磁振造影測驗

Magnetic Resonance Imaging

2019 年 8 月 25 日星期日

1. 除題意不清楚或是圖片有問題，禁止詢問與試題有關的問題。

2. 應答時禁止使用任何文件。

3. 請在電腦答案卡上圈選作答

項目	填寫內容
姓名	您的中文與英文姓名
試題名稱	MRI Test
項目	不用填寫
科目	不用填寫
受試者識別代碼	您的准考證號碼 25XXX 將您選定之數字的圓圈塗滿。
科目代碼	不用填寫
地點代碼	不用填寫
作答方式	本測驗共有 100 題問題。請使用 1 到 100 作答欄位。 請將測驗卷 Q1 的答案填入答案卷的答案選擇 1。Q2 = 答案選擇 2，Q3 = 答案選擇 3…Q100= 答案選擇 100

Q1.   Which of the followings is true about in-vivo (i.e. clinical) MR Spectroscopy?
1)   STEAM (STimulated Echo Acquisition Mode) has higher patient SAR than PRESS (Point RESolved Spectroscopy) when both of them have the same parameter settings, especially NEX.
2)   STEAM (STimulated Echo Acquisition Mode) has higher patient SNR than PRESS (Point RESolved Spectroscopy) when both of them have the same parameter settings, especially NEX.
3)   PRESS (Point RESolved Spectroscopy) is less susceptible to magnetic field than STEAM (STimulated Echo Acquisition Mode), so is better choice for CSI (Chemical Shift Image).
4)   PRESS (Point RESolved Spectroscopy) is more susceptible to magnetic field than STEAM (STimulated Echo Acquisition Mode), so is not preferred for CSI (Chemical Shift Image).

Q2.   Which of the following statements about adiabatic excitation is *false*?
1)   Unlike "conventional" RF-pulses that are purely amplitude-modulated, adiabatic RF-pulses are also frequency-modulated.
2)   The fat-suppression technique SPAIR uses adiabatic inversion.
3)   Adiabatic pulses are relatively insensitive to B1 field inhomogeneities.
4)   Doubling the duration of a 90°-adiabatic pulse creates a 180°-adiabatic pulse.

Q3.   When the current flowing through a wire reverses direction, the magnetic field around the wire:
1)   Does not change
2)   Reverses direction
3)   Disappears
4)   Increases

Q4.   Concerning the relationship between electricity and magnetism, which of the following statements is *false*?
1)   A constant magnetic field induces voltage in a nearby stationary wire.
2)   A constant current in a wire induces a constant magnetic field around the wire.
3)   A changing current in a wire induces a changing magnetic field around the wire.
4)   A changing magnetic field induces voltage in a nearby wire.

Q5.   The direction of magnetic field lines surrounding a wire can be determined by using:
1)   Ampere's right-hand rule
2)   Fleming's left-hand rule
3)   Faraday's Law

4)   Lenz's Law

Q6.   Which kind of the following substances exhibits a very slight negative or repelling effect when placed in externally applied magnetic field?
1)   Diamagnetic
2)   Paramagnetic
3)   Superparamagnetic
4)   Ferromagnetic

Q7.   An MR scanner employs three different magnetic fields— the main field (B0), gradient fields (G), and radiofrequency field (B1). In terms of relative strength from weakest to strongest, the proper ranking is:
1) $B1 < G < B0$
2) $G < B0 < B1$
3) $G < B1 < B0$
4) $B1 < B0 < G$

Q8.   Which of the following materials is paramagnetic?
1)   Water
2)   Fat
3)   Bone
4)   Air

Q9.   The main purpose of the gradient subsystem is to:
1)   Select the slice plane
2)   Select the imaging place
3)   Spatially encode the MR signal
4)   All the above

Q10.   The function of the array processor in MRI system is to:
1)   Generate triggers for the array of RF-pulses and gradient waveforms used for imaging.
2)   Reconstruct the raw NMR data into images.
3)   Calculate RF frequency offsets and gradient strengths for desired slice selection and field-of-view.
4)   Activate and/or disable various coil elements in an array.

Q11.   Which of the following is _**not**_ an advantage of low- and intermediate-field (< 1.0 T) MR scanners?

1) Lower price

2) Lower fringe field

3) Improved detection of gadolinium enhancement

4) Lower energy deposition in tissues

Q12. Which of the following is **_not_** an advantage of high-field (≥ 1.0 T) MR scanners?

1) Higher signal-to-noise

2) Better detection of calcifications and hemorrhage

3) Smaller artifacts around metallic implants

4) Better magnetic field homogeneity

Q13. The time for a gradient to ramp from zero to its maximum value is known as its:

1) Rise time

2) Gradient time

3) Slew rate

4) Duty cycle

Q14. As field strength increase from 0.5T to 3.0T, the T2 of most tissues:

1) Increases

2) Decreases

3) Remains about the same

4) Decreases then increases

Q15. As field strength increases from 0.5T to 3.0T, the T1 of most tissues:

1) Increases

2) Decreases

3) Remains about the same

4) Decreases then increases

Q16. The slight difference in resonant frequencies noted between ^{1}H-nuclei in different molecular environments is due to:

1) Different gyromagnetic ratios.

2) Different local magnetic fields.

3) Different relaxation times.

4) Different spin quantum numbers.

Q17. The diffusion weighting in DWI images is created by means of:

1) Two balanced gradients spaced in time.

2) Tri-phasic flow compensation gradients.

3) One inversion pulse.

4) Two inversion pulses.

Q18. Which kind of the following substances exhibits a slight increase in the magnetic field when placed in an externally applied magnetic field?

1) Diamagnetic

2) Paramagnetic

3) Superparamagnetic

4) Ferromagnetic

Q19. Gadolinium (Gd) is an example of a ___ substance.

1) Diamagnetic

2) Paramagnetic

3) Superparamagnetic

4) Ferromagnetic

Q20. The slice location is determined by:

1) Phase gradient

2) Transmit frequency of the rf coil

3) Receiver frequency of the rf pulse

4) Transmit frequency of the rf pulse

Q21. The receiver bandwidth represents the range of frequencies sampled during the:

1) Phase gradient

2) Slice selection gradient

3) Frequency encoding gradient

4) Gradient coils

Q22. What is the signal created after applying a 90-degree RF pulse?

1) GRADIENT ECHO SIGNAL

2) FID

3) SPIN ECHO SIGNAL

4) HAHN ECHO SIGNAL

Q23. Although most local RF coils are "receive only", some specially designed to operate in "transmit-receive (T/R)" mode. T/R coils commonly offered by MR vendors include all of the following *except*:

1) Head coils

2) Knee coils

3)   Spectroscopy coils

4)   Spine coils

Q24.   Concerning passive shielding, which statement is true?

1)   It is performed by placing heavy copper plates along the walls of the scanner room.

2)   It is a method to reduce extraneous radiofrequency interference with the MR signal.

3)   It is more commonly required for 7.0T than for 1.5 T installations.

4)   Active shielding technology found in modern scanner design has not changed the need for it.

Q25.   The difference in precessional frequence of the proton in fat and water is known as:

1)   Fourier transform

2)   Free induction decay

3)   Spin density

4)   Chemical shift

Q26.   Chemical shifts (δ) are typically reported in units of:

1)   Gauss (G)

2)   Millitesla per meter (mT/m)

3)   Parts per million (ppm)

4)   Percent (%)

Q27.   Which of the following statements about nuclear precession is true?

1)   Nuclear precession will not begin until a radiofrequency pulse is applied.

2)   Protons in every drop of water in the ocean and in every snowflake at the north pole are precessing right now.

3)   Sustaining nuclear precession requires the continual input of energy from the environment.

4)   It is impossible to obtain MR images using the earth's magnetic field because it is so small.

Q28.   Which kind of MR magnet is made of blocks, slabs, or naturally occurring ferrous material?

1)   Resistive

2)   Permanent

3)   Superconducting

4)   Selenoid

Q29.   The fringe fields of cylindrical superconducting magnet are highest:

1) In the x-direction (transverse and horizontal to the axis bore)
2) In the y-direction (transverse and vertical to the axis bore)
3) In the z-direction (along the axis bore)
4) They are equal in all directions.

Q30. Concerning nuclear spin (I), which of the following statements is _**false**_?
1) A longer but equivalent name for "spin" is "spin angular momentum".
2) For hydrogen (^{1}H) MRI it is common and acceptable to use the terms "nucleus", "spin", and "proton" interchangeably.
3) Routine clinical MRI measures signal from hydrogen (^{1}H) nuclei only.
4) The hydrogen (^{1}H) nucleus contains one proton and one electron.

Q31. Which one of the followings is the only way to increase spatial resolution?
1) Increase the FOV
2) Decrease the phase encoding steps
3) Increase the acquisition volume
4) Decrease the voxel size

Q32. Which kind of the following substances exhibits positive susceptibility when placed in an external magnetic field, but remains magnetized when external magnetic field is removed?
1) Diamagnetic
2) Paramagnetic
3) Superparamagnetic
4) Ferromagnetic

Q33. An MR scanner employs three different magnetic fields— the main field (B0), gradient fields (G), and radiofrequency field (B1). In terms of relative strength from weakest to strongest, the proper ranking is:
1) Diamagnetic
2) Paramagnetic
3) Superparamagnetic
4) Ferromagnetic

Q34. Which of the following items are usually allowed to enter the scan room in high magnetic field systems?
1) Copper tools
2) Surgical stainless steel hemostats
3) Surgical stainless steel scissors
4) All the above

Q35. Magnetic field gradients for imaging are typically measured in units of:
   1) Milliteslsa per meter (mT/m)
   2) Gauss per second (G/s)
   3) Tesla (T)
   4) Tesla per meter per second (T/m-s)

Q36. What is the approximate gyromagnetic ratio (γ) of the ^{1}H nucleus?
   1) 10.7 MHz/Tesla
   2) 42.6 MHz/Tesla
   3) 64.0 MHz/Tesla
   4) 128 MHz/Tesla

Q37. The direction of the main magnetic field (Bo) in a cylindrical closed bore scanner is:
   1) Longitudinal (along the main axis) of the cylinder
   2) Horizontal (cross-wise to the cylinder and parallel to the floor)
   3) Vertical (cross-wise to the cylinder and perpendicular to the floor)
   4) Can be at any angle depending on which gradients are turned on

Q38. The gyromagnetic ratio (γ) of the ^{13}C nucleus is about 10.7 MHz/T. What is the ^{13}C resonance frequency at 3.0T?
   1) 10.7 MHz
   2) 21.4 MHz
   3) 32.1 MHz
   4) 64.2 MHz

Q39. When is the slice selection gradient applied?
   1) During the echo
   2) During the 90-degree RF pulse
   3) After the 180-degree RF pulse
   4) During the 90 and 180-degree RF pulse

Q40. If a thicker slice is desired and all other parameters are fixed:
   1) A lower amplitude of the Y gradient is selected
   2) A higher amplitude of the Z gradient is selected
   3) A higher amplitude of the X gradient is selected
   4) A lower amplitude of the Z gradient is selected

Q41. Which of the following is _**not**_ an advantage of low- and intermediate-field (< 1.0 T) MR scanners?

1)   Lower price

2)   Lower fringe field

3)   Lower dosage of gadolinium-based contrast media

4)   Lower energy deposition in tissues

Q42. What is the effect of applying the x- and z-gradients simultaneously during slice selection?

1)   The image will be distorted.

2)   Significant interslice cross-talk will occur.

3)   An oblique slice will be created.

4)   The scanner will display a warning that such a combination is not allowed.

Q43. Comparing linear and quadrature coils:

1)   Quadrature coils offer twice the signal-to-noise.

2)   Quadrature coils offer four times the signal-to-noise.

3)   Quadrature coils offer about 40% greater signal-to-noise.

4)   Quadrature coils are about 40% larger.

Q44. During a magnetic quench, why should patients and employees be evacuated from the scan room?

1)   Even in small quantities gaseous helium causes burning and irritation to the eyes.

2)   Asphyxiation may occur.

3)   Severe frostbite would be likely.

4)   The released helium may catch fire or explode.

Q45. Which of the following statements about eddy currents is _**false**_?

1)   They create a wide range of image artifacts, including ghosts and blurring.

2)   They are a manifestation of Faraday's Law of induction.

3)   They especially affect traditional spin-echo sequences with long TE's.

4)   They create tissue heating.

Q46. Which of the following devices would be considered SAFE to enter the MRI room?

1)   Typical hospital respirator

2)   Hospital fire extinguisher

3)   Aluminum oxygen cylinder

4)   None of the above

Q47. Which of the following statements about superconductivity is correct?

1)   All elements can become superconducting if the temperature is low enough.

2)   Only metals can become superconductors.

3) The magnetic field is zero inside the center of a superconducting wire.

4) The resistance of a wire linearly decreases toward zero as the temperature falls below the transition temperature (T_C).

Q48. Which of the following statements concerning the spin-system immediately after a 90°-pulse is true?

1) If the z-component of angular momentum were measured for all protons, an equal number of spin-up and spin-down states would be observed.

2) The 90°-pulse causes the spins to precess around B1.

3) The spins all become locked into phase coherence with one another.

4) The spin angular momentum for each proton is turned so that it points horizontally in the direction of B1.

Q49. Which of the following statements concerning net magnetization (M) is _**false**_?

1) Net magnetization (M) develops when an unmagnetized sample of tissue is placed in an external magnetic field.

2) Initially M grows in the longitudinal direction as the individual spins seek to align with B0.

3) When tipped out of alignment with B0, M will precess at the same resonance frequency as the individual nuclei comprising it.

4) M will continue to precess even when completely inverted and pointing in the −z direction (i.e. opposite to B0).

Q50. Which coils are located closest to the patient in an MR scanner?

1) Gradient coils

2) RF-receiver coils

3) Shim coils

4) Body RF-transmit coils

Q51. What is the range of frequencies that is sampled during frequency encoding?

1) RECIEVER BANDWITH

2) TRANSMITTER BANDWITH

3) GRADIENT SLOPE

4) RF SLOPE

Q52. How many sets of paired physical gradients are present in an MR scanner?

1) 1

2) 2

3) 3

4)   6

Q53.   Which of the following statements about gradient duty cycle is *false*?
1)   It is commonly measured in percent (%).
2)   It represents the fraction of time that the gradient works at maximum amplitude.
3)   Its value depends on the pulse sequence timing parameters and number of slices.
4)   Its value is independent of the type of pulse sequence (SE, IR, etc).

Q54.   When the phase encoding gradient is activated, steep slopes produce what type of signal amplitude?
1)   Low
2)   High
3)   Medium
4)   Strong

Q55.   Which of the following is *not* an advantage of parallel (multi-)transmit RF?
1)   Decreased RF-energy deposition in tissues.
2)   Reduced shading artifacts.
3)   Increased standing waves due to dielectric effect.
4)   More uniform excitation.

Q56.   Which of the following statements about flip angle using conventional RF-pulses is *false*?
1)   Flip angle depends on the strength of the RF-pulse.
2)   Flip angle depends on the duration of the RF-pulse.
3)   Flip angle is measured relative to the direction of B1.
4)   More energy is injected into the system by a 180°- than a 90°-pulse.

Q57.   In a T2 weighted image, CSF has a _____ T2 relaxation time and therefore appears _____.
1)   Long, Bright
2)   Long, Dark
3)   Short, Dark
4)   Short, Bright

Q58.   A sinusoidal wave can be described by the equation $S(t) = A \sin (\omega t - \varphi)$. The constant A represents:
1)   Angular frequency.
2)   Difference in height between positive and negative peaks.
3)   Half the difference in height between positive and negative peaks.

4)   Phase shift.

Q59.   A 180-degree RF pulse is used to _____ the dephasing net vector in the transverse plane.
1)   Magnetize
2)   Refocus
3)   Decay
4)   Delay

Q60.   The Dixon method of fat suppression relies on:
1)   Employing a saturation pulse based on the precessional frequency of fat.
2)   Obtaining a water-only image by varying TE.
3)   Obtaining a fat-suppressed image with an inversion pulse.
4)   Mathematically calculating a water-only image by acquiring two echoes.

Q61.   The basic coil configuration used to generate the z-gradient in a cylindrical MR scanner is known as:
1)   Maxwell pair.
2)   Double saddle.
3)   Golay.
4)   Fingerprint.

Q62.   The primary purpose for passive magnetic shielding is:
1)   To reduce fringe magnetic fields outside the scanner room.
2)   To keep extraneous radiofrequency noise from entering the scanner room.
3)   To constrain the NMR signal to remain within the bore of the magnet for better reception.
4)   To reduce the effects of moving equipment (such as cars and elevators) from distorting the magnetic field.

Q63.   Which of the following statements about passive shimming is true?
1)   Its primary purpose is to correct for field distortions produced by a patient's body.
2)   Ferromagnetic materials cannot be used for passive shimming.
3)   Passive shimming is affected by room temperature.
4)   Once the field is calibrated and magnetic homogeneity achieved, the passive shim materials can be removed.

Q64.   Concerning the main transmit RF-body coil, which statement is *false*?
1)   It is commonly used to receive the MR signal.
2)   It is built into the scanner gantry housing and cannot be seen by the patient.

3) It is considered a transceiver coil, capable of both RF transmission and reception.

4) Its transmission field (B1) is perpendicular to the main magnetic field (B0).

Q65. The definition of gradient slew rate is:
1) Peak gradient strength ÷ main field strength (Bo)
2) Peak gradient strength ÷ total time the gradient is on
3) Peak gradient strength ÷ Rise time
4) The number of times a gradient is turned on and off per second

Q66. The fringe magnetic field arising from an MR scanner:
1) Can be eliminated by active shielding.
2) Can be reduced by radiofrequency shielding.
3) Can be eliminated by passive shielding.
4) None of the above.

Q67. Comparing phased array and parallel array coils, which of the following is true?
1) Both types of coils offer improved signal-to-noise and increased field-of-view.
2) Overlap of coil elements is avoided in both types.
3) Phased array coils are also known as switchable arrays.
4) Both can be used equally well with parallel imaging acquisition methods.

Q68. Advantages of parallel receiver coil arrays include all the following ***except***:
1) Increased signal-to-noise.
2) Increased field-of-view.
3) Ease of design.
4) Reduced imaging time.

Q69. The radiofrequency (RF) field used to inject energy into a spin system to induce nuclear resonance is called:
1) B_0
2) B_1
3) M_{xy}
4) M_z

Q70. Diffusion is typically ***NOT*** restricted by:
1) Intracellular water.
2) Extracellular water.
3) Pus.
4) Tumor cells.

Q71. Use of a single element surface coil placed directly on the patient offers which advantages?
1) High signal-to-noise.
2) Increased depth of penetration.
3) Capability for larger fields-of-view.
4) All of the above.

Q72. MRI facilities often display a sign on the door that says: "Warning! The magnet is always on." This sign would not strictly apply to a:
1) Permanent magnet scanner
2) Resistive magnet scanner
3) Superconducting magnet scanner
4) The sign is applicable to all types of scanners, always.

Q73. Concerning nuclear spin (I), which of the following is true?
1) Spin is due to rotation of the nucleus about its axis.
2) Protons have spin, but neutrons do not.
3) Spin can only have integer or half-integer values.
4) Another name for spin is "precession".

Q74. When an unmagnetized sample is placed in a magnetic field, an internal magnetization (M) will develop and grow to a maximum value in the longitudinal direction (M0). The first order exponential time constant for this growth is defined as:
1) PD
2) T1
3) T2*
4) T2

Q75. Which of the following statements about the gradient subsystem is true?
1) The gradient coils are located within the cryostat.
2) Gradient coils generate considerable heat during operation.
3) The gradient coils are cooled by liquid helium.
4) Increasing power supplied to a gradient decreases the slope of the gradient.

Q76. If the T1 relaxation time for brain tissue is 1000 ms, what is its relaxation rate (R1)?
1) 1000 msec
2) 1 sec
3) 1/sec
4) 1/msec

Q77. Which of the following relaxation time pairs for tissue-in-vivo is impossible?
1) T1 = 4000 ms, T2= 2000 ms.
2) T1 = 1000 ms, T2 = 100 ms.
3) T1 = 500 ms, T2 = 20 ms.
4) T1 = 500 ms. T2 = 600 ms.

Q78. Concerning the single-voxel MR Spectroscopy, which of the followings is true?
1) STEAM (STimulated Echo Acquisition Mode) is a spin-echo based sequence, thus TE cannot be set shorter than 25 ms.
2) PRESS (Point RESolved Spectroscopy) is a spin-echo based sequence, thus TE cannot be set shorter than 25 ms.
3) STEAM (STimulated Echo Acquisition Mode) is the better choice than PRESS (Point RESolved Spectroscopy) on low-field-strength scanner, for the higher SNR.
4) PRESS (Point RESolved Spectroscopy) is the better choice than STEAM (STimulated Echo Acquisition Mode) on high-field-strength scanner, for the lower SAR.

Q79. Which of the following statements about T1 relaxation is *false*?
1) T1 is the time constant for regrowth of longitudinal magnetization (Mz).
2) T1 relaxation requires an energy transfer between spins and their environment ("lattice").
3) T1 relaxation results in a net energy loss from the spin system.
4) This energy loss occurs by spontaneous emission of photons from the protons.

Q80. Which of the following biological materials would be expected to have the shortest T2 values?
1) Urine
2) Achilles tendon
3) Spleen
4) Quadriceps muscle

Q81. The conventional units for angular frequency (ω_0) are:
1) Cycles per second (cps)
2) Hertz (Hz)
3) Radians/sec
4) Revolutions per minute (rpm)

Q82. The chemical shift (δ) between water and fat protons measured at 1.5T is approximately 3.5 ppm. What would their chemical shift be at 3.0T?

1) 1.75 ppm
2) 3.5 ppm
3) 7.0 ppm
4) 10.5 ppm

Q83. The methyl protons of two brain metabolites, N-acetyl aspartate (NAA) and Creatine (Cr), have a chemical shift difference of 1.0 ppm. At a field strength of 1.5 T (where the water Larmor frequency is 64 MHz), their difference in frequency would be about:
1) 64 MHz
2) 1.0 MHz
3) 64 kHz
4) 64 Hz

Q84. Which of the following statements concerning the magnetic dipole moment is **_false_**?
1) It is a representation of the nucleus modeled as a tiny bar magnet with north and south poles.
2) The dipole moment will precess when placed in an external magnetic field.
3) An alternative representation is a vector (μ) arising from a small current loop.
4) Like a compass needle, a dipole moment will tend to align with an externally applied magnetic field to assume its lowest energy state.

Q85. Fat-water phase differences in an MR image are determined by which imaging parameter?
1) TE in a spin echo (SE) sequence.
2) TR in a spin echo (SE) sequence.
3) TE in a gradient echo (GRE) sequence.
4) TR in a gradient echo (GRE) sequence.

Q86. Which component of a superconducting MR scanner does not require specialized cooling to maintain function?
1) Gradient coils
2) Gradient amplifiers.
3) Radiofrequency coils.
4) Radiofrequency amplifiers.

Q87. Which of the following ^{1}H-containing molecules account for nearly 100% of the signal recorded within the brain parenchyma using routine MRI sequences?
1) Water
2) Triglycerides
3) Myelin

4)   N-acetyl aspartate (NAA)

Q88.   What intrinsic tissue parameter determines the rate at which the longitudinal component of the net magnetization (M) initially develops?
1)   Spin density (ρ)
2)   T1
3)   T2
4)   T2*

Q89.   Passive magnetic shielding of the scanner room is typically achieved using sheets or rods made of:
1)   Copper
2)   Iron
3)   Aluminum
4)   Lead

Q90.   Which of the following components of an MR system is typically not located in an adjoining equipment room?
1)   RF-power amplifiers.
2)   Gradient amplifiers.
3)   Helium pump.
4)   Gradient coils.

Q91.   Which of the following statements about nuclear magnetic resonance is _**false**_?
1)   Tipping the net magnetization (M) out of initial alignment with B0 requires absorption of energy by the spin system.
2)   In MRI, the source of energy required to initiated NMR is typically provided by a rotating/oscillating radiofrequency field named B1.
3)   This tipping of (M) is a manifestation of the NMR phenomenon.
4)   Nuclear precession and resonance are essentially the same.

Q92.   ADC maps negate T2 shine-through by:
1)   Using multiple directions of diffusion gradients.
2)   Using multiple intensities of diffusion gradients.
3)   Averaging multiple acquisitions of diffusion.
4)   Using a different pulse sequence to acquire diffusion.

Q93.   Which of the following statements concerning T1 and T2 relaxation times in tissues at 1.5T are correct?

1) For most solid organs (like the brain and liver) T2 values are about 10x longer than T1 values.

2) Dense fibrous tissues (like tendons and cartilage) have very short T1 values.

3) Fat has a relatively short T1 value compared to most other tissues.

4) Liquids (like CSF and urine) have the shortest T1 and T2 values.

Q94. As field strength increases from 0.5T to 3.0T, the T1 of most tissues:
1) Increases
2) Decreases
3) Remains about the same
4) Decreases then increases

Q95. The loud noise produced by an MR system during a scan is primarily due to:
1) Vibrations of the gradient coils.
2) Vibrations of the radiofrequency coils.
3) Vibrations of the main magnet windings.
4) Vibrations from the chiller and helium pump.

Q96. When an un-magnetized sample is placed in a magnetic field, an internal magnetization (M) will develop and grow to a maximum value in the longitudinal direction (M0). The first order exponential time constant for this growth is defined as:
1) T1
2) T1*
3) T2
4) T2*

Q97. By irradiating tissue with an off-resonance RF-pulse it is possible to affect image contrast by transferring energy between macromolecular and free-water pools. This process is known as:
1) T1 exchange
2) Magnetization transfer
3) Chemical shift
4) Energy swap

Q98. Newer "quiet" MR sequences with longer gradient ramp times are now available. Which of the following statements about these sequences is true?
1) This strategy can be applied to all pulse sequences.
2) They can reduce noise levels to within 10 dB of background.
3) They can be employed with no signal-to-noise penalty.

4)   They do not affect number of slices for a given TR.

Q99.   The complex motion of the net magnetization vector (M) when acted upon by both B0 and B1 can be simplified by considering the system in the:
1)   Laboratory frame of reference.
2)   Rotating frame of reference.
3)   Earth's frame of reference.
4)   Adiabatic frame of reference.

Q100.   Comparing superparamagnetic and ferromagnetic materials, which statement is *false*?
1)   Ferromagnetism is usually more powerful than superparamagnetism.
2)   Ferromagnetism persists when the magnetizing field is removed.
3)   Superparamagnetism persists once the external field is removed.
4)   Superparamagnetism can be thought of as a single-domain particle.