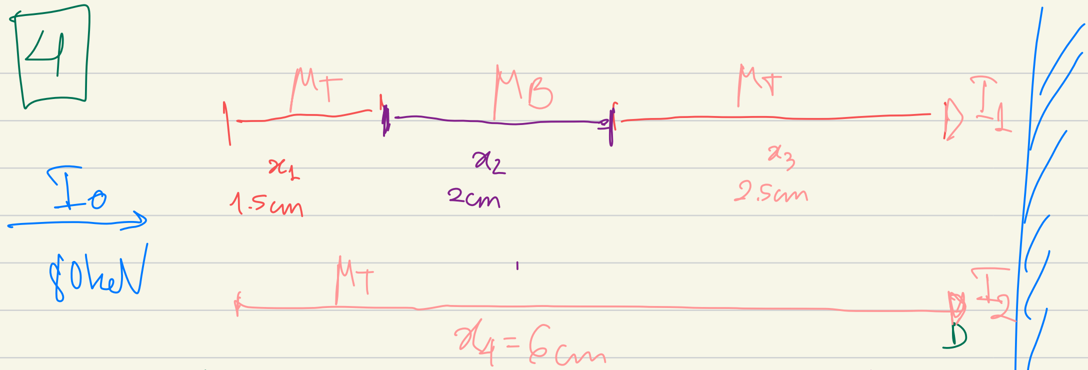
$\boxed{4}$



Attenuation coefficients

	ρ (g/cm³)	30keV μ/ρ (cm²/g)	μ (cm⁻¹)	80keV μ/ρ (cm²/g)	μ (cm⁻¹)
Tissue	1.060	0.3790	0.4018	0.1823	0.1933
Bone	1.920	1.331	2.5555	0.2229	0.4279

a)

At 80keV

$$I_1 = I_0 . \exp\left[-\int_0^x dx\, \mu(x)\right]$$

$$= I_0 . \exp\left[-\left(\mu_T . x_1 + \mu_B x_2 + \mu_T . x_3\right)\right]$$

$$= 0.196\, I_0$$

$$I_2 = I_0 . \exp\left[-\mu_T x_4\right]$$

$$= 0.313\, I_0$$

The bone added an extra $\frac{I_2 - I_1}{I_2} \times 100 = \frac{(0.313 - 0.196) I}{0.313\, I_0} \times 100\% = 37\%$ attenuation compared to having the tissue only.

b) At 30 keV

$I_1 \simeq 1.2 \times 10^{-3} I_0$

$I_2 = 89.7 \times 10^{-3} I_0$

$\boxed{1}$ For Copper (Cu):

$E_K \simeq 8.98$ keV

$E_L \simeq 0.95$ keV

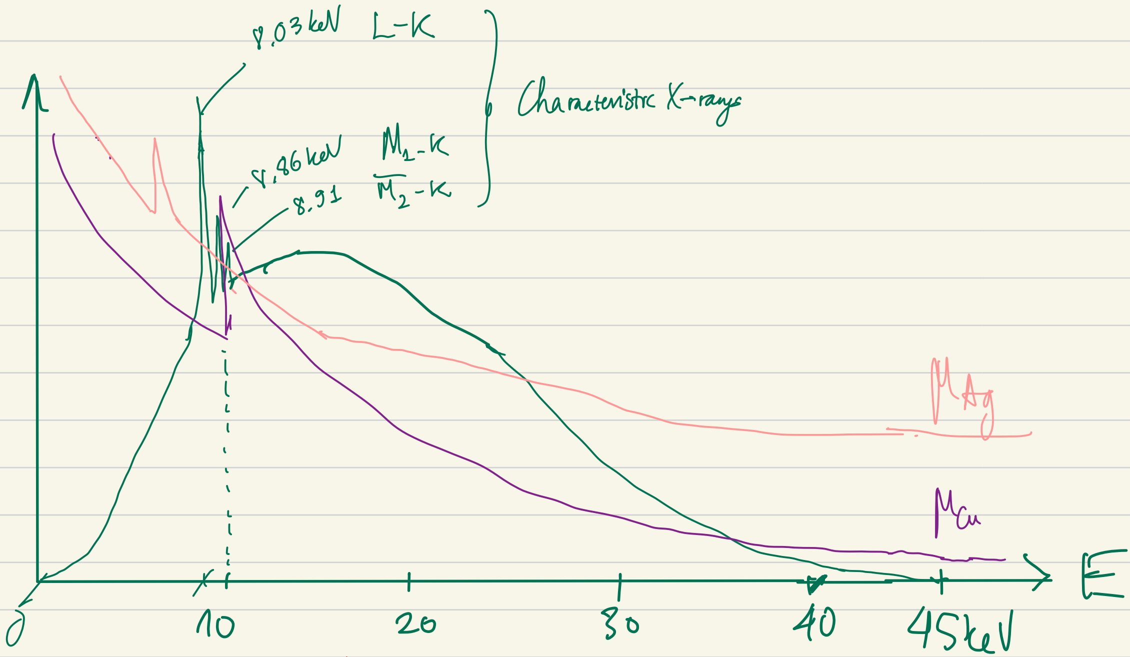
$E_{M_1} \simeq 0.12$ keV

$E_{M_2} = 0.07$ keV

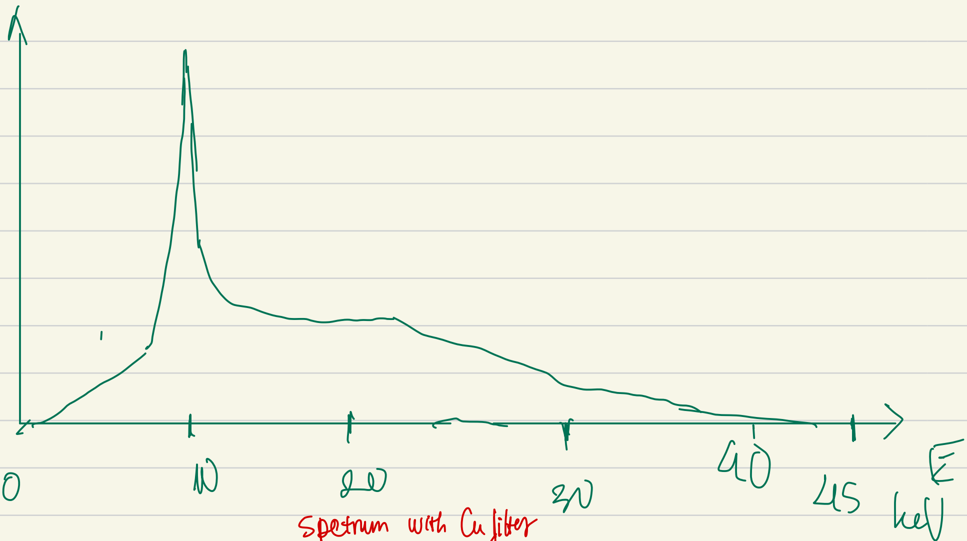
$E_{L-K} = 8.03$ keV

$E_{M_1-K} = 8.86$ keV

$E_{M_2-K} = 8.91$ keV



Unfiltered spectrum



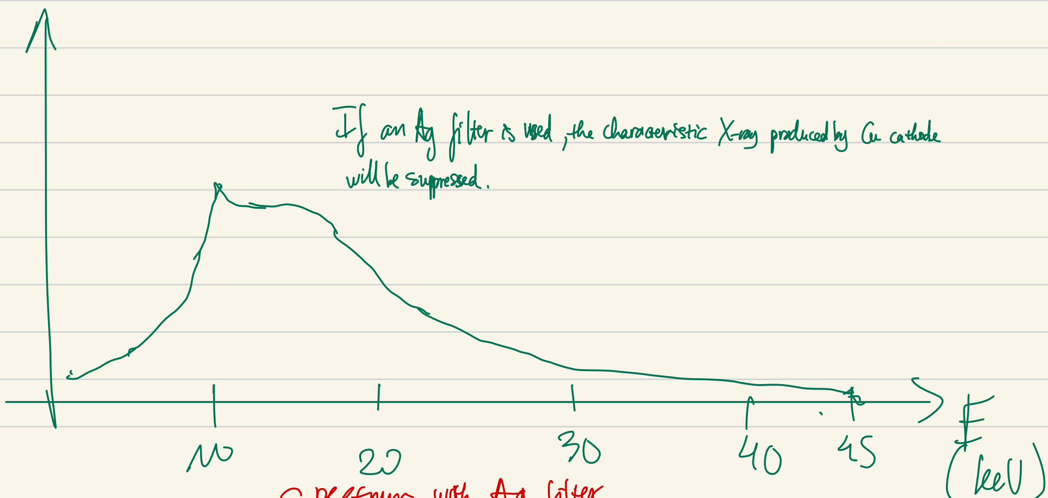
Spectrum with Cu filter

We obtain the unfiltered spectrum due to the combination of Bremsstrahlung effect & characteristic X-rays (caused by the L-K & M-K shell electron transitions).

With the Cu filter we have the attenuation coefficient μ_{Cu} as above, where we have a low-attenuation window right before the K-edge energy.

Thus, we obtain a filtered spectrum that mainly concentrates at Cu L-K energy, and the majority of low & high energy X-rays are eliminated.

If an Ag filter is used, the characteristic X-ray produced by Cu cathode will be suppressed.



Spectrum with Ag filter