

You may answer in English, Finnish or Swedish.

1. Please explain concisely the following terms and their meaning in the context of medical imaging technology (each term 1p, total 6p):

a) Compton scattering

b) Elastic scattering

c) Absorption

d) Gamma camera

e) Photomultiplier tube

f) RF coil

2. Contrast agents in medical imaging: explain the purpose, method of application, materials used, and benefits. (6p)

3. A modern 3 T MRI device can generate gradient fields with strengths of 40 mT/m. With these parameters, you intend to acquire an image slice with 256 x 256 in-plane pixel resolution with frequency and phase encodings. Let the field of view (FOV) be 25 cm x 25 cm. The detector is a copper coil that has been tuned to enhance the MR signal. What should the bandwidth (BW) of the receiver be to image the FOV? What happens if the BW is too small and why? The quadrature-detected signals are demodulated so that the receiver sees only the frequency range that is relevant for image generation. The gyromagnetic ratio $\gamma = 42.58 \text{ MHz/T}$. (6p)

4. Explain how electrical brain activity can be measured and interfered with non-invasively. (6p)

5. Physical properties relevant to ultrasound imaging:

Attenuation:

Bone: $\mu_{\text{dB}} = 45 \text{ (dB/cm)}$

Air: $\mu_{\text{dB}} = 220 \text{ (dB/cm)}$

Muscle: $\mu_{\text{dB}} = 5 \text{ (dB/cm)}$

(turn page)