

## For General Medicine

### Topic of section: Ionizing radiations

### Topics of seminar: Radioactivity

#### Answer the questions:

1. Specify the atomic nucleus characteristics.
2. Describe the basic properties of the nuclear forces.
3. Describe modes of radioactive decay.
4. Explain why some radionuclides decay is accompanied by emitting of  $\gamma$ -radiation.
5. Give  $\beta$ -particles kinetic energy spectrum and explain its characteristics.
6. Derive Radioactive Decay Law. Explain the meaning of decay constant, half-life and mean lifetime. Describe the relation between them.
7. What is the activity of a radioactive substance? Give the relationship between different activity units.
8. How does activity depend on the time and the radionuclide mass?
9. Describe the features for interaction of  $\alpha$ - and  $\beta$ -particles and  $\gamma$ -radiation with the matter.
10. Explain the principles of radionuclide diagnostics methods.
11. Describe the physical basics of the radiation therapy.

#### Solve problems:

1. The activity of a radioactive substance has decreased from 16 to 2 mCi during 24 hours. Evaluate the half-life time of radionuclide.

*Answer:*  $\ln 8/24 = 2.08/24 = 0.09 \text{ h}^{-1}$

2. Complete a reaction of nuclear decay:  ${}_{94}^{239}\text{Pu} \rightarrow \mathbf{X} + \dots$

3. Estimate the number of  $\alpha$ -particles emitted from 1 gram  ${}^{226}_{88}\text{Ra}$  during 1 second.

*Answer:*  $3.7 \cdot 10^7$

4.  $\frac{3}{4}$  of the initial amount of the radionuclides were disintegrated for 1 day.

Determine the decay constant.

*Answer:  $1.39 \text{ day}^{-1}$*

5. What is the activity of 1 gram  $^{137}\text{Cs}$ , if its half-life time is equal to  $10^9$  s?

*Answer:  $1 \text{ Ci} = 3.7 \cdot 10^{10} \text{ Bq}$*

6. Activity of radioactive substance with mass of 2 kg is equal to 740 Bq.

Evaluate the specific mass activity of this substance.

*Answer:  $370 \text{ Bq/kg}$*

## **Literature**

1. Medical and biological physics for medical students, p. 229-241.