MRI IN PRACTICE COURSE POST-TEST

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CHAPTER ONE: BASIC PRINCIPLES

1. As much as ——— atoms lined up together are narrower than a human hair.
A 150,000 **B** 220,000 **C** 340,000 **D** half a million

2. The isotope of the hydrogen nucleus called ——— is the MR active nucleus used in clinical MRI.
A protium **B** platinum **C** palladium **D** promethium

3. The unit of precessional frequency is megahertz (MHz). 1 MHz is ——— cycles or rotations per second.
A 100 **B** 1,000 **C** 100,00 **D** one million

4. The application of an RF pulse that causes resonance to occur is termed:
A resonance **B** the Larmor effect **C** excitation **D** phasing

5. ——— is the position of each magnetic moment on the precessional path around B_0 (B_0 is the magnetic field strength of the magnet).
A Spin **B** Phase **C** NMV **D** Frequency

6. The ——— time (TE) is the time from the application of the RF pulse to the peak of the signal induced in the coil - measured in ms.
A edge **B** echo **C** encoding **D** eletron

CHAPTER TWO: IMAGE WEIGHTING AND CONTRAST

7. ——— contrast parameters are those that cannot be changed because they are inherent to the body's tissues.
A Extrinsic **B** TR **C** TE **D** Intrinsic

8. Fat molecules consist of large molecules called ——— that are closely packed together.
A histidine **B** lipids **C** isoleucine **D** glycine

9. Proton density contrast is always present and differs in each patient. It is the basic MRI contrast and is called proton density:
A weighting **B** scale **C** differential **D** value assignment

10. ——— weighted images are characterized by bright fat and dark water.
A T2 **B** T1 **C** Proton density **D** Nuclear density

11. When the NMV (net magnetization vector) is pushed to a full ——— degrees, it is said to be fully saturated.
A 45 **B** 90 **C** 135 **D** 180

12. The spin echo pulse sequence commonly uses 90 degrees excitation pulse to flip NMV into the ——— plane.
A coronal **B** sagittal **C** transverse **D** frontal

13. ——— is the time between each 90 degree excitation pulse for each slice.
A TAU **B** TR **C** TE **D** RF

14. Magnetic field gradients are generated by coils of wire situated ——— the magnet.
A surrounding **B** on opposite ends outside **C** within the bore **D** both inside and outside

15. Gradients that dephase are called:
A degraders **B** spoilers **C** zero gradients **D** obsolete factors

16. Gradients that rephase are called:
A backward gradients **B** rewinders **C** backtrackers **D** step backs

17. ——— is the time from the excitation pulse to the peak of gradient echo.
A TE **B** TAU **C** RF **D** TR

CHAPTER THREE: ENCODING AND IMAGE FORMATION

18. Nuclei that experience a lower magnetic field strength due to the gradient:
A speed up slightly **B** speed up by a factor of 4 **C** slow down **D** maintain their speed

19. Spatially locating (encoding) signal along a short axis of the anatomy is called ——— encoding.
A phase **B** frequency **C** slice **D** gradient

20. In gradient echo pulse sequences, the slice select gradient is switched on during the excitation pulse only.
A True **B** False

21. The frequency encoding gradient is switched on when the signal is received and is often called the ——— gradient.
A FOV **B** reading **C** readout **D** uneven

22. Regarding imaging of the head, the ——— gradient performs phase encoding.
A Y **B** X **C** K **D** readout

23. The duration of the readout gradient is called the sampling time or ——— window.
A gathering **B** accumulation **C** set **D** acquisition

24. The sampling ——— is the rate at which frequencies are sampled or digitized during the acquisition window *per second*.
A period **B** duration **C** acceleration **D** frequency

25. In MRI the sampling frequency is determined by the ——— theorem.
A Netter **B** Nacci **C** Nyquist **D** Nace

26. As data of each signal position is collected, the information is stored as data points in ——— space.
A K **B** X **C** Y **D** T

27. To produce an image from the acquired data points we need to complete a mathematical process called Fast Fourier ——— (FFT).
A transition **B** transient **C** transform **D** tertiary

28. Frequency data digitized from the echo are the same on one side as they are on the other. The result is called ——— symmetry.
A identical **B** conjugate **C** harmonious **D** balanced

29. The phase ——— determines the number of lines that must be filled to complete the scan.
A cube **B** matrix **C** parameters **D** encoding

30. As long as at least ——— of the lines of K space that have been selected are filled during acquisition, then an image may be produced.
A one third **B** one fourth **C** one fifth **D** half

CHAPTER FOUR: **PARAMETERS AND TRADE-OFFS**

31. The brightness of the pixel represents the strength of the MRI signal generated by a *unit volume of patient tissue*, called a:
A cuboid **B** voxel **C** matrix **D** slice

32. A ——— matrix is one with a low number of frequency encodings and/or phase encodings and results in a low pixel count in the FOV.
A coarse **B** pixilated **C** broad **D** fine

33. A long TR ——— SNR (signal to noise ratio).
A increases **B** slightly decreases **C** has no effect on **D** decreases (by a factor of 4)

34. A short TE ——— SNR.
A slightly decreases **B** decreases (by a factor of 4) **C** increases **D** has no effect on

35. The ——— controls the amount of data stored in each line of K space.
A NMV **B** NTC **C** NEX **D** SNR

36. To double the SNR we need to increase the NEX and the scan time by a factor of:
A three **B** four **C** two **D** five

37. The CNR (——— to noise ratio) is probably the most critical factor affecting image quality.
A coil **B** core **C** console **D** contrast

38. The use of MTC (magnetization transfer contrast) increases CNR between pathological and normal tissues and is useful in many areas.
A True **B** False

39. In large voxels, individual signal intensities are averaged together and not represented as distinct within the voxel. This results in:
A partial voluming **B** a black space **C** a white space **D** no image detail displayed

40. In obtaining good resolution, achieving *thin slices* requires the slice select gradient slope to be:
A horizontal **B** gradual **C** steep **D** vertical

41. To obtain equal resolution in every plane and at every angle of obliquity, each voxel should be symmetrical (isotropic).
A True **B** False

CHAPTER FIVE: **PULSE SEQUENCES**

42. Spin echo pulse sequences are rephrased by a ——— degree rephrasing pulse.
A 45 **B** 90 **C** 135 **D** 180

43. Another name for turbo factor is echo ——— length.
A line **B** train **C** replication **D** value

44. Very steep phase encoding slopes ——— the amplitude of the resultant echo.
A increase by a factor of 3 **B** reduce **C** slightly increase **D** has no effect on

45. Fat remains bright on T2 weighted images due to the multiple RF pulses, which reduce the effects of spin-spin interactions in fat – called:
A J coupling **B** J spacing **C** Z coupling **D** Z spacing

46. It is possible to acquire fast spin echo images in shorter scan times by using a technique known as ——— shot fast spin echo (SS-FSE).
A super **B** sign **C** single **D** slice

47. ——— recovery (IR) was developed in the early days of MRI to provide good T1 contrast on low field systems.
A Interval **B** Isotropic **C** Inversion **D** Image

48. Pathology ——— produces an image that is predominantly T1 weighted, but where pathological processes appear bright.
A contrast **B** density **C** algorithms **D** weighting

49. Regarding the STIR sequence, the T1 required to null the signal from a tissue is ——— times its T1 relaxation time.
A 0.85 **B** 0.41 **C** 0.32 **D** 0.69

50. ——— is used to suppress the high CSF signal in T2 weighted images so that pathology adjacent to CSF is seen more clearly.
A Tau **B** STIR **C** FLAIR **D** IR

51. FLAIR is used in brain and spine imaging to see periventricular and cord lesions more clearly – as high signal from adjacent CSF is:
A nulled **B** halted **C** increased **D** not perceived

52. Gradient echo sequences allow for a reduction in the scan time as the TR:
A is greatly reduced **B** is increased **C** is slightly reduced **D** remains constant

53. In the ——— state, there is co-existence of both longitudinal and transverse magnetization.
A constant **B** steady **C** holding **D** frozen

54. Any two 90 degree RF pulses produce a ——— ehco.
A Hahn **B** Harris **C** Handel **D** Herbert

55. Gradient spoiling is ——— rewinding.
A almost the same as **B** the same as **C** the opposite of **D** dependent on

56. Balanced gradient echo was developed *initially* for imaging the:
A brain **B** abdomen **C** limbs **D** heart and great vessels

57. Fast gradient systems permit multi-slice gradient echo sequences with TEs as short as ——— ms.
A 0.2 **B** 1.3 **C** 2.1 **D** 0.7

58. *K space segmentation by acquisition* acquires a section of K space at a time so that there are ——— excitations and TR periods.
A four **B** three **C** eight **D** two

CHAPTER SIX: **FLOW PHENOMENA**

59. The motion of flowing nuclei causes mismapping of signals and results in artefacts known as phase:
A disappearance **B** ghosting **C** apparitions **D** shifting

60. Flowing nuclei present in the slice for the excitation may exit the slice before rephrasing. This is called ——— phenomenon.
A time of flight **B** unphased **C** exit **D** time of exit

61. Nuclei that receive repeated RF pulses during an acquisition with a short TR are said to be:
A full **B** partial **C** saturated **D** spent

62. When nuclei within the same voxel are out of phase with each other, it is called ——— dephasing.
A extra-voxel **B** intra-voxel **C** motion **D** reversible

63. When gradient moment rephrasing assumes a constant velocity and direction across the gradient at all times, it is called first order:
A motion compensation **B** kinetic compensation **C** frozen compensation **D** time compensation

64. The frequency difference between fat and water is called ——— shift.
A permeability **B** gradient **C** chemical **D** magnetic

65. The interval between the pre-saturation pulses is called SAT TR and is equal to the scan TR ——— the number of slices.
A divided by **B** times **C** minus **D** plus

66. Pre-saturation does *not* give flowing nuclei a signal void (spatial pre-saturation).
A True **B** False

CHAPTER SEVEN: **ARTEFACTS AND THEIR COMPENSATION**

67. Swallowing and pulsatile motion of the carotids along the phase axis produces ——— over the spinal cord.
A chemical shift artifact **B** Moire' artifact **C** ghosting **D** cross-excitation

68. Placing pre-saturation volumes over the area producing artifact nullifies signal ——— the artifact.
A and slightly increases **B** and increases by a factor of 2 **C** and reduces **D** but has no effect on

69. Some systems use a method known as respiratory gating or ——— that times the excitation RF with a certain phase of respiration.
A popping **B** blending **C** navigating **D** triggering

70. ——— gating uses a light sensor attached to the patient's finger to detect the pulsation of blood cells through the capillaries.
A Limb **B** Side **C** ECG **D** Peripheral

71. Aliasing along the frequency encoding axis is known as frequency:
A wrap **B** encasement **C** pulse alignment **D** compensation

72. Aliasing along both the frequency and phase axis can totally degrade an image and should be compensated for.
A True **B** False

73. Increasing the sampling rate so that all frequencies are digitized sufficiently would ——— aliasing in the frequency direction.
A enhance or sharpen the **B** eliminate **C** double the rate of **D** triple the rate of

74. Chemical ——— artifact is caused by the different chemical environments of fat and water.
A dots **B** movement **C** shift **D** gradient

75. ——— artifact produces distortion of the image together with large signal voids.
A Truncation **B** Out of phase **C** Magnetic susceptibility **D** Cross-excitation

76. ——— artifact appears as a dense line on the image at a specific point.
A Moire' **B** Shading **C** Magic angle **D** Zipper

CHAPTER EIGHT: **VASCULAR AND CARDIAC IMAGING**

77. Blood ——— flow(s) at a constant velocity.
A always **B** usually **C** never **D** does not usually

78. Images in which the signal from blood has been largely eradicated is known as ——— imaging.
A black blood **B** bright blood **C** wipe-out **D** deletion

79. A technique known as ——— applies a *non* slice selective 180 degree pulse followed by a slice selective 180 degree pulse.
A IR pairing **B** double IR prep **C** doppia IR **D** IR redundant

80. Vascular structures can be visualized by making vessels appear *hyper*-intense rather than *hypo*-intense - producing ——— imaging.
A deletion **B** black blood **C** bright blood **D** wipe-out

81. ——— is maximized by enhancing the signal from moving spins in flowing blood and/or suppressing the signal from stationary spins.
A Vascular scale **B** Vascular contrast **C** Vascular eradication **D** Vascular subtraction

82. Digital subtraction MRA, also known as ——— imaging, is a technique that allows visualization of the vasculature over a wide FOV.
A minus **B** blood enhancement **C** fresh-blood **D** MOTSA

83. MOTSA essentially provides the high resolution of 3D inflow techniques coupled with the wider coverage of 2D inflow MRA.
A True **B** False

84. Suppression of in-plane vascular signal, especially in 3D acquisitions, can be overcome by the utilization of ——— RF pulses.
A projectile **B** slowed **C** ramped **D** more leveled

85. MRA can be obtained through several techniques, including maximum intensity projection (MIP) and ——— surface display (SSD).
A shaded **B** stationary **C** signal **D** slice

86. The strength and duration of the velocity encoding gradient pulse is selected based on the blood flow ——— that is to be imaged.
A acceleration **B** velocity **C** pressure **D** volume

87. ——— MRA sequences have the ability to evaluate vasculature with blood flow in multiple directions and with varying flow velocities.
A NEX **B** AVM **C** PC **D** 2D

88. Regarding the parameters and clinical suggestions for PC-MRA, the TR should be ——— ms.
A 30 **B** 20 **C** 10 **D** 40

89. CE-MRA images can be post-processed (like TOF-MRAs) with the MIP technique, but not the SSD technique.
A True **B** False

90. As cardiac imaging uses each R wave to trigger the pulse sequence, the TR depends on the time interval between each R wave – called:
A the R^2 period **B** the Double R interval **C** the R to R interval **D** the R duration

CHAPTER NINE: **INSTRUMENTATION AND EQUIPMENT**

91. The ——— converts 'signals' into images.
A radio frequency source **B** computer system **C** field gradient system **D** image processor

92. ——— materials have paired electrons.
A Diamagnetic **B** Paramagnetic **C** Superparamagnetic **D** Ferromagnetic

93. In the equation, $B_0 = H_0 (1 + X)$, the apparent magnetization of an atom is shown. In the equation, H_0 refers to:
A magnetic field **B** magnetic intensity **C** magnetic deceleration **D** magnetic acceleration

94. The most common material used to produce a permanent magnet is an alloy of aluminum, nickel, and cobalt known as:
A pachinko **B** chromium **C** manganese **D** alnico

95. To create a strong magnet, one wire is wrapped around to form many loops (like a spring), which creates a(n) ——— electromagnet.
A rotating **B** solenoid **C** even echo **D** processional

96. An electromagnet at room temperature is subject to Ohm's law and is said to be a ——— magnet.
A superconducting **B** natural **C** resistive **D** simple

97. The capacity of an MRI cryostat varies with machine design, but a volume of ——— liters would probably be a good average.
A 750 **B** 900 **C** 1200 **D** 1500

98. ——— shimming is performed by scanning a phantom and adjusting the position of the shim plates for optimum field homogeneity.
A Passive **B** Active **C** Determined **D** Placement

99. The ——— defines the time it takes for a given gradient to reach maximum amplitude and what the amplitude is.
A slew rate **B** duty cycle **C** gradient speed **D** gradient rise time

100. A(n) ——— is a cylindrical array of electrically conductive elements positioned around the inner circumference of the magnet bore.
A head coil **B** body coil **C** extremity coil **D** central coil

CHAPTER TEN: **MRI SAFETY**

101. Created by a panel assembled by the American College of Radiology, the *White Paper on MRI Safety* was published for the first time in:
A 2003 **B** 1999 **C** 1998 **D** 2002

102. The text defines MR ——— as 'an item that is known to pose hazards in all MRI environments'.
A conditional 7 **B** unsafe **C** precautionary **D** conditional 3

103. In the USA, the SAR (specific absorption rate) limits for extremities is ——— W/kg – in 5 minutes – per gram of tissue.
A 9 **B** 14 **C** 12 **D** 8

104. There have been a number of burns and even fires associated with exposure to the RF fields in MRI.
A True **B** False

105. Some reversible biological effects have been observed on human subjects exposed to ——— T and above.
A 2.5 **B** 4.0 **C** 2.0 **D** 3.5

106. In a scanner with a cryostat volume of 1,500 liters, a spontaneous helium boil-off would liberate over ——— liters of gas.
A 1,000 **B** 10,000 **C** 100,000 **D** 1,000,000

107. Ferromagnetic metal objects can become airborne as projectiles in the presence of a strong static magnetic field, known as the:
A dart phenomena **B** target affect **C** missile affect **D** airborne phenomena

108. Regarding MRI facility zones, the ACR white paper would term an area that generally pertains to the patient waiting room as Zone:
A I **B** II **C** III **D** IV

109. Regarding levels of personnel, the ACR white paper deems individuals who have very extensive training in MR safety issues as Level:
A 1 **B** 2 **C** 3 **D** 4

CHAPTER ELEVEN: **CONTRAST AGENTS IN MRI**

110. Gadolinium is highly toxic, but it can be made safe for use by binding or chelating the gadolinium to other molecules.
A True **B** False

111. Unpaired electrons have a magnetic moment (μ) that is ——— times that of a hydrogen proton.
A 5,000 **B** 50,000 **C** 500,000 **D** 5,000,000

112. The recommended dosage of gadolinium is ——— millimoles per kilogram (mmol/kg) of body weight, (0.2 ml/kg).
A 0.001 **B** 0.05 **C** 0.01 **D** 0.1

113. Gadolinium is a rare earth metal (lanthanide) – more commonly known as a ——— metal.
A base **B** noble **C** precious **D** heavy

114. Studies have shown that approximately 80% of gadolinium is excreted by the kidneys in ——— hours.
A 1 **B** 3 **C** 10 **D** 48

115. Perfusion imaging measures blood volume to tissues; however, fewer than ——— % of tissue protons are intravascular.
A 20 **B** 15 **C** 10 **D** 5

116. Regarding CE-MRA, within ——— minutes after injection lesions begin to enhance so that they are isointense with normal parenchyma.
A 1 **B** 4 **C** 2 **D** 5

CHAPTER TWELVE: **FUNCTIONAL IMAGING TECHNIQUES**

117. ——— is a term used to describe the movement of molecules in the extra-cellular space due to random thermal motion.
A Diffusion **B** Transference **C** Osmosis **D** Tensor motion

118. The anatomy of white matter tracts can be mapped using strong multidirectional gradients in diffusion ——— imaging (DTI).
A tensor **B** tertiary **C** transference **D** trace

119. Blood oxygenation level ——— (BOLD) produces MR signal intensity changes between stimulus and rest.
A dependent **B** dosage **C** diffusion **D** data

120. Magnetic resonance ——— (MRM) uses very fine resolution data to image structures with the same resolution as pathology sections.
A micro **B** microscopy **C** movement **D** motion

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22		**46**		**70**		**94**		**118**	
23		**47**		**71**		**95**		**119**	
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