

**MID-EXAM (5/3/00, 14:00-16:00) Closed Book**

**Problem 1 (30 points):** Briefly explain the following terms:

- a. health physics
- d. becquerel
- g. LET
- j. Compton effects
- m. roentgen
- b. radioactivity
- e. sievert
- h. bremsstrahlung
- k. radiation weighting factor
- n. dose commitment
- c. transformation constant
- f. secular equilibrium
- i. rad
- l. total effective dose equivalent
- o. SEE (specific effective energy)

**Problem 2 (10 points):** Explain the nature of cosmic radiation in the environment.

**Problem 3 (10 points):** What is the mass (gram) of 1 MCi of Na-24 ( $T_{1/2} = 14.8$  h)?

**Problem 4 (10 points):** 1 mg of pure U-235 foil was put in the reactor and irradiated at a uniform rate with thermal neutron flux of  $5 \times 10^{13}$  n/sec.cm<sup>2</sup> for 25 days. After it was taken out of the reactor, it was cooled for 12.5 days. Find the activity of Ba-140, which was a fission product of U-235. The fission yield of Ba-140 is 3.1%. The half-life of Ba-140 is 12.5 days. Assume that the average fission X-section of U-235 in the reactor is 400 barns.

**Problem 5 (10 points):** Calculate the exposure rate (r/hr) at 3 meters away from an infinite line source of Cs-137 having source strength of 1 mCi/cm.

- Data: Cs-137:  $T_{1/2} = 30.0$  year  
 $E = 0.661$  Mev (95%)  
 $(\mu_a)_{air} = 0.0035$  m<sup>-1</sup> (  $\approx 293$  kg/m<sup>3</sup> )  
 $1 R = 5.48 \times 10^{10}$  MeV/kg(air)

**Problem 6 (20 points):** Find the committed dose equivalent to the thyroid if 1 MBq of I-131 is uniformly distributed in a thyroid.

- Data: thyroid weight = 18 grams  
 effective radius of the thyroid = 2.5 cm  
 biological half-life of iodine in the thyroid = 138 days  
 radiological half-life = 8.05 days

iodine beta radiation energies (in MeV)

$f_R$	$\bar{E}_\beta$
0.016	0.0701
0.069	0.0855
0.005	0.1428
0.904	0.1917
0.006	0.285

**Problem 7 (10 points):** Explain the thermal neutron interactions with the soft tissue in the human body.