Help to exercise 3

The last question of exercise 3 asks you to calculate how much there was of the irradiated metal. Per will lecture on this on Wednesday, I believe, so this problem might have been a little more challenging than I intended...

Therefore, here is a little help on this subject:

Yield in neutron irradiation and nuclear reactions

Chapter 8 in the textbook deals with nuclear reactions and you'll find what you need in sub-chapter 8.5: "Yield of Nuclear Reactions". Equation 8.27 is what you want:

$$A = \lambda N_B = \sigma \varphi N_A \left(1 - e^{-\lambda t}\right)$$

where

- A is the activity of the produced nucleus B (which you calculate from your efficiency curve),
- λ is the half life of the product nucleus B,
- N_A is the number of atoms of the target nucleus (in the case of exercise 3 this is the amount of the unknown metal),
- σ is the cross section (the likelihood of a reaction between the neutrons and the target nucleus A), and finally
- φ is the neutron flux (the number of neutrons hitting the target).

What this equation tells you is that if you irradiate N_A atoms of A (usually referred to as your "target") with neutrons of intensity φ for a time t, the disintegration rate of your product will be A (do not mix the target nucleus A with the *activity, A,* of the product nucleus B!).

You'll find σ in the nuclear chart (it's around 20 for the unknown metal). It's unit is barn, which is equal to 10^{-24} cm^2. The neutron flux is given in the exercise text and is equal to $10^5 \; {}^{n}\!/_{s\,cm^2}$. When you multiply these two numbers you are left with s^{-1}, which is the correct unit for the disintegration rate.

PS! Have you read the messages on the web-page lately? The deadline for exercise 3 has been postponed to Friday...

Good luck!