

ELT-64206 Magnetic Resonance and Ultrasound Imaging

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Use of non-programmable calculator accepted

1. Principle of ultrasound imaging. Answer shortly to these questions:
 - a) Which properties of the tissue produce the tissue contrast?
 - b) Which parameters of the crystal affect the length of the near field?
 - c) Which ultrasound imaging modes are used for studying the valves and blood flow in the heart?
2. Doppler ultrasound imaging.
 - a) In which direction the information is obtainable?
 - b) How are the colors and the greyscale coded in a Doppler image?
 - c) What is the effect of the position of the beam in the transducer to the measured velocity?
3.
 - a) What is the difference between Spin echo and Gradient echo imaging sequences?
 - b) What are the advantages and drawbacks of these methods?
4.
 - a) What is the basis of diffusion imaging?
 - b) What is fractional anisotropy (FA)?
 - c) What is expressed by tractography?
5. A patient with mild traumatic brain injury is to be examined with a 3T MRI scanner using Fast Spin Echo sequence (FSE).
 - a) What percentage of proton spins (in the brain) will align against the field at a body temperature of 36.5 °C?
 - b) If the interested brain tissues have a T₁ relaxation time of 900 ms, calculate how long will it last for the Z-magnetization M_z to recover 95% of its equilibrium value?

Boltzmann constant = $1.3806488 \times 10^{-23} \text{ m}^2 \text{ kg s}^{-2} \text{ K}^{-1}$ Planck's constant = $6.62606957 \times 10^{-34} \text{ m}^2 \text{ kg / s}$

Gyrometric ratio for proton = 42.57 MHz/T