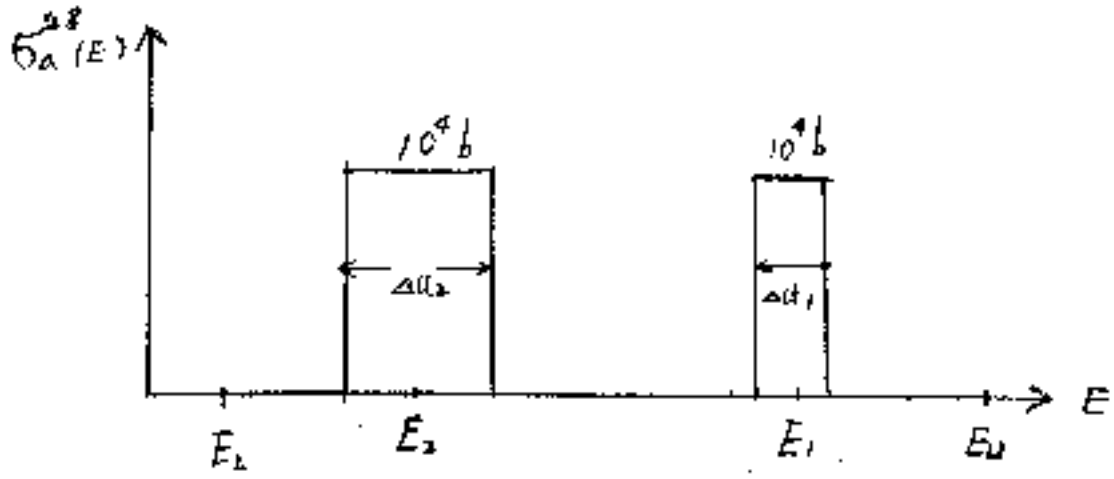
八十四學年度核工科學工程物理 所 組碩士班研究生入學考試

科目 反應器分析 科號 3305 共 2 頁第 1 頁 *請在試卷【答案卷】內作答

1. Consider a mixture of ^{238}U and hydrogen. In the energy range E_L to E_U, the microscopic absorption cross section of ^{238}U can be represented by two square resonances as shown in the figure. Suppose that within the resonances $\sigma_a = 10^4$b and $\sigma_{s,res} = 0$. The resonances occure at E_1=200eV and E_2= 100eV. The lethargy widths of the resonances are $\Delta u_1 = \frac{1}{200}$ and $\Delta u_2 = \frac{1}{100}$. Outside the resonances $\sigma_a = \sigma_{s,res} = 0$. The potential scattering cross sections for hydrogen and ^{238}U are 10 b. Calculate the resonance integrals and the resonance escape probabilities for (a) N_H/N_U=1.0 and (b) N_H/N_U=100. Comment your results.
(20%)



2. At high energies, the differential elastic scattering cross section of hydrogen in the center-of-mass system exhibits anisotropy of the form

$$\sigma_{CM}(\hat{\Omega}'\cdot\hat{\Omega}) = \sigma_{CM}(\theta_c) = \frac{\sigma_s}{4\pi}(1 + \cos\theta_c)$$

Find and plot the scattering probability $P(E_i \rightarrow E_f)$ against final energies E_f.
(15%)

3. (a)Write down the steady state,energy-dependent neutron transport equation in plane geometry assuming the scattering is linearly anisotropic.
(b)Write down the steady state, energy-dependent neutron diffusion equation in plane geometry.
(c)What is the relation between this two equations? What approximations are made in deriving (b) from (a)?
(d)Comment the validity of the diffusion theory.
(25%)

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4. Using two-group diffusion theory, show how you would solve for the critical size of an infinite-long square reactor containing fission source.
(20%)

5. Consider an isolated fuel rod in infinite moderator. By defining the first-flight escape probabilities for the fuel and moderator region, write down the neutron balance equation in the fuel region in the slowing down energy range. Describe how you would solve for the neutron spectrum in the fuel region.
(20%)