

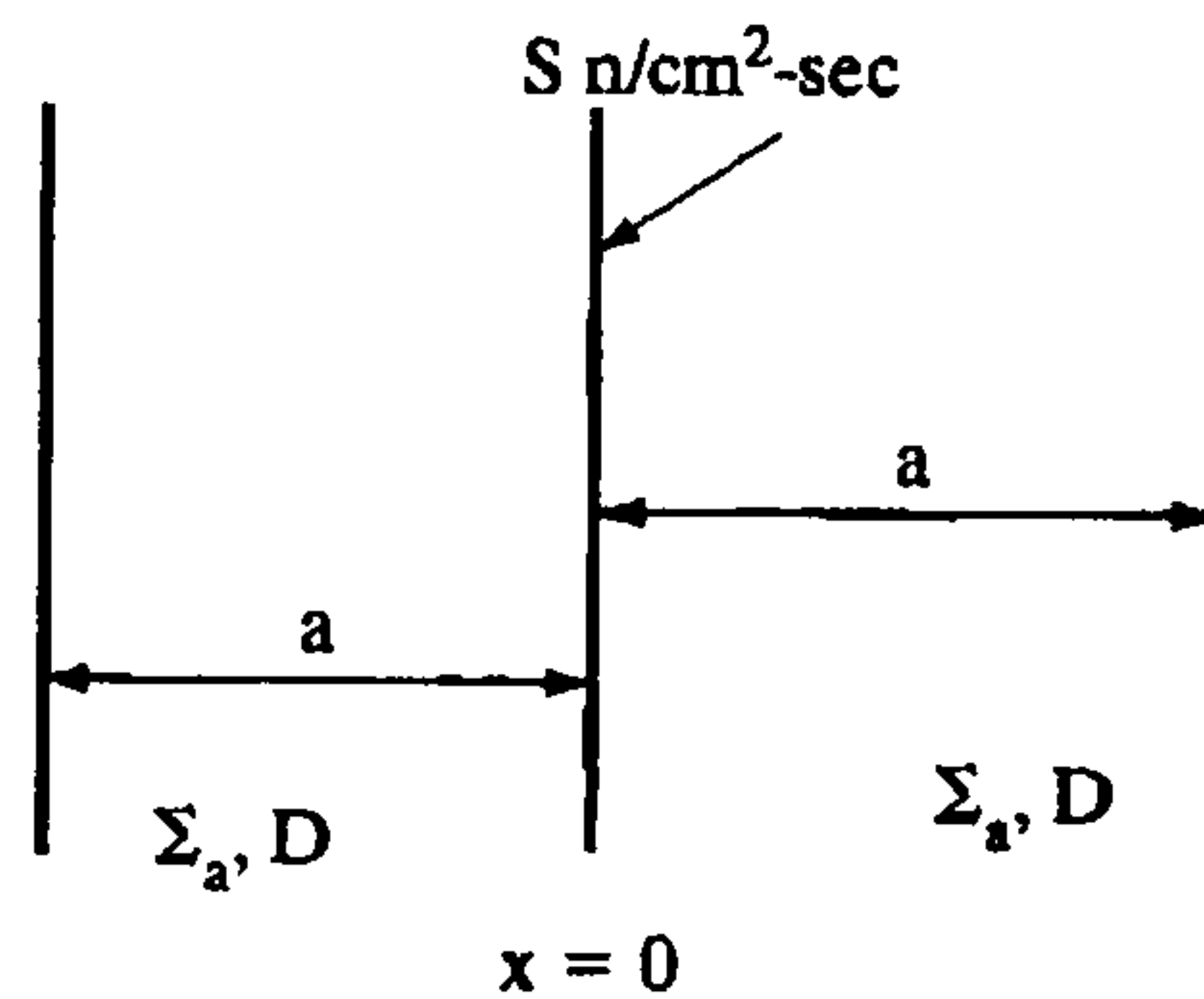
國立清華大學 105 學年度碩士班考試入學試題

系所班組別：核子工程與科學研究所(0526)

考試科目（代碼）：核工原理(2602)

共 1 頁，第 1 頁 *請在【答案卷】作答

- Briefly explain the following terms: (20%, each 5%)
 - Necessary conditions for the neutron diffusion theory to hold
 - Fuel conversion and breeding
 - Reflector saving
 - Neutron resonance escape probability
- Consider an infinite slab of thickness $2a$ that has an infinite planar source at its center emitting S neutrons per cm^2 per second, (a) based on the diffusion theory, derive an expression for the flux as a function of distance from the source plane; (b) what is the probability that a source neutron will leak from the slab? (20%)



- The total cross-section per atom for photon interaction is the sum of the cross sections for the photoelectric effect, Compton scattering, and pair production. Demonstrate that, at photon energies where Compton scattering is the dominant process, values of the mass attenuation coefficients (μ/ρ) tend to be roughly the same for all elements. (20%)
- Co-59 is activated when it absorbs a thermal neutron ($\sigma_\gamma=37.2$ barns) and becomes Co-60 ($T_{1/2}=5.27$ y). Assume that a cylindrical sample of Co-59 is exposed to a neutron flux of 10^9 neutrons/ $\text{cm}^2\cdot\text{s}$. In one year of steady state irradiation, what is the number of atoms activated in the sample and the approximate activity? Selected properties of the sample: radius 0.5 cm, length 1.0 cm, density 8.8 g/cm^3 , atomic weight 58.93. (20%)
- Using one-group diffusion theory to estimate the critical radius for a bare sphere consisting of homogeneous mixture of Fe-55 and Pu-239. Selected properties of the fast reactor are as follows. (20%)

Isotope	N (atoms/b.cm)	σ_a (barn)	σ_f (barn)	ν	σ_{tr} (barn)
Pu-239	0.0493	2.11	1.85	3.0	6.8
Fe-55	0.0848	0.006	-	-	2.7