

Quiz 2

TOTAL POINTS 15

1. Which of the following nuclei cannot be used for MRI?

1 point

- ☐ ^{17}O
- ☒ ^{12}C
- ☐ ^{23}Na
- ☐ ^{19}F

2. When protons are placed in a strong external magnetic field, their magnetic moments rotate around the axis of the magnetic field (wobbling). What is this process called?

1 point

- ☒ Precession
- ☐ Gyroscope
- ☐ Spin
- ☐ Spin excess

3. The gyromagnetic ratio of ^{31}P is known as $108.291 \times 10^6 \text{ rad} \cdot \text{s}^{-1} \cdot \text{T}^{-1}$ or $17.235 \times 10^6 \text{ Hz} \cdot \text{T}^{-1}$. By what factor are the two units related?

1 point

- ☐ 4π
- ☐ π
- ☒ 2π
- ☐ 3π

4. When protons are placed in a steady magnetic field B_0 , in which axis does the net magnetization (\vec{M}) exist?

1 point

- ☐ There is no net magnetization.
- ☐ x-axis
- ☒ z-axis
- ☐ y-axis

5. What is the gyromagnetic ratio of ^1H in 1 T MRI?

1 point

- ☐ 58.42 MHz
- ☒ 42.58 MHz
- ☐ 127.74 MHz
- ☐ 48.25 MHz

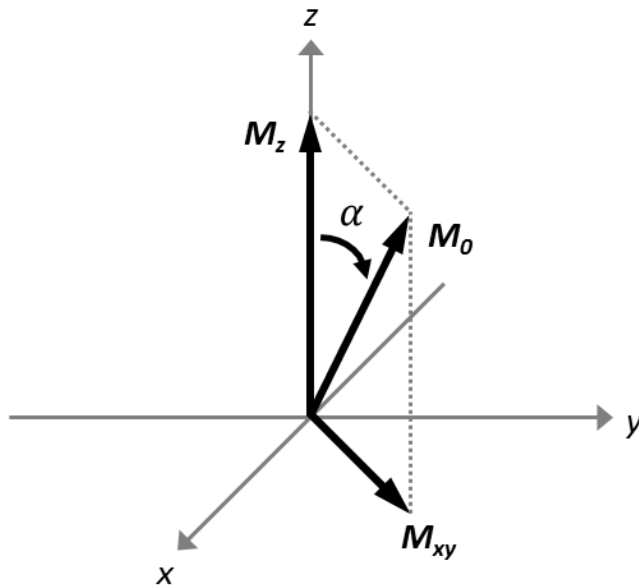
6. Clinical MRI scanners typically operate at magnetic field strength of 3T. What is the Larmor frequency of 1H at 3T? (Gyromagnetic Ratio of 1H is $267.513 \times 10^6 \text{ rad} \cdot \text{s}^{-1} \cdot \text{T}^{-1}$)

1 point

- ☐ $802.54 \times 10^6 \text{ Hz}$
- ☒ $127.74 \times 10^6 \text{ Hz}$
- ☐ $63.87 \times 10^6 \text{ Hz}$
- ☐ $401.27 \times 10^6 \text{ Hz}$

7. The following picture depicts magnetic resonance, the tipping of initial magnetization (M_0) vector with a flip angle (α). Which of the following is a correct expression for the resulting transverse magnetization (M_{xy})?

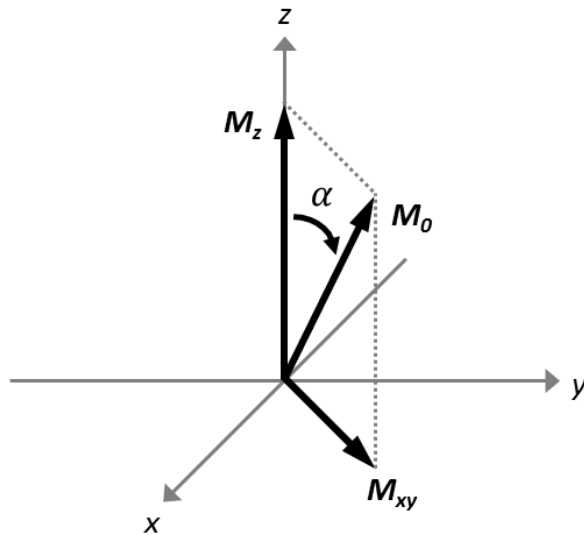
1 point



- ☐ $M_0 \cdot \tan \alpha$
- ☒ $M_0 \cdot \sin \alpha$
- ☐ $M_0 \cdot \cos \alpha$
- ☐ M_0

8. The following picture depicts magnetic resonance, the tipping of initial magnetization (M_0) vector with a flip angle (α). Which of the following is a correct expression for the resulting longitudinal magnetization (M_z)?

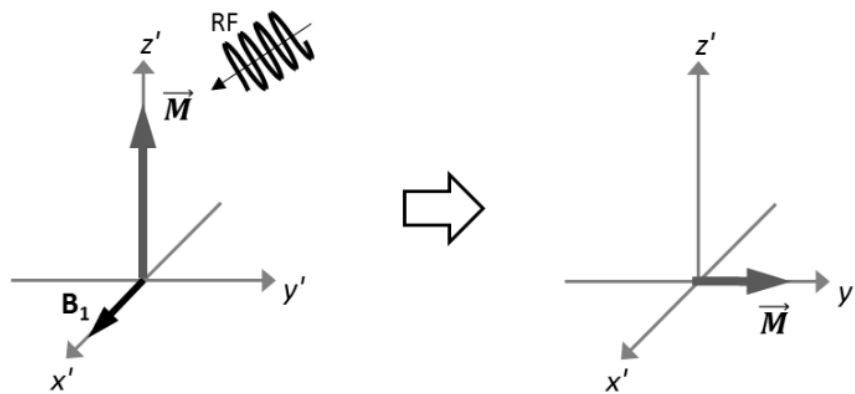
1 point



- ☐ M_0
☒ $M_0 \cdot \cos \alpha$
☐ $M_0 \cdot \sin \alpha$
☐ $M_0 \cdot \tan \alpha$

9. Which of the following statements is correct regarding magnetic resonance phenomenon (as shown in the picture)?

1 point



- ☐ In rotating reference frame, the net magnetization vector follows a spiral trajectory.
☒ The excess spins pick up energy and move from parallel to anti-parallel state.
☐ The protons start to precess out-of-phase, leading to disappearance of net magnetization.
☐ Only longitudinal magnetization can be detected and used for imaging.

10. Which of the following refer to the relaxation mechanism in the transverse direction?
(Choose all that apply)

1 point

- ☒ Spin-spin relaxation
- ☐ T_1 relaxation
- ☐ Spin-lattice relaxation
- ☒ T_2 relaxation

11. Which of the following refer to the relaxation mechanism in the longitudinal direction?
(Choose all that apply)

1 point

- ☒ T_1 relaxation
- ☒ Spin-lattice relaxation
- ☐ T_2 relaxation
- ☐ Spin-spin relaxation

12. The normal human brain at 3 T has tissue T_1 and T_2 times. Which of the following shows the correct tissue-longitudinal magnetization pair after 30° flip angle and 400 ms time delay if the initial magnetization $M_0 = 1$? (At 3 T, T_1 and T_2 values of **gray matter** are 1331ms and 80ms respectively. T_1 and T_2 values of **white matter** are 832ms and 110ms)

1 point

- ☐ Gray Matter, $M_z = 0.55$
- ☐ White Matter, $M_z = 0.74$
- ☐ White Matter, $M_z = 0.36$
- ☒ Gray Matter, $M_z = 0.90$

13. The normal human brain at 3 T has tissue T_1 and T_2 times. Which of the following shows the correct tissue-transverse magnetization pair after 60° flip angle and 50 ms time delay if the initial magnetization $M_0 = 1$? (At 3 T, T_1 and T_2 values of **gray matter** are 1331ms and 80ms respectively. T_1 and T_2 values of **white matter** are 832ms and 110ms)

1 point

- ☒ White Matter, $M_z = 0.55$
- ☐ Gray Matter, $M_z = 0.36$
- ☐ Gray Matter, $M_z = 0.67$
- ☐ White Matter, $M_z = 0.74$

14. Which statement is not true?

1 point

- ☐ The free induction decay (FID) signal is maximized when the net magnetization is excited with a 90° RF pulse.
- ☐ The receiver RF coil can detect signals from the transverse magnetization but not from the longitudinal magnetization.
- ☐ The net transverse magnetization does not rotate when represented in the rotating reference frame.
- ☒ The energy in the transmission RF coil should be applied parallel to B_0 .

15. Relaxation due to T_2 is a reversible process.

1 point

- ☒ X
- ☐ O