磁振造影測驗

Magnetic Resonance Imaging

2018年8月26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

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| --- | --- |
| ***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 1**”000\*\*”**  將您選定之數字的圓圈塗滿。 |
| *科目代碼* | 不用填寫 |
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| *作答方式* | 本測驗共有90題問題。請使用1到90作答欄位。  請將測驗卷Q1的答案填入答案卷的解答番號1。Q2 = 解答番號2，Q3 = 解答番號3…Q90 = 解答番號90。 |

1. Which kind of the following substances exhibits a very slight negative or repelling effect when placed in externally applied magnetic field?
2. Diamagnetic
3. Paramagnetic
4. Superparamagnetic
5. Ferromagnetic
6. Which kind of the following substances exhibits a slight increase in the magnetic field when placed in an externally applied magnetic field?
7. Diamagnetic
8. Paramagnetic
9. Superparamagnetic
10. Ferromagnetic
11. Gadolinium (Gd) is an example of a \_\_\_ substance.
12. Diamagnetic
13. Paramagnetic
14. Superparamagnetic
15. Ferromagnetic
16. 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?
17. Diamagnetic
18. Paramagnetic
19. Superparamagnetic
20. Ferromagnetic
21. Which kind of the following substances exhibits positive susceptibility, are stronger than paramagnetic substances, but are weaker than ferromagnetic substances, and are used as T2 contrast agents?
22. Diamagnetic
23. Paramagnetic
24. Superparamagnetic
25. Ferromagnetic
26. Which kind of MR magnet is made of blocks, slabs, or naturally occurring ferrous material?
27. Resistive
28. Permanent
29. Superconducting
30. Selenoid
31. The slice location is determined by:
32. Phase gradient
33. Transmit frequency of the rf coil
34. Receiver frequency of the rf pulse
35. Transmit frequency of the rf pulse
36. The receiver bandwidth represents the range of frequencies sampled during the:
37. Phase gradient
38. Slice selection gradient
39. Frequency encoding gradient
40. Gradient coils
41. The main purpose of the gradient subsystem is to:
42. Select the slice plane
43. Select the imaging place
44. Spatially encode the MR signal
45. All the above

1. The difference in precessional frequence of the proton in fat and water is known as:
2. Fourier transform
3. Free induction decay
4. Spin density
5. Chemical shift
6. When is the slice selection gradient applied?
7. During the echo
8. During the 90-degree RF pulse
9. After the 180-degree RF pulse
10. During the 90 and 180-degree RF pulse
11. If a thicker slice is desired and all other parameters are fixed:
12. A lower amplitude of the Y gradient is selected
13. A higher amplitude of the Z gradient is selected
14. A higher amplitude of the X gradient is selected
15. A lower amplitude of the Z gradient is selected
16. Which one of the followings is the only way to increase spatial resolution?
17. Increase the FOV
18. Decrease the phase encoding steps
19. Increase the acquisition volume
20. Decrease the voxel size
21. Which of the following items are usually allowed to enter the scan room in high magnetic field systems?
22. Copper tools
23. Surgical stainless steel hemostats
24. Surgical stainless steel scissors
25. All the above

1. Which of the following devices would be considered SAFE to enter the MRI room?
2. Typical hospital respirator
3. Hospital fire extinguisher
4. Aluminum oxygen cylinder
5. None of the above
6. In a T2 weighted image, CSF has a \_\_\_\_\_\_\_\_ T2 relaxation time and therefore appears \_\_\_\_\_\_\_.
7. Long, Bright
8. Long, Dark
9. Short, Dark
10. Short, Bright
11. When the phase encoding gradient is activated, steep slopes produce what type of signal amplitude?
12. Low
13. High
14. Medium
15. Strong
16. A 180-degree RF pulse is used to \_\_\_\_\_\_ the dephasing net vector in the transverse plane.
17. Magnetize
18. Refocus
19. Decay
20. Delay
21. What is the range of frequencies that is sampled during frequency encoding?
22. Receiver bandwidth
23. Transmitter bandwidth
24. Gradient slope
25. RF slope

1. What is the signal created after applying a 90-degree RF pulse?
2. Gradient echo signal
3. FID
4. Spin echo signal
5. Hahn echo signal
6. The direction of the main magnetic field (Bo) in a cylindrical closed bore scanner is:
7. Longitudinal (along the main axis) of the cylinder
8. Horizontal (cross-wise to the cylinder and parallel to the floor)
9. Vertical (cross-wise to the cylinder and perpendicular to the floor)
10. Can be at any angle depending on which gradients are turned on
11. Which of the following is not an advantage of low- and intermediate-field (< 1.0 T) MR scanners?
12. Lower price
13. Lower fringe field
14. Lower dosage of gadolinium-based contrast media
15. Lower energy deposition in tissues
16. 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.
17. Which of the following statements about superconductivity is correct?
18. All elements can become superconducting if the temperature is low enough.
19. Only metals can become superconductors.
20. The magnetic field is zero inside the center of a superconducting wire.
21. The resistance of a wire linearly decreases toward zero as the temperature falls below the transition temperature (TC).

1. 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:
2. Permanent magnet scanner
3. Resistive magnet scanner
4. Superconducting magnet scanner
5. The sign is applicable to all types of scanners, always.
6. During a magnetic quench, why should patients and employees be evacuated from the scan room?
7. Even in small quantities gaseous helium causes burning and irritation to the eyes.
8. Asphyxiation may occur.
9. Severe frostbite would be likely.
10. The released helium may catch fire or explode.
11. Magnetic field gradients for imaging are typically measured in units of:
12. Millitesla per meter (mT/m)
13. Gauss per second (G/s)
14. Tesla (T)
15. Tesla per meter per second (T/m-s)
16. What is the effect of applying the x- and z-gradients simultaneously during slice selection?
17. The image will be distorted.
18. Significant interslice cross-talk will occur.
19. An oblique slice will be created.
20. The scanner will display a warning that such a combination is not allowed.
21. When the y-gradient is turned on, what happens to the direction of the main (Bo) field?
22. The Bo field now points slightly to the right.
23. The Bo field now points slightly toward the ceiling.
24. The Bo field now is slightly weakened.
25. The Bo field remains pointing in its original (z)-direction.

1. Which of the following statements about eddy currents is false?
2. They create a wide range of image artifacts, including ghosts and blurring.
3. They are a manifestation of Faraday's Law of induction.
4. They especially affect traditional spin-echo sequences with long TE's.
5. They create tissue heating.
6. The time for a gradient to ramp from zero to its maximum value is known as its:
7. Rise time
8. Gradient time
9. Slew rate
10. Duty cycle
11. The definition of gradient slew rate is:
12. Peak gradient strength ÷ main field strength (Bo)
13. Peak gradient strength ÷ total time the gradient is on
14. Peak gradient strength ÷ Rise time
15. The number of times a gradient is turned on and off per second
16. How many sets of paired physical gradients are present in an MR scanner?
17. 1
18. 2
19. 3
20. 6
21. Which of the following statements about gradient duty cycle is false?
22. It is commonly measured in percent (%).
23. It represents the fraction of time that the gradient works at maximum amplitude.
24. Its value depends on the pulse sequence timing parameters and number of slices.
25. Its value is independent of the type of pulse sequence (SE, IR, etc).

1. Which of the following statements about the gradient subsystem is true?
2. The gradient coils are located within the cryostat.
3. Gradient coils generate considerable heat during operation.
4. The gradient coils are cooled by liquid helium.
5. Increasing power supplied to a gradient decreases the slope of the gradient.
6. Which coils are located closest to the patient in an MR scanner?
7. Gradient coils
8. RF-receiver coils
9. Shim coils
10. Body RF-transmit coils
11. 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:
12. Head coils
13. Knee coils
14. Spectroscopy coils
15. Spine coils
16. Use of a single element surface coil placed directly on the patient offers which advantages?
17. High signal-to-noise.
18. Increased depth of penetration.
19. Capability for larger fields-of-view.
20. All of the above.
21. The fringe fields of cylindrical superconducting magnet are highest:
22. In the x-direction (transverse and horizontal to the axis bore)
23. In the y-direction (transverse and vertical to the axis bore)
24. In the z-direction (along the axis bore)
25. They are equal in all directions.

1. The primary purpose for passive magnetic shielding is:
2. To reduce fringe magnetic fields outside the scanner room.
3. To keep extraneous radiofrequency noise from entering the scanner room.
4. To constrain the NMR signal to remain within the bore of the magnet for better reception.
5. To reduce the effects of moving equipment (such as cars and elevators) from distorting the magnetic field.
6. Concerning passive shielding, which statement is true?
7. It is performed by placing heavy copper plates along the walls of the scanner room.
8. It is a method to reduce extraneous radiofrequency interference with the MR signal.
9. It is more commonly required for 7.0T than for 1.5 T installations.
10. Active shielding technology found in modern scanner design has not changed the need for it.
11. 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:
12. B1 < G < B0
13. G < B0 < B1
14. G < B1 < B0
15. B1 < B0 < G
16. Which of the following is not an advantage of parallel (multi-)transmit RF?
17. Decreased RF-energy deposition in tissues.
18. Reduced shading artifacts.
19. Increased standing waves due to dielectric effect.
20. More uniform excitation.
21. Comparing phased array and parallel array coils, which of the following is true?
22. Both types of coils offer improved signal-to-noise and increased field-of-view.
23. Overlap of coil elements is avoided in both types.
24. Phased array coils are also known as switchable arrays.
25. Both can be used equally well with parallel imaging acquisition methods.

1. Advantages of parallel receiver coil arrays include all the following except:
2. Increased signal-to-noise.
3. Increased field-of-view.
4. Ease of design.
5. Reduced imaging time.
6. The basic coil configuration used to generate the z-gradient in a cylindrical MR scanner is known as:
7. Maxwell pair.
8. Double saddle.
9. Golay.
10. Fingerprint.
11. Comparing linear and quadrature coils:
12. Quadrature coils offer twice the signal-to-noise.
13. Quadrature coils offer four times the signal-to-noise.
14. Quadrature coils offer about 40% greater signal-to-noise.
15. Quadrature coils are about 40% larger.
16. A sinusoidal wave can be described by the equation S(t) = A sin (ωt − φ). The constant A represents:
17. Angular frequency.
18. Difference in height between positive and negative peaks.
19. Half the difference in height between positive and negative peaks.
20. Phase shift.
21. Concerning the main transmit RF-body coil, which statement is false?
22. It is commonly used to receive the MR signal.
23. It is built into the scanner gantry housing and cannot be seen by the patient.
24. It is considered a transceiver coil, capable of both RF transmission and reception.
25. Its transmission field (B1) is perpendicular to the main magnetic field (B0).

1. Which of the following components of an MR system is typically not located in an adjoining equipment room?
2. RF-power amplifiers.
3. Gradient amplifiers.
4. Helium pump.
5. Gradient coils.
6. The function of the array processor in MRI system is to:
7. Generate triggers for the array of RF-pulses and gradient waveforms used for imaging.
8. Reconstruct the raw NMR data into images.
9. Calculate RF frequency offsets and gradient strengths for desired slice selection and field-of-view.
10. Activate and/or disable various coil elements in an array.
11. Which component of a superconducting MR scanner does not require specialized cooling to maintain function?
12. Gradient coils
13. Gradient amplifiers.
14. Radiofrequency coils.
15. Radiofrequency amplifiers.
16. The fringe magnetic field arising from an MR scanner:
17. Can be eliminated by active shielding.
18. Can be reduced by radiofrequency shielding.
19. Can be eliminated by passive shielding.
20. None of the above.
21. Passive magnetic shielding of the scanner room is typically achieved using sheets or rods made of:
22. Copper
23. Iron
24. Aluminum
25. Lead

1. Concerning nuclear spin (I), which of the following is true?
2. Spin is due to rotation of the nucleus about its axis.
3. Protons have spin, but neutrons do not.
4. Spin can only have integer or half-integer values.
5. Another name for spin is "precession".
6. Concerning nuclear spin (I), which of the following statements is false?
7. A longer but equivalent name for "spin" is "spin angular momentum".
8. For hydrogen (¹H) MRI it is common and acceptable to use the terms "nucleus", "spin", and "proton" interchangeably.
9. Routine clinical MRI measures signal from hydrogen (¹H) nuclei only.
10. The hydrogen (¹H) nucleus contains one proton and one electron.
11. Which of the following statements concerning the magnetic dipole moment is false?
12. It is a representation of the nucleus modeled as a tiny bar magnet with north and south poles.
13. The dipole moment will precess when placed in an external magnetic field.
14. An alternative representation is a vector (μ) arising from a small current loop.
15. Like a compass needle, a dipole moment will tend to align with an externally applied magnetic field to assume its lowest energy state.
16. What is the approximate gyromagnetic ratio (γ) of the ¹H nucleus?
17. 10.7 MHz/Tesla
18. 42.6 MHz/Tesla
19. 64.0 MHz/Tesla
20. 128 MHz/Tesla
21. Chemical shifts (δ) are typically reported in units of:
22. Gauss (G)
23. Millitesla per meter (mT/m)
24. Parts per million (ppm)
25. Percent (%)

1. The radiofrequency (RF) field used to inject energy into a spin system to induce nuclear resonance is called:
2. B0
3. B1
4. Mxy
5. Mz
6. Which of the following statements about T1 relaxation is false?
7. T1 is the time constant for regrowth of longitudinal magnetization (Mz).
8. T1 relaxation requires an energy transfer between spins and their environment ("lattice").
9. T1 relaxation results in a net energy loss from the spin system.
10. This energy loss occurs by spontaneous emission of photons from the protons.
11. 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:
12. PD
13. T1
14. T2\*
15. T2
16. Which of the following statements concerning T1 and T2 relaxation times in tissues at 1.5T are correct?
17. For most solid organs (like the brain and liver) T2 values are about 10x longer than T1 values.
18. Dense fibrous tissues (like tendons and cartilage) have very short T1 values.
19. Fat has a relatively short T1 value compared to most other tissues.
20. Liquids (like CSF and urine) have the shortest T1 and T2 values.

1. Which of the following relaxation time pairs for tissue-in-vivo is impossible?
2. T1 = 4000 ms, T2= 2000 ms.
3. T1 = 1000 ms, T2 = 100 ms.
4. T1 = 500 ms, T2 = 20 ms.
5. T1 = 500 ms. T2 = 600 ms.
6. Which of the following biological materials would be expected to have the shortest T2 values?
7. Urine
8. Achilles tendon
9. Spleen
10. Quadriceps muscle
11. The loud noise produced by an MR system during a scan is primarily due to:
12. Vibrations of the gradient coils.
13. Vibrations of the radiofrequency coils.
14. Vibrations of the main magnet windings.
15. Vibrations from the chiller and helium pump.
16. Newer "quiet" MR sequences with longer gradient ramp times are now available. Which of the following statements about these sequences is true?
17. This strategy can be applied to all pulse sequences.
18. They can reduce noise levels to within 10 dB of background.
19. They can be employed with no signal-to-noise penalty.
20. They do not affect number of slices for a given TR.
21. Comparing superparamagnetic and ferromagnetic materials, which statement is false?
22. Ferromagnetism is usually more powerful than superparamagnetism.
23. Ferromagnetism persists when the magnetizing field is removed.
24. Superparamagnetism persists once the external field is removed.
25. Superparamagnetism can be thought of as a single-domain particle.

1. Which of the following statements about flip angle using conventional RF-pulses is false?
2. Flip angle depends on the strength of the RF-pulse.
3. Flip angle depends on the duration of the RF-pulse.
4. Flip angle is measured relative to the direction of B1.
5. More energy is injected into the system by a 180°- than a 90°-pulse.
6. Which of the following statements concerning the spin-system immediately after a 90°-pulse is true?
7. 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.
8. The 90°-pulse causes the spins to precess around B1.
9. The spins all become locked into phase coherence with one another.
10. The spin angular momentum for each proton is turned so that it points horizontally in the direction of B1.
11. 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:
12. Laboratory frame of reference.
13. Rotating frame of reference.
14. Earth's frame of reference.
15. Adiabatic frame of reference.
16. 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:
17. T1
18. T1\*
19. T2
20. T2\*

1. If the T1 relaxation time for brain tissue is 1000 ms, what is its relaxation rate (R1)?
2. 1000 msec
3. 1 sec
4. 1/sec
5. 1/msec
6. Which of the following ¹H-containing molecules account for nearly 100% of the signal recorded within the brain parenchyma using routine MRI sequences?
7. Water
8. Triglycerides
9. Myelin
10. N-acetyl aspartate (NAA)
11. 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:
12. T1 exchange
13. Magnetization transfer
14. Chemical shift
15. Energy swap
16. As field strength increases from 0.5T to 3.0T, the T1 of most tissues:
17. Increases
18. Decreases
19. Remains about the same
20. Decreases then increases
21. As field strength increase from 0.5T to 3.0T, the T2 of most tissues:
22. Increases
23. Decreases
24. Remains about the same
25. Decreases then increases

1. The gyromagnetic ratio (γ) of the ¹³C nucleus is about 10.7 MHz/T. What is the ¹³C resonance frequency at 3.0T?
2. 10.7 MHz
3. 21.4 MHz
4. 32.1 MHz
5. 64.2 MHz
6. Which of the following statements about nuclear precession is true?
7. Nuclear precession will not begin until a radiofrequency pulse is applied.
8. Protons in every drop of water in the ocean and in every snowflake at the north pole are precessing right now.
9. Sustaining nuclear precession requires the continual input of energy from the environment.
10. It is impossible to obtain MR images using the earth's magnetic field because it is so small.
11. The slight difference in resonant frequencies noted between ¹H-nuclei in different molecular environments is due to:
12. Different gyromagnetic ratios.
13. Different local magnetic fields.
14. Different relaxation times.
15. Different spin quantum numbers.
16. Which of the following statements concerning net magnetization (M) is false?
17. Net magnetization (M) develops when an unmagnetized sample of tissue is placed in an external magnetic field.
18. Initially M grows in the longitudinal direction as the individual spins seek to align with B0.
19. When tipped out of alignment with B0, M will precess at the same resonance frequency as the individual nuclei comprising it.
20. M will continue to precess even when completely inverted and pointing in the −z direction (i.e. opposite to B0).

1. Which of the following statements about nuclear magnetic resonance is false?
2. Tipping the net magnetization (M) out of initial alignment with B0 requires absorption of energy by the spin system.
3. In MRI, the source of energy required to initiated NMR is typically provided by a rotating/oscillating radiofrequency field named B1.
4. This tipping of (M) is a manifestation of the NMR phenomenon.
5. Nuclear precession and resonance are essentially the same.
6. Which of the following statements about adiabatic excitation is false?
7. Unlike "conventional" RF-pulses that are purely amplitude-modulated, adiabatic RF-pulses are also frequency-modulated.
8. The fat-suppression technique SPAIR uses adiabatic inversion.
9. Adiabatic pulses are relatively insensitive to B1 field inhomogeneities.
10. Doubling the duration of a 90°-adiabatic pulse creates a 180°-adiabatic pulse.
11. Diffusion is typically NOT restricted by:
12. Intracellular water.
13. Extracellular water.
14. Pus.
15. Tumor cells.
16. The diffusion weighting in DWI images is created by means of:
17. Two balanced gradients spaced in time.
18. Tri-phasic flow compensation gradients.
19. One inversion pulse.
20. Two inversion pulses.
21. ADC maps negate T2 shine-through by:
22. Using multiple directions of diffusion gradients.
23. Using multiple intensities of diffusion gradients.
24. Averaging multiple acquisitions of diffusion.
25. Using a different pulse sequence to acquire diffusion.
26. Fat-water phase differences in an MR image are determined by which imaging parameter?
27. TE in a spin echo (SE) sequence.
28. TR in a spin echo (SE) sequence.
29. TE in a gradient echo (GRE) sequence.
30. TR in a gradient echo (GRE) sequence.
31. The Dixon method of fat suppression relies on:
32. Employing a saturation pulse based on the precessional frequency of fat.
33. Obtaining a water-only image by varying TE.
34. Obtaining a fat-suppressed image with an inversion pulse.
35. Mathematically calculating a water-only image by acquiring two echoes.
36. Concerning the single-voxel MR Spectroscopy, which of the followings is true?
37. STEAM (STimulated Echo Acquisition Mode) is a spin-echo based sequence, thus TE cannot be set shorter than 25 ms.
38. PRESS (Point RESolved Spectroscopy) is a spin-echo based sequence, thus TE cannot be set shorter than 25 ms.
39. STEAM (STimulated Echo Acquisition Mode) is the better choice than PRESS (Point RESolved Spectroscopy) on low-field-strength scanner, for the higher SNR.
40. PRESS (Point RESolved Spectroscopy) is the better choice than STEAM (STimulated Echo Acquisition Mode) on high-field-strength scanner, for the lower SAR.
41. Which of the followings is true about in-vivo (i.e. clinical) MR Spectroscopy?
42. 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.
43. 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.
44. 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).
45. 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).