BASIC RADIOLOGICAL PHYSICS COURSE

CLASS GROUP: _____
(Radiation Therapy, Radiation Oncology Resident, Post Doctoral..)

YEAR: _____
(2004, 2005 …)

Objective:

After completing this Study Guide #12, the students should be able to understand (a) the concepts of radioactive decay, (b) half-lives of radionuclides, (c) units of radioactivity, and (d) cumulative activity. Cumulative activity is an important parameter relating treatment to biological response.

Study Guide #12:	Radioactivity (Part 1 of 2)
Read Sections:	Foundation of Radiological Physics (CBSaw) **Sections 8.1 to 8.4**
Suggested Reference:	Faiz Khan's text – Section 2-1 to 2-6
Assignments:	Answer all questions as directed in this handout
Clinical Rotation Assignment:	

Study Guide

8.1 In your own words, define the following terms:

(a) nuclear transformation	(b) decay chain
(c) radioisotope	(d) decay constant
(e) decay factor	(f) half-life
(g) average or mean life	(h) effective half-life
(i) radioactivity	(j) specific activity
(k) becquerel	(l) curie

8.2 Explain why gamma rays are not deflected as they pass through a magnetic field.

8.3 How is the activity related to the number of nuclei in a sample?

8.4 List the mass and charge of an alpha particle, a beta particle, and gamma rays. Express them in units of mass and unit charge.

8.5 Under what conditions will the effective half-life is approximately equal to (a) the physical half-life and (b) the biological half-life?

8.6 Relate the units, Ci and Bq to dps.

Problems

8.1 The half-life of iodine-131 is 8.02 days. What is the decay constant expressed in d^{-1}?

8.2 What is the (a) decay factor and (b) activity after 3 days if the original activity of the iodine-131 sample is 12 mCi?

8.3 The activity of cesium-137 is adjusted every 6 months. What is the percent decay every 6 months?

8.4 Assume that a 10 mCi vial of gallium-67 (τ = 78.3 hr) arrives at the nuclear medicine department at 12 noon, June 1, 2004. What would be the activity at the time of administration a week later, at 12 noon?

8.5 Iodine-125 sources with a half-life of 59.5 days, are routinely used in permanent implants. What is the fraction of activity remaining after 5 half-lives? Approximately how long are 5 half-lives?

8.6 Given that the physical half-life is 9 hr, compute the effective half-life if the physical half-life is three times the biological half-life of an administered radionuclide.

8.7 Compute the mass of radium-226 (τ = 1600 yr) that would produce 0.5 mCi of radioactivity.

Multiple Choice Questions
Select the one correct answer.

8.1 Compute the mean life of gold-198 if its half-life is 2.7 days.
a) 3.9 d
b) 1.9 d
c) 2.7 d
d) 5.4 d
e) 7.8 d

8.2 Which of the following statements is true?
a) Lead-206 decays via alpha particle emission.
b) Half-life of radium-226 is 30 years.
c) Half-life of gold-198 is longer than phosphorus-32.
d) Cobalt-60 decays to cobalt-59.
e) Average life is longer than half-life.

8.3 The fraction of activity from a radioactive source after 10 half-lives is
a) 1/10.
b) $(1/10)^2$.
c) (9/10).
d) $(1/2)^{10}$.
e) $(1/2)^{-10}$.

8.4 Which statement is NOT true of the effective half-life?

a) The effective half-life is shorter than the biological half-life if $\tau_{phy} > \tau_{biol}$.
b) The effective half-life is equal to one-half biological half-life if $\tau_{phy} = \tau_{biol}$.
c) The effective half-life is longer than the biological half life if $\tau_{phy} < \tau_{biol}$.
d) The effective half-life is always larger than the smallest of either τ_{phy} or τ_{biol}.
e) none of the above.

8.5 The decay constant is

a) inversely proportional to the half-life.
b) the fractional decay in a given time.
c) equal to the reciprocal of the average life.
d) all of the above.
e) none of the above.

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