Quiz-3 on Radiation Dosimetry – Internal Exposure (April 30, 2001)

3-1: Following the instantaneous intake of 1 MBq of I-131 through inhalation,

a. Find the effective half-life of I-131 in the thyroid.
b. Find the time-dependent activity (Mbq) of I-131 in the thyroid.
c. Find the committed dose equivalent (Sv) to the thyroid.

Data: thyroid weight = 20 grams
effective radius of the thyroid = 3 cm
biological half-life of iodine in the thyroid = 138 days
radiological half-life = 8.05 days
fraction of iodine reaching the thyroid after inhalation = 0.2
iodine radiation energies (in MeV/t)

f_R	$\bar{E}^R_\beta$	f_R	E^R_γ	$AF(T \leftarrow T)_R$
0.016	0.0701	0.026	0.080	0.111
0.069	0.0955	0.054	0.284	0.120
0.005	0.1428	0.82	0.364	0.122
0.904	0.1917	0.068	0.637	0.124
0.006	0.285	0.016	0.723	0.120

3-2: A child drinks 1 liter of milk per day. The milk is contaminated by 900 pCi of I-131 isotope on average per liter.

a. what is the time-dependent activity (mCi) of I-131 in the thyroid of the child if he drinks the milk for 30 days, when fraction of iodine reaching the thyroid after ingestion is 0.3?
b. what is the time-dependent dose-equivalent rate (mrem/hr) of the thyroid?
c. what is the committed dose equivalent (mSv) to the thyroid?
d. what is the risk of inducing the fatal cancer to thyroid due to this intake if the radiation risk factor is 0.25×10^{-2} per Sv?

3-3: Explain the major thermal neutron interactions with the soft tissue in the human body.