CAIRO UNIVERSITY
BIOMEDICAL ENGINEERING DEPARTMENT

MRI EXAM 2

Wed. April 14, 1999 - Time: 1:30

SOLVE AS MUCH AS YOU CAN AND ASSUME ANY MISSING INFORMATION

1. **[2 points]** The 180 deg. pulse that follows the initial 90 deg pulse in a spin echo sequence will cause the NMR signal to be corrected for:
a) Slight magnetic field inhomogeneities
b) Cross talk
c) Motion
d) All of the above
e) None of the above

2. **[2 points]** If the TR of a gradient echo pulse sequence is considerably larger than T1 while TE is of the same order as T2, the resultant image will have a contrast that is a function of:
a) Proton density b) T1 c) T2*
d) All of the above e) None of the above

3. **[2 points]** The gradient that is on during the data acquisition of an echo is usually for:
a) Slice selection b) Frequency encoding c) Phase encoding
d) All of the above e) None of the above

4. **[2 points]** To collect a 256x128 MR image using Fourier imaging with NEX=2, the number of RF pulses used should be:
a) 64 b) 128 (c) 256 d) 512 e) Other = ...

5. **[2 points]** With conventional spin echo each row in the k-space is filled in each:
a) Frequency encoding period b) TE period c) TR period
d) Excitation period e) TI period

6. **[2 points]** To create a projection image in MRA, the technique most commonly employed is:
a) Multiplanar reconstruction
b) region of interest calculation
c) Maximum intensity projection
d) Summation pixel projection
e) None of the above

7. **[2 points]** The time between excitation pulses is known as:
a) TI b) TE c) TR
d) Acquisition time e) None of the above

8. **[2 points]** In a spin echo sequence, the time between the 90 deg pulse and the 180 pulse is:
a) TE b) TI c) TR d) T2* e) None of the above

9. **[2 points]** Increasing TE:
a) Increases the contrast based on T2
b) Reduces the contrast based on T2
c) Reduces the contrast based on T1
d) All of the above
e) None of the above

10. **[2 points]** In a gradient echo sequence, reducing the flip angle while holding TR constant reduces:
a) T2* contrast weighting
b) Spin density contrast weighting
c) SNR
d) Scan time
e) None of the above

11. **[2 points]** In an inversion recovery pulse sequence, image contrast is controlled by:
a) TR b) TI c) TE d) All of the above
e) None of the above

12. **[2 points]** A short T1 inversion recovery sequence (STIR) sequence can suppress the signal from:
a) Fat b) Water c) Blood vessels
d) All of the above e) None of the above

13. **[2 points]** Decreasing the receiver bandwidth:
a) Decreases SNR
b) Inverts SNR
c) Increases SNR
d) Stabilizes SNR
e) Has no effect on SNR

14. **[2 points]** Doubling the number of signals averaged (NEX) will:
a) Improve the resolution
b) Double the SNR
c) Enhance the contrast
d) All of the above
e) None of the above

15. **[2 points]** Increasing the number of phase encoding steps will produce an image with:
a) Higher resolution
b) Low SNR
c) Better contrast
d) All of the above
e) None of the above

17. **[2 points]** Changing the matrix size on an MR image from 192x128 to 256x128 will:
a) Reduce the scan time
b) Have no effect on the scan time
c) Increase the scan time by a factor of 256/192
d) Increase the scan time by the square root of 256/192
e) Other: .....

18. **[2 points]** The transmit bandwidth of an RF pulse affects:
a) Spatial resolution b) Image contrast c) TR
d) All of the above e) None of the above

19. **[2 points]** The gradient magnetic fields in MRI are:
a) Always on.
b) Superimposed over the main magnetic field
c) Used for contrast control
d) Controlled by RF pulses
e) Usually have nonlinear spatial dependence

20. **[2 points]** The B1 magnetic field is produced by:
a) A gradient coil b) A static magnet coil c) A radiofrequency coil
d) Any of the above e) None of the above

21. **[2 points]** T1 relaxation time is defined as when:
a) 76% of the longitudinal magnetization has been recovered
b) 63% of the longitudinal magnetization has been recovered
c) 63% of the transverse magnetization has been recovered
d) 76% of the transverse magnetization has been recovered
e) None of the above

22. **[2 points]** The receiver bandwidth is related to the slope of the:
a) Frequency encoding gradient
b) phase encoding gradient
c) slice selection gradient
d) transmitting gradient
e) B1 field

23. **[2 points]** Following a 90 deg RF pulse, the signal created is called:
a) Spin echo b) Gradient echo c) free induction decay
d) stimulated echo e) Inversion recovery

24. **[2 points]** Maximum signal is produced in the receiver coil when the net magnetization is tipped:
a) 180 deg b) 90 deg c) Away from the z-axis
d) Through the transverse plane e) Other : .....

25. **[2 points]** The MR signal is produced by magnetization:

a) Out of phase b) In the longitudinal direction c) Decayed
d) In the transverse plane e) All of the above

26. **[2 points]** Slice thickness is controlled by:
a) gradient coil and direction
b) gradient magnitude and duration
c) gradient slope and RF pulse bandwidth
d) SNR and image contrast
e) Tissue type and proton density

27. **[2 points]** The gyromagnetic ratio for Hydrogen is:
a) 63.86 MHz/T b) 42.6 MHz/T c) 1G/cm d) 4W/kg
e) 24.58 MHz/T

28. **[2 points]** The gradient that varies in amplitude with each TR is:
a) The slice selection gradient
b) The frequency encoding gradient
c) The phase encoding gradient
d) All of the above
e) None of the above

29. **[2 points]** k-space is:
a) The image in its natural state
b) A negative of an MR image
c) The raw data from which MR image is created
d) All of the above
e) None of the above

30. **[2 points]** Aliasing occurs because tissue outside the selected FOV is:
a) Undersampled b) Oversampled c) Not sampled
d) Too large e) Too obvious

31. **[2 points]** Chemical shift artifact occurs because:
a) The system is undersampling the fat and water molecules
b) The SNR is low.
c) Fat and water precess at different frequencies
d) The tissue is undersampled in the frequency direction
e) Fat has a different T1 from that of water

32. **[2 points]** Flow artifacts can be reduced by:
a) Gradient moment nulling
b) Spatial presaturation pulses
c) Shortening TE
d) All of the above
e) None of the above

33. **[2 points]** If the slice thickness is reduced by a factor of 2, the factor by which NEX must be increased to maintain the same SNR is:
a) 8 b) 1.41 c) 4 d) 2 e) 0.707

34. **[2 points]** Changing the voxel size in the frequency direction will:
a) Double the scan time
b) Decrease the scan time
c) have no effect on the scan time
d) Increase the scan time by a factor of 0.5
e) Improves the scan time

35. **[2 points]** For Half Fourier imaging at matrix size 256x256, the number of RF pulses is:
a) 520 b) 264 c) 136 d) 72 e) 1032

36. **[10 points]** Design a suitable imaging protocol that enables the acquisition of a volumetric data set that enables further postprocessing segmentation to assist a neurosurgical operation. The sequence should be able to eliminate the problem of the fat ring around the skull and to show the cortex (white matter/gray matter) as clear as possible. It is also important to visualize the blood vessel.

37. **[10 points]** A patient was referred to the Radiology Department to investigate a possible aneurysm in the vessels of his right leg. It is required to determine the location of that disease (i.e., position in 3-D, arterial side or venous side. etc.). Design an imaging procedure that allows you to do that.

38. **[10 points]** Draw the pulse sequence diagram of 3 different imaging sequences of your choice and draw their k-space traversal trajectories.

39. **[10 points]** Design a 2-D imaging sequence that enables the visualization of a small region 2cm x 2cm in size located 1cm away from the center of the magnet (center to center distance) within the brain tissue (dimensions: 20cm x 20cm) at the maximum SNR. The sequence should be T2* weighted to enable functional imaging of the brain.

40. **[10 points]** Assume that you are imaging a uniform object that looks oval in shape. Draw the expected MR image in the following cases:
a) when properly scanning the object
b) when the FOV was redced to half that in a)
c) when the contents of the object is replaced by a different material with more fat
d) when the matrix size is reduced to half that in a) along the phase encoding direction
e) when the object moves during the scan