is not correct?

MRI is performed by placing the body in the strong magnetic field.

Gradient coil can also generate radio frequency energy.

Radio frequency energy transmitted to the body causes magnetic resonance.

RF coils receive RF energy induced by the body

Ans:b

Which statement about gradient coil is correct?

Varying magnetic field changes the precession speed of protons.

The X gradient coil is to generate magnetic fields along the Y direction

Varying magnetic field can change the size of protons.

There are only two gradient coils x, y gradient coil

Ans a

Which statement is true?

A RF coil modulates the gradient field along spatial X, Y, and Z direction.

The proton spins that precess at a frequency different from the frequency induced in the transmission coil will receive energy and get excited, which is called magnetic resonance.

High sensitivity to the object is important, so the reception of MR signals is often performed with gradient coil(s) close to the object.

d) When the RF energy is applied to cause magnetic resonance and then turned off, MR signals will be induced and detectable in the receiver RF coil

Ans d)

Which statement describes MRI magnet correctly?

MRIs with field strength greater than 3 Gauss are mostly for research purpose at this point.

Magnet field strength of permanent magnet is limited to about 9.4T.

Helium for MRI magnet exists in liquid state.

d) There are no maintenance cost for superconducting magnet

Ans: C

Which statement is true?

It may not be safe for a person to perform MR scan more than 5 times in a year.

You are not allowed to carry your watch into the MR scanner.

It is difficult to make a small MRI, so the price is also higher than that of larger MRIs.

d) Varying magnetic field caused by gradient coils increases the SAR

Ans: b

Who discovered nuclear magnetic resonance?

Seji Ogawa

Raymond Damadian

Felix Bloch

d) Paul Lauterbur

Ans: Felix Bloch

Which of the following nucleus is most widely used for MRI?

^{23}Na23*Na*

^{13}C13*C*

^{1}H1*H*

^{19}F19*F*

Which statement describes functions of RF coils correctly?

All above.

Receiving signals from protons

Transmitting the energy to protons

d) Inducing magnetic resonance of protons

Ans: All

Which component is to get spatial information in MRI?

Reception RF coil

Transmission RF coil

Gradient coil

Main magnet

Ans: Gradient coil

Which component is to get spatial information in MRI?

a) **Gradient coil**

b) **Reception RF coil**

c) **Main magnet**

d) **Transmission RF coil**

Ans: a)

Gradient coils are to modulate the magnetic field in a spatially different manner to spatially encode the MR signals

Which statement is not true?

a) **Magnetic field strength of a 3T MRI corresponds to 60000 times the earths magnetic field.**

b) **There are 3T human MRIs with permanent magnets**

c) **MRI price increases with field strength and bore size**

d) **MRI with superconducting magnets are popular in hospitals**

Ans: b) Permanent magnets can generate field strength up to about 1T for human MRI, therefore 3T human MRIs cannot be made using a permanent magnet

Ultrasound:

I. Sounds of frequency higher than 20,000 Hz which are inaudible to normal human ear are called

A) noise b) frequency c) ultrasonics D)amplitude

II Ultrasonic waves carry more

A) energy
B) frequency
C) heat
D) both frequency and energy

III Frequency of ultrasonic waves is

A. more than audible sound
B. less than audible sound
C. equal to audible sound
D. greater than light wave

Sound waves of wavelength greater than that of audible sound are called _____.

A . ultrasonic waves

B .infrasonic waves

C .sonic waves

D . seismic waves

IV Sound energy passing per second through a unit area held perpendicular is called

A. intensity
B. frequency
C. amplitude
D. quality

What property of sound waves acts like the principle of ultrasound?

a) Reflection and Refraction

b) Reflection only

c) Refraction only

d) Propagation

View Answer

Answer: a
Explanation: The ultrasound works on the principle of reflection and refraction. While it is necessary that sound waves need a medium to travel, so we can say propagation is important but it is only because the sound wave gets refracted when the medium changes and are reflected back that the image is formed. Thus, the principle for ultrasound is reflection and refraction.

A piezoelectric crystal is used to produce the ultrasound waves. What kind of ultrasound is produced?

a) Pressure wave ultrasound

b) Electrical wave ultrasound

c) Sound wave ultrasound

d) Simple ultrasound

View Answer

Answer: a
Explanation: A piezoelectric crystal is a special transducer which converts mechanical energy into electrical energy and vice-versa. Thus, when the electrical impulses are given to the transducer, it is converted into mechanical energy. The transducer starts vibrating causing a pressure difference and the ultrasound waves are produced.

Which of the following medical imaging modality other than ultrasound does not use any form of radiation?

a) PET Scan

b) SPECT Scan

c) CT scan

d) MRI

View Answer

Answer: d
Explanation: MRI uses the electromagnetism of the atoms present in the body to get the images while all the other imaging modalities use some sort of radioactivity in order to take the images. Ultrasound relies on the sound waves while MRI relies on the electromagnetic waves. Thus, they are both non radioactive imaging modalities.

How is a medium characterized?

a) By its thickness

b) By its acoustic impedance

c) By its water content

d) By its density

View Answer

Answer: b
Explanation: Acoustic impedance is the resistance that a sound wave faces when it propagates from one medium to another in the body. Thickness, density and water content (for a living body) are all factors that are taken into account when measuring the acoustic impedance. Thus the medium is characterized by its acoustic impedance. The impedance offered by the bones is extremely high.

MRI

Increasing the magnetic field?

a. produces less susceptibility artifacts.
b. Reduces the risk of tissue heating.
c. Increase the signal to noise.
d. Reduces the danger from metallic projectiles.

A major advantage of MRI is:

a. the ease with which equipment is updated or replaced.
b. its relatively low cost, compared to CT scans.
c. dose not require specialized room

d. the ability to reposition the 'cross-section' through the body without repositioning the patient.

What is a major health concern wth MRI?

a. Reaction to applied drugs
b. extrerme cold?
c. Radiation dose
d. localized burns due to metallic implants?

Compare MRI to CT ("CAT scans"). Which is true?

a. Both methods use X-rays, but exposure is higher with CT.
b. CT reveals soft structures, while MRI is better at dense material, such as bone.
c. Both methods produce cross-sectional images at a specified plane through the body.

What is the maximum strength of magnet approved for medical imaging of patient?

a. 7.0 T
b. 1.5 T
c. 5.0 T
d. 3.0 T

Both a 90-degree and a 180-degree pulse is used for what MRI sequence?

a. Gradient Echo (GR)
b. FLASH
c. Spin Echo (SE)
d. EPI

What does PRECESSION mean?

a. The spinning of Hydrogen protons around their own axis
b. Change in orientation of Hydrogen molecules when exposed to radiowaves at the Larmor frequency
c. The wobble of Hydrogen protons exposed to a large magnetic field
d. Water molecules gain an extra molecule of Hydrogen when exposed to a magnetic field

What colour is water in a T1 weighted MRI scan?

a. White
b. Dark grey
c. Black

d. Light grey

Which of these are different colours on T1 and T2 weighted MRI images?

a. Cortical bone
b. Flowing blood
c. Fat
d. None of the listed

Which of these is a disadvantage of MRI?

a. High dose of ionizing radiation
b. Shows vasculature without contrast
c. Unsuitable for pacemaker wearers
d. Two-dimensional images

What is Zeeman splitting?

a. The formation of energy eigenstates as a result of the quantization of angular momentum, in the presence of an external magnetic field.
b. The transition between the spin up and spin down states of nuclear spins, in the presence of an external magnetic field.
c. Magnetic Resonance Imaging
d. Maximal Radiology Imaging

What is a T2*

a. A time constant describing the exponential decay of signal, due to spin-lattice interactions.
b. A time constant describing the exponential decay of signal, due to spin-spin intractions, magnetic field inhomogeneities, and susceptibility effects.
c. A time constant describing the exponential decay of signal, due to spin-spin intractions.

What are the time constants T1 and T2?

a. T1 is the spin-lattice or longitudinal relaxation time, and T2 is the spin-spin or transverse relaxation time
b. T1 and T2 indictate the shape of the exponential recovery and decay curves of the lonitudinal and transverse magnetisation, respectively.
c. T1 and T2 are magnetic timming parameters which differ from one tissue to anther. They can be used as a source of contrast in MRI images.

How is proton-density weighting achieved?

a. Short TR, long TE.
b. Long TR, short TE.
c. Short TR, short TE.

Which are included in the system components of conventional gamma camera for single photon imaging?

A. Scintillation crystal
B. Collimator
C. Pulse height analyser
D. All of the above

Ans D

The amount of energy available in radio frequency radiation is sufficient for which of the following?

a) Excite an atom

b) Vibrate an atom

c) Vibrate a molecule

d) Affect the nuclear spin of an atom

View Answer

Answer: d
Explanation: The amount of energy available in radio frequency radiation is sufficient for affecting the nuclear spin of an atom. It constitutes the most fundamental part of spectroscopy.

Nuclei having either the number of protons or neutrons as odd have _____ spin.

a) Integral spin

b) Half integral spin

c) Zero spin

d) Positive spin

View Answer

Answer: b
Explanation: Nuclei having either the number of protons or neutrons as odd have half-integral spin. Examples are H1 and B11.

NMR is the study of the absorption of _____ by nuclei in a magnetic field.

a) Radioactive radiation

b) IR radiation

c) Radio frequency radiation

d) Microwaves

View Answer

Answer: c
Explanation: NMR is the study of absorption of radio frequency radiation by nuclei in a magnetic field. For a particular nucleus, an NMR absorption spectrum may consist of one to several groups of absorption lines.

The bulk magnetic properties of matter derive primarily from

a. Protons
b. Neutrons
c. Electrons
d. Whole nuclei

When the current flowing through a wire reverses direction, the magnetic field around the wire

a. Does not change
b. Increases
c. Disappears
d. Reverses direction

If the current in a wire doubles, the induced magnetic field

a. Doubles
b. Quadruples
c. Remains the same
d. Is reduced by half

The direction of magnetic field lines surrounding a wire can be determined using

a. The right-hand rule
b. The left-hand rule
c. Faraday's Law
d. Lenz' Law

Which question about the Tesla (T) is correct?

a. It is the official unit for magnetic induction field strength in the cgs system.
b. 1 Tesla = 1,000 Gauss (G)
c. 1 G = 1 mT
d. 1Tesla = 10,000 Gauss (G)

The Tesla is the unit for magnetic induction field strength in the International System of Units (SI), formerly known as the mks (meter-kilogram-second) system. Gauss is the equivalent unit in the cgs (centimeter-gram-second) system, so a) is false. .

1 Tesla = 10,000 G, and 1 G = 0.1 mT, so both b) and c) are false.

Concerning magnetic field strengths, which statement is true?

a. The earth's magnetic field is about 0.5 G.

b. A junkyard electromagnet that picks up cars is much stronger than the main field of most MR scanners.

c. Research MR scanners for humans now exist with field strengths exceeding 20 T.

d. Higher field strength scanners have wider bores than lower field strength scanners to accommodate the extra flux lines

The earth's magnetic field at the equator is about 0.5 G, so a) is the correct answer. Junkyard electromagnets generally have field strengths of about 1T, limited by the flux density of steel, so they are much weaker than most MR scanners, and thus b) is false. The largest current human scanners are 11.7T, so c) is false. Higher field strength scanners have smaller bores, not larger ones, so d) is false.

The first company to produce a clinical whole-body MRI scanner for commercial use was

a. GE

b. Fonar

c. Siemens

d. Technicare

Raymond Damadian formed the first company FONAR to manufacture MR scanners for clinical use in 1982. Link to Q&A discussion

The most common design configuration for clinical MR scanners is

a. Open bore superconducting

b. Closed bore superconducting

c. Open bore permanent

d. Dipolar electromagnet

Over 90% of MR scanners sold today are of the closed bore (cylindrical) superconducting type. The second most common is open bore permanent.

The direction of the main magnetic field (B_0) in a cylindrical closed bore scanner is

a. Longitudinal (along the main axis) of the cylinder

b. Horizontal (cross-wise to the cylinder and parallel to the floor)
c. Vertical (cross-wise to the cylinder and perpendicular to the floor)
d. Can be at any angle depending on which gradients are turned on

Poor magnetic field homogeneity may affect image quality in the following ways

a. Shading artifacts
b. Spatial distortion
c. Poor fat suppression
d. Only a) and b)
e. All of the above

The temperature of liquid helium is approximately

a. 4 °K
b. 0 °K
c. −4 °K
d. −400 °C

Interaction between matter and Helium radiation can be observed by subjecting a substance to magnetic fields in which of the following manner?

a) Both fields should be stationary

b) Both fields should be varying

c) One field should be stationary and the other should be varying

d) It must be subjected to only one field

View Answer

Answer: c
Explanation: Interaction between matter and electromagnetic radiation can be observed by subjecting a substance to two magnetic fields. One magnetic field must be stationary and the other field must be varying at some radio frequency.

Which of the following are considered to be the lowest form of Electromagnetic radiation?

a) IR radiation

b) Micro waves

c) UV radiation

d) Radio waves

View Answer

Answer: d
Explanation: Radio waves are considered to be the lowest form of Electromagnetic radiation. NMR uses radio frequency radiation for detection of the structure of substances.

If the number of protons or neutrons is even the spin of the nucleus will be which of the following?

a) Integral spin

b) Half integral spin

c) Zero spin

d) Positive spin

View Answer

Answer: c
Explanation: If the number of protons or neutrons is even the spin of the nucleus will be zero. Examples are C12 and O16.

Which of the following components are used to separate the nuclear spin energy states?

a) RF channels

b) Magnet

c) Sample probe

d) Sweep generator

View Answer

Answer: b
Explanation: A magnet is used to separate the nuclear spin energy states. Permanent magnet or electromagnets can be used.

How is the inhomogeneity of magnetic fields compensated?

a) With large magnetic fields

b) With small magnetic fields

c) By using two or more magnets

d) By providing required insulation

View Answer

Answer: b
Explanation: The magnet must be stable and homogeneous. The inhomogeneity of magnetic fields is compensated with small magnetic fields.

Thermal Imaging

1. The resolution quality on an infrared imager is measured in which of the following units:

A. pixels
B. pixenes

C. degrees

D. bytes

2. Thermal imagers can be used to diagnose all of the following conditions except:

A. types of mold growths
B. concealed plumbing leaks behind walls

C. areas of air infiltration and exfiltration

D. hot electrical fuses

3. The minimum resolution quality for an infrared imager used in energy auditing, according to RESNET standards, is:

A. 80 x 80

B. 120 x 120
B. 120 x 160

D. 240 x 180

4. In thermal imaging of buildings, ΔT commonly refers to:

A. the thermal accuracy of the camera
B. the temperature difference between daytime high and overnight low
C. the difference between outside and inside temperatures
D. the average of outside and inside temperatures

5. What physical property allows thermal imaging cameras to be a useful tool in diagnosing moisture problems?

A. the fact that ice has a lower density than water

B. freeze-thaw cycle
C. evaporative cooling
D. transpiration

Gamma camera uses which of these components to produce a position intensity picture of a radioactive area?

a) Collimator

b) Scintillation detector

c) Photo multiplier tubes

d) Position circuitry

View Answer

Answer: b
Explanation: Gamma camera uses a scintillation detector to produce a position intensity picture of a radioactive area. It is an imaging device commonly used in medical applications.

Which of the following components adds all the signals and determines where each scintillation event occurred in the detector?

a) Collimator

b) Detector crystal

c) Photo multiplier tubes

d) Position circuitry

View Answer

Answer: d
Explanation: Position circuitry adds all the signals and determines where each scintillation event occurred in the detector. It is an electronic circuit and it receives all the signals from photo multiplier tube.

When the energy of an absorbed gamma photon is released, a flash of light is produced. This is similar to which of the following effects?

a) Photoelectric effect

b) Compton effect

c) Pair production

d) Collision effect

View Answer

Answer: a
Explanation: The given effect is similar to the photoelectric effect. It occurs in a scintillation detector.

Which of the following is a pattern of holes through gamma ray absorbing material, usually lead or tungsten?

a) Collimator

b) Detector crystal

c) Photo multiplier tubes

d) Position circuitry

View Answer

Answer: a
Explanation: Collimator is a pattern of holes through gamma ray absorbing material, usually lead or tungsten. In the conventional method, the collimator is placed over the detector crystal.

Which of the following is the first object that an emitted gamma photon encounters after exciting the body?

a) Collimator

b) Detector crystal

c) Photo multiplier tubes

d) Position logic circuit

View Answer

Answer: c
Explanation: Collimator is the first object that an emitted gamma photon encounters after exciting the body. In the conventional method, the collimator is placed over the detector crystal.

Which of the following is not a component of gamma camera?

a) Collimator

b) Detector crystal

c) Pre-amplifier

d) Position logic circuit

View Answer

Answer: c
Explanation: Pre-amplifier is not a component of the gamma camera. It is an imaging device commonly used in medical applications.

The first gamma camera is also known by which of the following names?

a) Hal camera

b) Anger camera

c) Muller camera

d) West camera

View Answer

Answer: b
Explanation: The first gamma camera is also known as an Anger camera. It was developed by Hal Anger.

IA1 QP 2019

I. Who is given credit for the discovery of X-ray?

A)Henri Becquerrel B) Wilhelm Roentegen C) Marie Curie D) Pierre Curie

II. X-rays and Gamma rays have significant penetrating power due to their ---------- wavelength

A) Short B) Medium C) Long D) Wide range

III. Collimators are used to:

A)Reduce the radiation beam spread B) Filter the radiation beam C) Increase film latitude
D) Decrease film latitude

IV. Attenuation of radiation is due to:

A) Absorption B) Scattering C) Radioactive decay D) Both A and B

V. Bremsstrahlung production of X-rays produces radiation that is composed of:

A) A small number of very defined energies B) A continuous spectrum of energies over some range C) Radiation of only one energy D) None

VI. Computed tomography X-ray techniques allow the test component to be:

A)Viewed in various cross-sectional slices B) Viewed from different angles

C) Analysed for chemical composition D) None

VII. The target of an X-ray tube is often made out of tungsten because:

A)It has a high atomic mass which will result in more X-rays being generated due to atomic particle interactions B) It is an inexpensive material that is easy to machine C) It have very high thermal conductivity which makes it easy to cool D) None

VIII. Exposure to ionizing radiation can be limited:

A) With the use of shielding B) By increasing distance from the source
C) By limiting the time exposed to the radiation D) All

IX. Higher energy radiation will have more:

A) Speed B) Incident energy C) Penetrating power D) both B and C

X. X-rays are often referred to as photons because:

A) They possess a charge B) They have mass C) They occur as small packets of energy
D) None of the above

IA2 QP

XI. Which of the following pair of scattering is important for diagnostic purposes?

a) Coherent and Compton b) Photoelectric and Pair Production
c) Compton and Photoelectric d) Pair Production and Disintegration

XII. Radiation emission used for imaging is

A)Alpha emissions B) Beta emissions C) Gamma emissions D) Delta emissions

XIII. Which are included in the system components of conventional gamma camera for single photon imaging?

A) Scintillation crystal B) Collimator
B) Pulse height analyser D)All of the above

XIV. PET stands for_____

XV. Protons added to the nucleus through bombardment using

A)Cyclotron B) Ionization chamber C) Scintillation detector D) Accelerator

XVI. Planck's equation for excitation energy is given by_____

XVII. The bulk magnetic properties of matter derive primarily from

A) Protons B) Neutrons C) Electrons D)whole nuclei

ⴰVIII. Larmor equation is given by_____

XIX. The most common design configuration for clinical MR scanners is

A) Open bore superconducting B)Closed bore superconducting C) Open bore magnet D)Dipolar electromagnet

XX. The first company to produce a clinical whole-body MRI scanner for commercial use was_____

A) GE B) FONAR C) SIEMENS D) Philips

Thermal Imaging

Thermal Imaging is for _____ detection

a) Breast cancer
b) Inflammatory Arthritis
c) Both
d) None

Ans: C

Isotherms will register temperature differences as small as_____

A) 2^0C
B) 10^0C
C) 0.2^0C
D) 1^0C

Ans :C

Which is statement is true?

- If emissivity decreases, there is a corresponding increase in the reflection coefficient
- If emissivity increases, there is a corresponding decrease in the reflection coefficient
- If emissivity decreases, There is corresponding increase in square of reflection coefficient
- If emissivity decreases, There is corresponding increase in square root of reflection coefficient

Ans: A

VIII	moisture of human skin between the range _____ is 0.02–0.05			
	A) 10 and 20 µm	B) 2 and 6 µm	C) 0.1 and 0.5 µm	D) 2 and 6 mm

Ans: B

_____ is the name given to pyroelectric vidicon manufactured by Thomson CSF

Teflon

Pyricon

Standard Vidicon

Pyrocon

Ans: B

Ultrasonic waves are produced by utilizing

a) Piezoelectric effect
b) Peltier effect
c) Doppler effect
d) Magneto optic effect

Ans: A

The velocity of ultrasonic waves is generally greater in solids than in gases because

a) The density of solids is high but elasticity is low
b) Both density and elasticity of solids are low
c) The density of solids is low but elasticity is high
d) Both density and elasticity of solids are high

Ans: D

Ultrasonic waves travel with a velocity

a)equal to the velocity of light

b) more than velocity of sound

c) equal to the velocity of sound waves

d) less than the velocity of sound

Ans: C

Wavelength of 0.6 cm is produced in air and it travels with a velocity 300 m/s, then it is

a) Ultrasonic waves
b) Sound waves
c) Light waves
d) Micro waves

Ans: A