Medical Equipment Part 2 **Problem Assignment #2**

1. Aliasing artifact in the phase encoding direction results from:
a) A number of phase encoding steps that is too small
b) A number of phase encoding steps that is too large
c) A phase encoding step that is too small
d) A phase encoding step that is too large
e) Under-sampling the received time-domain echoes

2. In designing an RF pulse to select a 5mm slice in a 1.5T magnet, if the slice selection gradient is set at 5mT/m and the desired flip angle is ?/6, a proper design for the duration of a rectangular RF pulse can be selected approximately as:
a) 1 msec
b) 2 msec
c) 8 nsec
d) 1 nsec
e) Other: ……

3. To acquire an oblique slice that makes an angle of 45 degrees with x-, y- and z-axes, the slice selection design consists of:
a) Three similar RF pulses in x-, y-, and z-directions with no gradients
b) One RF pulse and no gradients
c) Two RF pulses in x- and y-directions and a gradient in z-direction
d) One RF pulse and equal gradients in x-, y-, and z-directions (*)
e) Other: ……

4. To control the flip angle of an RF pulse, one can do the following:
a) Change the modulation of the RF pulse b) Change the duration of the RF pulse
c) Change the bandwidth of the RF pulse d) Change the amplitude of the RF pulse
e) Change the direction of the X and Y RF coils

5. Fourier encoding means:
a) Frequency encoding b) Phase encoding c) Slice selection
d) Frequency or phase encoding e) Frequency encoding, phase encoding and slice selection

6. The Larmor frequency at 10 cm away from the iso-center of a 1.5 Tesla magnet is:
a) 63.9 MHz b)42.6 MHz c) 28.4 MHz d) 21.3 MHz e) 85.2 MHz

7. frequency encoding can be applied for:
a) Spatial encoding in one dimension b) Spatial encoding in two dimensions
c) Spatial encoding in three dimensions d) Shimming the magnet
e) Slice selection

8. In conventional gradient echo, a single row in the k-space is filled within each:
a) Scan time b) TE period c) TR period
d) RF Excitation e) TI period

9. The field of view is primarily determined by:
a) The sampling bandwidth and read-out gradient b) SNR
c) The number of acquired k-space samples d) The size of the reception coils
e) The image resolution.

10. Increasing the voxel size in the phase encoding direction at same coverage will:
a) Increase the scan time b) Decrease the scan time
c) Have no effect on the scan time d) Cause aliasing
e) Cause motion artifacts

11. In Fourier imaging sequence, each TR enables the acquisition of:
a) One point in the image
b) One line in the image
c) One point in the k-space of the image
d) One line in the k-space of the image
e) A collection of random points in the image

12. The cause of aliasing artifact is:
a) The absence of sampling in RO direction
b) The absence of sampling in PE direction
c) The under-sampling in PE direction
d) The over-sampling of the RO direction
e) The over-sampling of both the PE and RO directions

13. Cross-talk is the result of:
a) Interference in signal lines
b) Interference between gradient coils
c) Overlapping between adjacent slice profiles
d) Overlapping of gradients
e) Overlapping of RF pulses

14. A slice selection gradient of 5 mT/m if combined with an RF pulse of bandwidth of 1kHz will select a slice of thickness:
a) 1 cm b) 1 mm c) 2 mm d) 5 mm e) 8 mm

15. The negative gradient lobe applied right before the RO gradient in the same direction is used to:
a) Make phase encoding b) Make better slice selection c) Allow longer acquisition
d) Make center of k-space in the center of acquisition window e) Center image

16. To increase the resolution in the frequency encoding direction for the same FOV,
a) use higher sampling rate for same duration
b) use same sampling rate for longer duration
c) use higher sampling for longer duration
d) apply additional phase encoding
e) use a thinner slice selection

17. The key component for spatial encoding in MRI systems is,
a) main magnet b) quadrature coils c) gradient coils d) shim coils e) gantry

18. In a multi-slice TOF MRA imaging sequence, the scan parameters were: TR/TE: 300/20 msec, FOV: 20cm x 20cm, Matrix 256x256, Number of slices: 128, slice thickness: 5mm, NEX: 2, flip angle: 30 degrees. The shortest total acquisition time for this sequence is approximately:
a) 18 minutes
b) 245 minutes
c) 2 minutes
d) 9 minutes
e) Other: …….

19. Image resolution can be expressed in units of,
a) bits b) lp/mm c) 1/sec d) mm/sec e) points

20. Inversion time for suppressing fat (T1=300 ms) in an image is approximately,
a) 400 ms b) 800 ms c) 200 ms d) 1 sec e) other: -------

20. The resolution in the read-out direction depends on,
a) Sampling duration (k-space coverage)
b) Sampling bandwidth (k-space sampling rate)
c) Sampling dynamic range (number of bits of sampling A/D)

21. The FOV in the phase encoding direction depends mainly on,
a) Phase encoding step size only
b) Number of phase encoding steps and step size
c) Matrix size in the phase encoding direction only

22. To maintain the same resolution in the read-out direction at a larger FOV, one can,
a) Increase the k-space sampling bandwidth only
b) Increase the k-space coverage in the read-out direction only
c) Increase both k-space sampling bandwidth and k-space coverage

23. The acquisition time for 30 128? 128 slices when NEX=2, TE=50 ms, and TR=1 sec is approximately,
a) 8.5 min
b) 4.3 min
c) 6.4 min

24. For a multi-slice imaging sequence with parameters given as: slice thickness: 5mm, flip angle: 60?, matrix size: 128? 192, FOV: 20cm? 25cm, NEX: 1, and TR/TE: 600/20, the ratio of acquisition time to acquire 25 slices to that of acquiring 20 slices using this sequence is,
a) 1
b) 1.25
c) 2

25. A material that is chemically shifted from water by 1.7k has a different resonance frequency at 4T from that of water by approximately,
a) 10 ppm.
b) 100 ppm.
c) 1 ppm.

26. The total acquisition time for a 3-D Fourier acquisition of a volume of matrix size 128? 128? 256 with TR/TE: 100/15ms is approximately,
a) 14 minutes.
b) 27 minutes.
c) 54 minutes.

27. The k-space represents,
a) The Fourier domain of the image
b) The MR image space
c) The space where k-space trajectories are designed.

28. The FOV in the read-out direction depends on,
a) Sampling bandwidth
b) Sampling duration
c) Sampling dynamic range

29. The FOV in the phase encoding direction depends mainly on,
a) Phase encoding step size
b) Number of phase encoding steps
c) Matrix size in the phase encoding direction

30. The implementation of FOV selection in MRI systems is done through,
a) Proper selection of sampling steps in k_x and k_y directions.
b) Proper selection of k-space coverage in in k_x and k_y directions.
c) Proper positioning of the patient inside the magnet.
d) Proper adjustment of the image reconstruction software.
e) Proper selection of the Larmor frequencies inside the patient.

31. Given a 60? RF pulse that is implemented using a Sinc time domain envelope using a slice selection gradient G_z=15mT/m at 1.5T to excite a 3mm slice centered at z=1cm, we can derive

another RF pulse to excite a similar slice profile at z=2cm by modifying the current pulse as follows,

a) Increase the modulation frequency by 6.4kHz.
b) Shift the slice selection gradient by 1 cm.
c) Double the time domain width of the RF pulse.
d) Decrease the amplitude of the RF pulse by one half.
e) Change the RF envelope function.

32. Draw a properly labeled T2-weighted magnetic resonance imaging sequence that can be used for imaging 3-D volume using 3-D Fourier imaging. Draw a clear diagram of its k-space trajectory.

33. Draw a properly labeled T2* -weighted sequence that has the shown k-space trajectory: