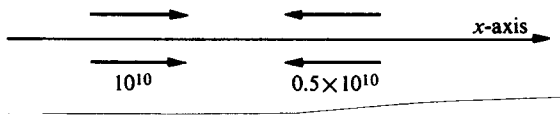
4D3
QUIZ

CLOSED BOOK 15 minutes 88-10-05

1. **At one point in a block of graphite** the remarkable situation is found that the **neutrons are traveling in only the positive and** negative x-directions (see Fig.), and all have the energy 0.025 eV. There are 10^{10} neutrons/sec crossing unit area normal to the x-axis in the positive direction and 0.5×10^{10} neutrons/sec crossing unit area in the negative direction. Compute the neutron flux and current at this point.



(40%)

2. Derive an expression for the decay of a radioactive nuclide as a function of time.

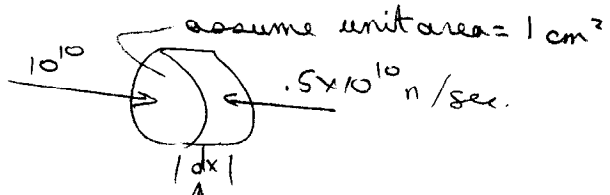
(30%)

3. Write down the one speed neutron diffusion equation in transient form and explain each term briefly.

(30%)

QUIZ SOLUTION SHEET

8810-05



dx = length swept by neutrons in 1 second $= 2.2\times10^5$ cm.

1. $\phi = \int_V n v \, dV \Big/ \int_V dV$

$= \dfrac{1.5\times10^{10} \times 2.2\times10^5}{2.2\times10^5}$

$= 1.5\times10^{10}$ $\dfrac{\text{neutrons}}{\text{cm}^2\text{-sec}}$

$$J = \int_S n \underline{v} \cdot d\underline{S} = (1.0\times10^{10} - .5\times10^{10}) \cdot 1\,\text{cm}^2$$

$$= 0.5\times10^{10}\ \hat{x}\ \frac{\text{neutrons}}{\text{cm}^2\text{-sec}}$$

(+ve x direction)

2. $\dfrac{dN}{dt} = \lambda N \Rightarrow N = N(0)\, e^{-\lambda t}$

3. $\dfrac{1}{v}\dfrac{\partial \phi}{\partial t} = \nabla \cdot D \nabla \phi + \nu \Sigma_f \phi - \Sigma_a \phi$

$\dfrac{\partial n}{\partial t}$ = rate of change of neutron density

$\nabla \cdot D \nabla \phi$: diffusion as per Fick's Law

$\nu \Sigma_f \phi$: fission source term

$\Sigma_a \phi$: absorption

or $= S(\underline{r}, t)$ in general