Punkteverteilung:

1	2	3	4	5	6	Σ

Aufgabe (1)

In X-Ray CT Filtered Backprojection is used to reconstruct the image. To do that, the images taken from each angle get projected into a virtual copy of the space in the angle it was taken. As no depth information is available, the projections go through the complete virtual copy of the space. The points in which most of the projections overlap are the places where the object actually is, the remaining noise gets filtered out.

With MRI, the resonance of atoms is exploited by sending RF energy through the tissue. The rays encode different information which can be measured and then reconstructed using Fourier transformations.

The MRI is supposedly faster, because it has to run only once for the data, unlike the backprojection, which has to run for every angle again.

Aufgabe (2)

We know the thickness of the tissue (2cm). Assuming that the tissue is muscle we can determine from a table that the attenuation coefficient μ is 0.25 when put through a 50 keV CT.

$$\frac{I}{I_0} = e^{-\mu x} = e^{-0.25 \cdot 2} \approx 0.6 \tag{1}$$

Aufgabe (3)

We assume that the tissue was a mouses upper torso, so we can take the values for μ_a and μ_s from the In-Vivo book, Chapter 5.1, Table 5.1.3 as $\mu_a = 0.25\ cm^{-1}$ and $\mu_s = 20\ cm^{-1}$.

So using the formula from Beer-Lamberts law, we can calculate the scattering:

$$\frac{I_s}{I_0} = e^{-\mu_s x} = e^{-20 \cdot 2} \approx 4.25 \cdot 10^{-18} \tag{2}$$

$$\frac{I_a}{I_0} = e^{-\mu_a x} = e^{-0.25 \cdot 2} \approx 0.37 \tag{3}$$

Now we would have to subtract I_s from I_a but as I_a is very small, it would not make a difference.

With a laser (we assume a HeNe laser with a light beam of $632nm$) the μ_a would sink, according to Figure 5.1.14, as well as the μ_s, because lasers tend to have a lower spread than normal light.

Aufgabe (4)

The result of X-Ray is higher because it gets absorbed less than light at 750 nm by the tissue.

Aufgabe (5)

Conventional microscopy relies on the reflection of light from the surface of tissues and a system of lenses to magnify.

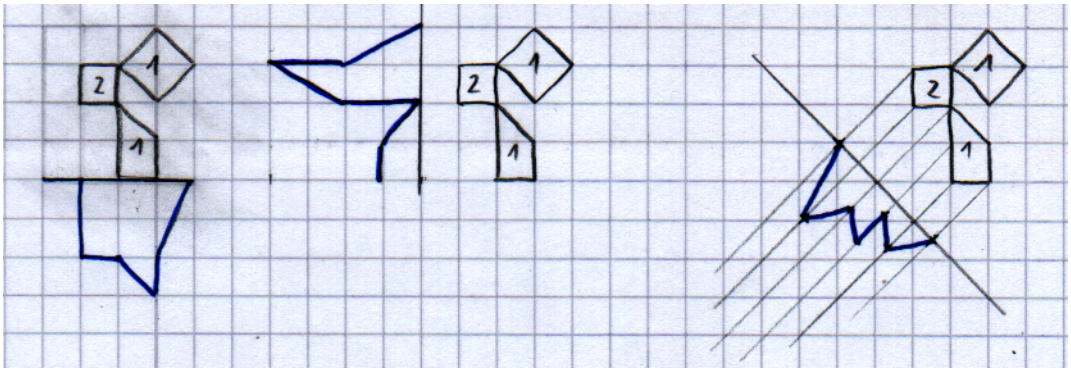
Confocal microscopy uses an additional pinhole so that light that is not reflected from the focal point gets blocked and does not light up the image gathering process, thus giving better quality pictures.

Two-photon microscopy works by sending two photons separately that together have enough energy for the molecule to be hit to send out light. Other molecules on the way only get hit my one photon at a time, so they stay dark.

Two-photon microscopy can image deeper, because it uses wavelengths between 700 and 1200 nm, which allows up to fivefold deeper tissue penetration than confocal microscopy.

Aufgabe (6)

Graphing the attenuation intensity for each angle:



(0, 90 and 45 degrees respectively)

To construct the image, one would create images with darker and lighter lines, depending on the intensity at that point and then overlay the graphics to form an image. Note that 3 measurements does not lead to an accurate image, realistically there would be a lot more measurements to form an overlay that resembles reality more.