CHAPTER ONE: **BASIC PRINCIPLES**

1. There are essentially two ways of explaining the fundamentals of MRI: the classical theory also called Newtonian and via:

A quantum physics **B** mechanics theory **C** quantum mechanics **D** mass theory

2. ——— are two or more atoms arranged together.

A Molecules **B** Protons **C** Electrons **D** Nucleons

3. ——— is the most abundant atom in the human body.

A Water **B** Carbon **C** Oxygen **D** Hydrogen

4. The atom consists of a central nucleus and orbiting:

A molecules **B** protons **C** electrons **D** nucleons

5. The ——— gives an atom its chemical identity.

A mass number **B** atomic number **C** type of molecules **D** number of protons

6. Atoms of elements with the same number of protons but a different number of neutrons are called isotopes.

A True **B** False

7. Some of the particles in the atom possess an electrical charge, protons have:

A variable electrical charge **B** negative electrical charge **C** no electrical charge **D** positive electrical charge

8. Ionization occurs when energy knocks protons out from the atom and causes electrical instability.

A True **B** False

9. The proton consists of ——— spinning quarks.

A 1 **B** 2 **C** 3 **D** 4

10. B0 refers to the large magnetic field of the MRI scanner and it is measured in:

A Teslas **B** Hounsfield **C** Boltzmann **D** Net magnetic vector

11. The speed at which each hydrogen nucleus precess around B0 is called:

A net magnetic vector **B** signal to noise ratio **C** larmor frequency **D** lambda frequency

12. The unit of precessional frequency is:

A Teslas **B** Hertz **C** Hounsfield **D** quartz

13. ——— means that magnetic moments of hydrogen are at different places on the precessional path at a moment in time.

A In phase **B** Radian **C** Coherent **D** Out of phase

14. ——— is caused when the spins are unable to absorb more energy or to be stimulated and release more energy.

A Saturation **B** Flip angle **C** Radiofrequency **D** Amplitude

15. The change of magnetic flux through a closed circuit induces a(n) ——— in the circuit.

A Radiofrequency **B** Electromotive force **C** Ionization **D** Tesla

16. The signal is produced when coherent magnetization cuts across the coil.

A True **B** False

17. ——— is the time from the application of the RF excitation pulse to the peak of signal induced in the receiver coil.

A Receiver coil **B** Electromotive **C** Echo-time **D** Repetition-time

18. The TR thus determines the amount of ——— relaxation that has occurred when signal is read.

A Gradient-echo **B** T1 **C** T2 **D** Proton density

CHAPTER TWO: **IMAGE WEIGHTING AND CONTRAST**

19. ——— contrast parameters are those that cannot be changed because they are inherent to the body's tissues.

A Longitudinal **B** Extrinsic **C** Parallel **D** Intrinsic

20. This is an extrinsic contrast parameter:

A Proton density **B** ACD **C** Flip angle **D** T1 recovery time

21. T2 decay occurs 5–10 times faster than T1 recovery.

A True **B** False

22. ——— is caused by hydrogen nuclei giving up their energy to the surrounding environment or molecular lattice.

A T2 recovery **B** T1 recovery **C** T2 decay **D** T1 decay

23. T1 recovery is the time it takes for——— of the longitudinal magnetization to recover in a tissue.

A 50% **B** 37% **C** 90% **D** 63%

24. The echo time (TE) therefore determines how much T2 decay occurs in a tissue when signal is collected.

A True **B** False

25. The ——— of a tissue is the number of mobile hydrogen protons per unit volume of that tissue.

A T2 **B** ACD **C** proton density **D** T1 recovery time

26. Fat has a low signal and is hypointense.

A True **B** False

27. ——— are used to show anatomy and pathology after administration of a contrast agent.

A Proton density **B** Long TR **C** T1-weighted images **D** T2-weighted images

28. ——— has low signal on T1-weighted images.

A Fat **B** Intraosseous lipoma **C** Cyst with proteinaceous **D** Avascualar necrosis

29. ——— has low signal on T2-weighted images.

A Inflammation **B** Bone island **C** Water **D** Hemangioma

30. ——— is a term used to describe the movement of molecules in the extracellular space due to random thermal motion.

A Diffusion **B** ADC **C** Proton density **D** Susceptibility-weighted

31. In areas of restricted diffusion, the ADC is high because the extracellular space is small.

A True **B** False

32. The b value is an intrinsic contrast parameter that controls how much the intrinsic ADC influences image contrast.

A True **B** False

33. ——— uses the magnetic susceptibility differences between tissues to generate image contrast.

A DWI **B** ADC **C** SWI **D** BOLD

34. The most commonly used contrast agent on MRI is:

A Pentolinium **B** Barium **C** Iodine **D** Gadolinium

35. The spin-echo pulse sequence commonly uses a ——— RF excitation pulse to flip the NMV fully into the transverse plane.

A 90° **B** 60° **C** 63° **D** 80°

36. In spin-echo pulse sequences, T2* dephasing is eliminated by the 180° RF rephasing pulse because magnetic field inhomogeneities are largely predictable.

A True **B** False

37. The spin-echo pulse sequence using one echo produces ——— images.

A Proton density **B** SWI **C** T1-weighted **D** T2-weighted images

38. The spin-echo pulse sequence using two echos produces a PD-weighted images using:

A long TE and a long TR **B** short TE and short TR **C** long TE and a short TR **D** short TE and long TR

39. The spin-echo sequences are considered the standard on MRI, they produce the following sequences:

A T1 and T2 weighted **B** T2 and DP weighted images **C** T1, T2 and DP weighted image **D** T1 and DP weighted images

40. One of the advantages of spin-echo sequences is their short scan-time.

A True **B** False

41. The scan time is reduced by:

A decreasing TE **B** increasing TR **C** increasing the phase matrix **D** decreasing number of signal averages

42. Muscle appears darker on TSE images than in conventional spin-echo sequences.

A True **B** False

43. Artifact from metal implants is significantly reduced when using ——— because repeated 180° RF rephasing pulses compensate for magnetic field inhomogeneity.

A Spin-echo TE **B** proton density **C** TSE **D** SWI

44. An advantage of TSE sequences is the increased T2-weighting.

A True **B** False

45. ——— is used to acquire data for the PD-weighted image, and then the whole scan is repeated to acquire the T2-weighted image.

A Half echo train **B** Shared echo train **C** Split echo train **D** Full echo train

46. Long turbo factors leads to more T2 contrast.

A True **B** False

47. ——— produces increased signal intensity in fluid-based structures such as CSF when using a shorter TR than normal in TSE.

A Spin-echo TE **B** DRIVE **C** DWI **D** Inversion recovery

48. ——— is a spin-echo pulse sequence that uses an RF inverting pulse to suppress signal from certain tissues.

A Spin-echo TE **B** DRIVE **C** DWI **D** Inversion recovery

49. The time from the 180° RF inverting pulse to the 90° RF excitation pulse is known as the TI, this means:

A turbo inversion **B** time from inversion **C** turbo imaging **D** time for image

50. Inversion recovery is used to produce heavily ——— images to demonstrate anatomy.

A Proton density **B** SWI **C** T1-weighted **D** T2-weighted

51. IR pulse sequences increase signal from contrast-enhanced structures.

A True **B** False

52. STIR is an extremely important sequence in ——— imaging.

A neurological **B** musculoskeletal **C** abdominal **D** pelvic

53. STIR should be used in conjunction with contrast agents to enhance the structures.

A True **B** False

54. ——— is used to suppress high CSF signal in T2 weighted images so that the pathology adjacent.

A DWI **B** STIR **C** T1-weighted **D** FLAIR

55. FLAIR is an extremely important sequence in ——— imaging.

A neurological **B** musculoskeletal **C** abdominal **D** pelvic

56. One of the advantages of inversion recovery sequences is their short scan-time.

A True **B** False

57. Triple IR prep adds a further inverting pulse at the TI of fat to null fat and blood together, it is useful when determining fatty infiltration of:

A the pancreas **B** breast tissue **C** heart walls **D** the liver

58. ——— determines the number of k-space lines filled every TR, it controls how many RF rephasing pulses are applied every TR.

A inversion time **B** Tau **C** half echo train **D** echo train length

CHAPTER FOUR: **GRADIENT-ECHO PULSE SEQUENCES**

59. Gradient echo pulse sequences use ——— rather than RF pulses to rephase the magnetic moments of hydrogen nuclei to form an echo.

A pulses **B** gradients **C** inversion **D** angles

60. Gradient echo pulse sequence has shorter scan times.

A True **B** False

61. The process of dephasing magnetic moments with gradients is called:

A inverse gradients **B** flip angles **C** gradient spoiling **D** tau

62. Wheather gradient field adds or subtracts from the main magnetic field depends on the direction of current that passes through the gradient coils, this is called:

A flip angles **B** gradient swiffer **C** gradient spoiling **D** polarity of the gradient

63. Gradient-echoes are created by a ———, this means that it consists of two lobes, one negative and one positive.

A inverse pulses **B** bipolar gradient **C** inversion time **D** flip angles

64. Gradient-echo sequences use gradients to rephase the magnetic moments of hydrogen nuclei and usually flip angles less than:

A 90° **B** 60° **C** 180° **D** 0°

65. In gradient echo pulse sequence less time is required for relaxation, this is why a long TR can be used.

A True **B** False

66. Magnetic susceptibility artifacts increase in gradient echo pulse sequences because inhomogeneities are not compensated.

A True **B** False

67. In G-echo pulse sequences T2 is termed ——— to reflect the fact that magnetic field inhomogeneities are not compensated.

A T1* **B** T2 GRE **C** T2* **D** T1 GRE

68. In gradient-echo pulse sequences, the TR and the ——— control the amount of T1 relaxation and saturation that occurs.

A T2* **B** Tau **C** gradient spoiling **D** flip angle

69. To maximize differences in T1 recovery times in gradient-echo pulse sequences, fat and water vectors are given time to recover full longitudinal magnetization before the next RF excitation pulse is applied.

A True **B** False

70. To minimize T2* decay in PD- weighted image, the TE ——— is so that neither the fat nor the water vectors have had time to decay.

A unchanged **B** equal **C** short **D** long

71. The steady state is generically defined as a stable condition that does not change over time.

A True **B** False

72. In gradient-echo there is no time for ——— to decay before the pulse sequence is repeated.

A T2* **B** transverse magnetization **C** longitudinal magnetization **D** polarity of the gradient

73. Tissues such as muscle do not have signal parity (very short T2 decay time and very long T1 recovery time), so they return a ——— in steady state sequences.

A similar **B** high signal **C** absence of signal **D** low signal

74. The ——— is the flip angle that provides optimum signal intensity for a tissue with a given T1 recovery time scanned using a given TR.

A similar signal **B** Ernst signal **C** absence of signal **D** low signal

75. The ——— affects image contrast and induces a voltage in the receiver coil.

A longitudinal magnetization **B** polarity **C** residual transverse magnetization **D** high signal

76. In T2* water is ——— because water has a good parity between its T1 recovery and T2 decay times.

A hyperintense **B** hypointense **C** enhancing **D** without signal

77. Flip angles between ——— are typically used in the steady state.

A 10° and 15° **B** 80° and 90° **C** 90° and 180° **D** 30° and 45°

78. Water has the longest ——— and is a large component of the residual transverse magnetization and therefore the stimulated echo.

A magnetization **B** T2 decay time **C** longitudinal magnetization **D** T1 recovery times

79. ——— pulse sequences use a variable flip angle RF excitation pulse followed by gradient rephasing to produce a gradient-echo.

A Incoherent **B** Spoiled echo-gradient **C** Coherent **D** Fast gradient echo

80. Rewound gradient-echo pulse sequences are generally used to create ——— -weighted images in a very short scan time.

A T2* I **B** T1 **C** PD **D** SWI

81. ——— enables only gradient-echoes produced from the most recently created transverse magnetization to affect image.

A Phase locked circuit **B** Rewound gradient-echo **C** C T1 recovery times **D** RF spoiling

82. Spoiled gradient echo sequences can be used after gadolinium injection.

A True **B** False

83. ——— is the time from the peak of the gradient-echo to a previous RF excitation pulse.

A Actual TE **B** SNR **C** Effective TE **D** Spoiling time

84. Reverse-echo gradient-echo pulses sequences has now largely been replaced by TSE, as it produces better T2 weighting in short scan times.

A True **B** False

85. Balanced gradient-echo is a steady state sequence in which longitudinal magnetization is maintained during the acquisition, therefore it prevents:

A noise **B** longer times **C** artifact **D** saturation

86. ——— is a rapid acquisition technique that begins with a sequence of one or more RF pulses and is followed by a series of gradient-echoes.

A Spoiled gradient echo **B** balanced gradient-echo **C** echo planar imaging **D** incoherent purse sequences

87. EPI pulse sequence decreases physiological motion in MR images, which is advantageous when imaging the ——— and when performing interventional techniques.

A heart **B** stomach **C** lung **D** liver

88. Blurring is an artifact that occurs as a result of T1 recovery times during the acquisition.

A True **B** False

89. ——— determines how much phase shift there is across an area of tissue per s in DWI.

A Flip angle **B** TE **C** TR **D** b value

CHAPTER FIVE: **SPATIAL ENCODING**

90. The middle of the axis of the gradient remains at the field strength of the main magnetic field even when the gradient is switched on, this is called:

A magnetic isocenter **B** polarity **C** gradient coils **D** echo planar imaging

91. ——— is commonly used to denote magnetic field strength or magnetic flux density using the SI system.

A Gauss **B** Tesla **C** Coulombs **D** Homs

92. Gradient amplitude determines the rate of change of the magnetic field strength along the gradient axis.

A True **B** False

93. ——— are conductors that cause a linear change in the magnetic field strength along their axes when a current is passed through them.

A Isocenter **B** Magnetic moment **C** Gradient coils **D** Gradient amplitude

94. ——— alters the magnetic field strength along the vertical axis of the magnet (from the back to the front of the patient).

A z gradient **B** x gradient **C** t gradient **D** y gradient

95. To achieve ———, a shallow slice-select slope and/or broad transmit bandwidth is applied.

A thin slices **B** thick slices

96. Slice thickness is altered by changing the slope of the slice-select gradient and the:

A polarity **B** amplitude **C** transmit bandwidth **D** magnetic moment

97. Once a slice is selected, signal coming from it is located along both axes of the image, the signal is usually located along the long axis of the anatomy by a process known as:

A RF excitation **B** carrier frequency **C** transmit bandwidth **D** frequency encoding

98. In ——— the long axis of the anatomy usually lies along the horizontal axis of the magnet (left to right of the patient), and, therefore, the x gradient performs frequency encoding.

A axial images **B** coronal images **C** sagittal images **D** neutral images

99. To achieve a ——— in the frequency direction, a shallow frequency-encoding gradient is applied.

A large FOV **B** small FOV

100. To achieve a ———, the phase-encoding gradient is applied many times during the pulse sequence.

A low phase matrix **B** high phase matrix

CHAPTER SIX: **K-SPACE**

101. The phase shift caused by the phase-encoding gradient creates a:

A single spin **B** spatial encoding **C** spin-echo sequence **D** spatial frequency

102. The ——— of K-space is horizontal and is centered in the middle of several horizontal lines.

A phase axis **B** frequency **C** spatial frequencies **D** spatial encoding

103. The slice-select gradient is not applied during the RF excitation and rephase pulses to selectively excite and rephase a slice.

A True **B** False

104. A few preliminary steps are needed to ensure that the data are in a format required for FFT mathematics to create an image of slice. The first step is to simplify the frequencies and amplitudes present in the echo. This step is called:

A frequency encoding **B** readout or measurement gradient **C** frequency and amplitude modulation **D** sampling time

105. The number of data points in each line of k-space depends on the frequency matrix.

A True **B** False

106. The digital sampling frequency determines the time interval between each data point, this time interval is called the sampling interval and is calculated by dividing the digital sampling frequency by 1.5.

A True **B** False

107. The bandwidth used in the ——— to excite a slice is called the transmit bandwidth.

A range of frequencies **B** low-frequency **C** RF excitation pulse **D** phase-encoding

108. The digital sampling frequency is a parameter directly selected in the scan protocol.

A True **B** False

109. The minimum TE is affected by the duration of the sampling window because the echo is not centered in middle of the time window.

A True **B** False

110. ——— is required to mathematically ¨unlock¨ these data so that the system can locate a signal at each pixel location in the slice and assign a signal intensity to it.

A FFT **B** FOV **C** TR **D** PE

111. The ——— of k-space are filled using shallow phase-encoding gradient slopes.

A outer lines **B** superior lines **C** low lines **D** central lines

112. The outer portion of k-space contains data that have low signal amplitude and high resolution.

A True **B** False

113. When the system calculates the scan time, it usually multiplies the following three parameters: TR, ——— and Number of signal averages (NSA).

A Phase axis **B** FFT **C** Phase matrix **D** spatial encoding

114. Partial echo is performed when only part of the echo is read during application of the:

A sequential and 3D acquisition **B** frequency-encoding gradient **C** polarity of the phase **D** RF excitation pulse

115. A ——— is a good screening radiograph for most dentoalveolar trauma.

A panorex **B** panrad **C** panphoton **D** panoria

CHAPTER SEVEN: **PROTOCOL OPTIMIZATION**

116. The ——— is defined as the ratio of the amplitude of signal received to the average amplitude of the background noise.

A contrast-to-noise ratio (CNR) **B** High spatial resolution **C** signal-to-noise ratio (SNR) **D** scan time

117. Noise represents frequencies that exist randomly in space and time.

A True **B** False

118. The magnetic field strength plays and important part in determining CNR.

A True **B** False

119. The ——— is inherent to the tissue and cannot be changed.

A proton density **B** signal **C** spatial resolution **D** echo gradient

120. Larger coils receive less noise in proportion to signal than smaller coils because noise is received from the entire receiving volume of the coil.

A True **B** False

121. The ———controls the amount of transverse magnetization created by the RF excitation pulse, which induces a signal in the receiver coil.

A TR **B** TE **C** noise **D** flip angle

122. Noise is additive over each signal average but the signal is not.

A True **B** False

123. Halving the bandwidth increases the SNR by about ———, but increases the sampling windows.

A 10% **B** 80% **C** 40% **D** 50%

124. The ——— is determined by the field of view (FOV) and the number of pixels in the FOV or image matrix.

A Voxel **B** slice thickness **C** pixel area **D** image matrix

125. In volume imaging, the entire volume of tissue is excited, and the volume contains no gaps, so the SNR decreases.

A True **B** False

126. To optimize the SNR select the following parameter in the scan: ——— flip angle in spin-echo or the Ernst angle in gradient-echo pulse sequences.

A 90° **B** 180° **C** 120° **D** 45°

127. ——— is probably the most critical factor affecting image quality, as it directly determines the eye's ability to distinguish areas of high signal from areas of low signal.

A NSA **B** SNR **C** MTC **D** CNR

128. There is always a transfer of magnetization between the bound and the free protons, which causes a change in the ——— recovery times of free spins.

A T2 **B** T2 GRE **C** T1 **D** T1 GRE

129. There are techniques that are specifically designed to produce signal only from nuclei with certain characteristics. Nuclei that do not possess such characteristics do not produce signal, and so there is a good CNR between them and those that do.

A True **B** False

130. Hydrogen exists in different chemical environments in the body, the precessional frequency of magnetic moments of fat nuclei is therefore slightly different from that of water, this is called:

A fat of water saturation **B** chemical shift **C** spatial inversion recovery **D** SAT TR

131. To saturate fat signal, a ——— presaturation RF pulse is applied at the precessional frequency of fat to the whole FOV.

A 90° **B** 120° **C** 180° **D** 60°

132. ——— is used in gradient-echo sequences to null signal from voxels in which fat and water nuclei coexist.

A Presaturation **B** T1 recovery times fat **C** Spatial resolution **D** Out-of-phase imaging

133. The voxel size is affected by: Slice thickness, ——— and number of pixels or image matrix.

A voxel **B** spatial resolution **C** FOV **D** large voxel

134. ——— is determined by the distance traveled in K-space.

A FOV **B** Pixel size **C** image matrix **D** slice thickness

135. The rise time of a gradient is the time required for it to achieve the correct slope or amplitude.

A True **B** False

136. A rectangular or asymmetric FoV maintains spatial resolution because pixel size is unchanged, but increases the scan time, as only a portion of the total number of phase-encoding steps are performed.

A True **B** False

137. The scan time is proportional to following:

A TR, NSA and phase FOV **B** TE, phase matrix and NSA **C** TR, phase matrix and NSA **D** TR, phase matrix and FOV

138. Protocol modification depends on the area under examination and the condition and cooperation of the patient.

A True **B** False

CHAPTER EIGHT: **ARTIFACTS**

139. Thoracic bioimpedance derives information from electrodes placed on the ——— chest and neck.

A phase axis **B** phase-encoding gradient **C** phase matrix **D** polarity of the gradient

140. There are several ways to reduce phase mismapping, the amount of separation between ghosts depends on the TR, phase matrix, ———, and the period of motion.

A NSA **B** CNR **C** image matrix **D** TE

141. As ghosting only occurs along the phase encoding axis of the image, its direction can´t be changed so that the artifact does not interfere with the area of interest.

A True **B** False

142. ——— techniques utilize signals collected by the transducer or navigator echoes.

A Respiratory navigator echoes **B** Respiratory compensation techniques **C** Respiratory gating and triggering **D** Presaturation pulse

143. The term triggering is used in cardiac imaging to describe pulse sequences where data are collected continuously and retrospectively reordered into a stack of images that show the heart at different positions along the cardiac cycle.

A True **B** False

144. ———, ghosting, or motion artifact is caused by periodic motion mainly as result of spins moving between each phase encode.

A Phase gating **B** Multiple NSA **C** Phase mismapping **D** Gradient moment

145. ——— is an artifact where anatomy that exists outside the FOV is folded onto the top of anatomy inside the FOV.

A phase wrap **B** Aliasing **C** respiratory moving **D** chemical shift artifact

146. Aliasing along the frequency encoding axis is known as:

A frequency wrap **B** high-frequencing aliasing **C** phase wrap **D** frequency axis

147. Aliasing in the frequency direction is eliminated by decreasing the digital sampling rate so that all frequencies are sufficiently digitized.

A True **B** False

148. ——— by increasing the number of phase encodings steps, increases the number of k-space lines, and more data is stored so that there is no duplication of spatial frequencies.

A phase wrap **B** antialiasing along the frequency axis **C** antialiasing software over samples **D** phase axis

149. Chemical shift artifacts cause the misplacement of signal from fat in the image. It can also create both ——— and signal superimposition (high signal) in areas where fat and water interfase.

A low signal **B** signal voids **C** intermediate signal **D** fat signal

150. The chemical shift artifacts occur because the difference in frequency between the magnetic moments of fat and water causes them to be placed into different pixels in the image.

A True **B** False

151. Chemical shift artifact is augmented by scanning at a lower field strength and by minimizing the FOV.

A True **B** False

152. Fat and water process at different frequencies. This is ——— ppm and is called chemical shift.

A 2.5 **B** 1.5 **C** 3 **D** 3.5

153. Out-of-phase signal cancellation produces a ———signal around certain organs where fat and water interfaces occur within the same voxel.

A void **B** ring of dark **C** glitter ring **D** noise

154. ——— is the ability of a substance to become magnetized.

A Out-of-phase signal **B** Gradient rephasing **C** Dixon Technique **D** Magnetic susceptibility

155. The ——— RF rephasing pulse used in spin-echo sequences is very efficient at compensating for phase differences caused by inhomogeneity.

A 180° **B** 60° **C** 120° **D** 90°

156. Truncation artifact produces a banding artifact at the interfaces only of high signal.

A True **B** False

157. Truncation artifacts result from undersampling of data so that interfaces on high and low signal are incorrectly represented on the image.

A True **B** False

158. Cross excitation can be reduced by ensuring that there is at least a ———gap between the slices.

A 20% **B** 50% **C** 30% **D** 45%

159. ——— appears as dense broken line across the image perpendicular to the frequency-encoding direction.

A Cross-excitation **B** Zipper artifact **C** Shading artifact **D** Moiré artifact

160. There is also a type of moiré effect seen in gradient-echo sequences that is caused by a combination of ——— and field inhomogeneity.

A banding artifact **B** aliasing **C** high signal **D** magnetic susceptibility

161. Magic angle artifact produces abnormally low signal intensity in tissues that contain collagen.

A True **B** False

162. Magic angle artifact occurs when collagen structures lie at angle of ——— to the main field.

A 45° **B** 60° **C** 50° **D** 55°

163. Entry-slice phenomenon increases at the first slice in the stack, when using a long TR in thin slices, ——— and when flow is in the opposite direction to slice excitation.

A with slow flow **B** with RF excitation pulse **C** with fast flow **D** with rephasing pulses

164. ——— is where the velocities (described earlier) coil around each other in a corkscrew formation. This is typically seen in large vessels such as the thoracic aorta.

A Vortex flow **B** Spiral flow **C** Laminar flow **D** Turbulent flow

165. ——— compensates for the altered phase values of magnetic moments of nuclei flowing along a gradient.

A rephrasing pulses **B** intravoxel dephasing **C** Gradient moment rephrasing **D** rephrasing signal

166. Presaturation uses additional RF pulses to nullify signal from flowing nuclei. It reduces artifacts due to time-of-flight and entry.slice phenomena. It is effective on fast and slow flow, and increases the TR deposition to the patient.

A True **B** False

167. The benefit of using a ——— sequential acquisition is that each slice is acquired separately.

A 3D **B** T2* **C** 2D **D** T1

168. Poor signal penetration into the slab may be offset by the use of spatially varying RF pulse, also known as:

A venetian blind **B** ramped RF **C** MIP **D** excitation pulse

169. ——— is a technique that produces images where unsaturated spins coming into the slice produce a higher signal intensity than the stationary spins within the slice.

A inflow MRA **B** 3D PC-MRA **C** MOTSA **D** PC-MRA

CHAPTER NINE: **INSTRUMENTATION**

170. ——— is the second most powerful fundamental force of nature.

A Gravity **B** Magnetism **C** Radiation **D** Electricity

171. ——— substances are strongly attracted to, and align with the applied magnetic field. They are permanently magnetized even when the applied field is removed.

A Super-paramagnetic **B** Paramagnetic **C** Ferromagnetic **D** Diamagnetic

172. Diamagnetic compounds are characterized by the fact that they exhibit a weak repulsion to an internal magnetic field.

A True **B** False

173. Gadolinium is always considered to be ———, but in its refined state, gadolinium is a silver metal that has unpaired electrons and magnetic domains.

A diamagnetic **B** super-paramagnetic **C** paramagnetic **D** ferromagnetic

174. ——— are the most popular type of MRI scanner worldwide. They feature the familiar tunnel-shaped magnet bore and resemble, in shape, a larger version of a computed tomography scanner.

A Open systems **B** Closed-bore systems **C** Magnetic systems **D** Extremity systems

175. The fringe field having a strength of ——— mT or greater must not extend outside of safety Zones III and IV, and should ideally be contained within the magnet room.

A 0.5 **B** 0.3 **C** 1.0 **D** 8.0

176. The phenomenon of electromagnetism was first discovered by Hans Christian Oersted in:

A 1810 **B** 1880 **C** 1840 **D** 1820

177. Resistive MRI scanners employ copper-wound solenoids that operate just below normal room temperature.

A True **B** False

178. The term cryostat is derived from the Greek words meaning ¨cold¨and ¨unstable.¨

A True **B** False

179. ——— uses shims to adjust for large changes in magnetic field homogeneity. The inner circumference of the warm bore of the cryostat is lined with several long plastic trays that fit along the full length of the bore.

A Homogeneity **B** Passive shimming **C** Active shimming **D** Gradient system

180. The ——— is a cylindrical solenoid electromagnet, is a copper- plated cylinder with the conductive elements etched into the surface of the metal plating.

A gradient **B** gradient system **C** extremity system **D** magnetic systems

181. ——— is the region in which free access by unscreened non-MR personnel or ferromagnetic objects or equipment can result in serious injury or death as a result of interactions between the individuals or equipment and the MR scanner´s particular environment.

A Zone I **B** Zone II **C** Zone III **D** Zone IV

182. The ACR guidance document on MRI safety identifies three levels of personnel: Non-MRI personnel, Level 2 personnel and Device safety.

A True **B** False

183. MR conditional. ¨An item that has been demonstrated to pose no known hazards in a specified condition of use.

A True **B** False

184. The static field of the MRI scanner presents four main implications for patient safety: Transient biological effects, projectile hazards, Torque on implanted devices and Foreign bodies in the static field.

A True **B** False

185. ——— This is ¨the mode of operation of the MRI equipment in which one or more outputs reach a value that can produce significant risk for subjects, for which explicit ethical approval is required according to local requirements.¨

A First-level controlled operating mode **B** Second-level controlled operating mode **C** Normal operating mode **D** Third-level operating mode

186. In temperature standards, normal mode shall only increase core body temperature by ——— , raising the core or local body temperature to no greater than 39°C.

A 0.1° C **B** 0.3° C **C** 0.8° C **D** 0.5°C

187. A second safety concern associated with RF is known as the ———. Any conductor acts as an antenna if it happens to be of a certain critical.

A length **B** heating **C** antenna effect **D** electromagnetic fields

188. To prevent ——— it is of key importance to ensure that conductive wires are kept away from the patient's skin surface, particularly if they are sedated, unconscious, or anesthetized.

A burns **B** freezing **C** anxiety **D** artifact

189. Complications associated with the inadvertent scanning of pacemakers are quite frequent.

A True **B** False

190. The degree to which different molecules reduce the TR field is defined as the relative permittivity of the medium in question.

A True **B** False

191. The parameter that determines the excitability of biological tissue is known as the:

A rheobase **B** safety viewpoint **C** chronaxie value **D** magnetic filed

192. Current safety guidelines state that in normal operating mode, the gradient system should operate at a level that does not exceed ——— of the mean threshold for peripheral nerve stimulation.

A 50% **B** 20% **C** 90% **D** 80%

MRI BASICS POST-TEST ANSWER SHEET RADUNITS.COM

(Page 1 of 2)

Fill in each blank. There are two options to submit the post-test. (812) 250-9729

Option 1: Submit the post-test answers online at radunits.com on the course page for instant grading and emailed CE certificate. A password is required, which is found in your email receipt.

Option 2: Fax this answer sheet to us at 866-386-0472, or you may instead email a phone pic of the answer sheet to clark@radunits.com. Allow 2 days for grading, and we will email the CE certificate.

First name:

Last name:

Email:

ARRT license number:

Florida techs only - enter state license number. All others enter N/A.

Telephone: Date:

When part of a group order or if the post-test is purchased under another name – enter the order number or purchasing name:

1		**25**		**49**		**73**		**97**	
2		**26**		**50**		**74**		**98**	
3		**27**		**51**		**75**		**99**	
4		**28**		**52**		**76**		**100**	
5		**29**		**53**		**77**		**101**	
6		**30**		**54**		**78**		**102**	
7		**31**		**55**		**79**		**103**	
8		**32**		**56**		**80**		**104**	
9		**33**		**57**		**81**		**105**	
10		**34**		**58**		**82**		**106**	
11		**35**		**59**		**83**		**107**	
12		**36**		**60**		**84**		**108**	
13		**37**		**61**		**85**		**109**	
14		**38**		**62**		**86**		**110**	
15		**39**		**63**		**87**		**111**	
16		**40**		**64**		**88**		**112**	
17		**41**		**65**		**89**		**113**	
18		**42**		**66**		**90**		**114**	
19		**43**		**67**		**91**		**115**	
20		**44**		**68**		**92**		**116**	
21		**45**		**69**		**93**		**117**	
22		**46**		**70**		**94**		**118**	
23		**47**		**71**		**95**		**119**	
24		**48**		**72**		**96**		**120**	

MRI BASICS COURSE POST-TEST ANSWER SHEET RADUNITS.COM

121		**145**		**169**					
122		**146**		**170**					
123		**147**		**171**					
124		**148**		**172**					
125		**149**		**173**					
126		**150**		**174**					
127		**151**		**175**					
128		**152**		**176**					
129		**153**		**177**					
130		**154**		**178**					
131		**155**		**179**					
132		**156**		**180**					
133		**157**		**181**					
134		**158**		**182**					
135		**159**		**183**					
136		**160**		**184**					
137		**161**		**185**					
138		**162**		**186**					
139		**163**		**187**					
140		**164**		**188**					
141		**165**		**189**					
142		**166**		**190**					
143		**167**		**191**					
144		**168**		**192**					