

## BASIC RADIOLOGICAL PHYSICS COURSE

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

YEAR: \_\_\_\_\_  
(2004, 2005 ...)

### Objective:

After completing this Study Guide #11, the students should be able to (a) define and use atomic mass units, (b) understand the behavior of binding energy of nucleus, and (c) nuclear model.

**Study Guide #11:** Nuclear Structure (Part 2 or 2)

Read Sections: Foundation of Radiological Physics (CBSaw)  
**Sections 7.5 to 7.8**

Suggested Reference: Faiz Khan's text – Section 1-2, 1-3, 1-6, and 1-7

Assignments: Answer all questions as directed in this handout

Clinical Rotation  
Assignment:

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### Study Guide

- 7.1 In your own words, define the following terms:  
(i) gram atomic weight (j) magic numbers
- 7.11 Define amu or u. What is the energy equivalence of 1 u expressed in MeV?
- 7.12 Describe the mass defect and the nuclear binding energy for a nuclide.
- 7.13 What are the K-shell binding energies of a hydrogen atom and a tungsten atom? How do these binding energies compare to the binding energy of a nucleon?
- 7.14 What do the irregularities or spikes on the average binding energy per nucleon versus mass number represent?
- 7.15 Identify the components in the nuclear binding energy formula for the liquid drop model and what do each term represents?
- 7.16 Explain nuclear stability based on the shell model and the pairing preference.

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**Problems**

- 7.1 From its mass (in kg), show that the energy equivalence of an electron is 0.511 MeV.
- 7.2 What is the energy equivalence of (a) a proton and (b) a neutron?
- 7.3 Calculate the mass difference between a hydrogen atom and the sum of an electron and a proton.

- 7.4 Calculate the mass defect and the average binding energy per nucleon of helium.

**Table 7.5** Isotopes with A = 133

Isobar	Z	Atomic Mass (u)
I-133	53	132.907460
Xe-133	54	132.905550
Cs-133	55	132.905090
Ba-133	56	132.905610

- 7.5 Calculate the average binding energy per nucleon for the isobars in Table 7.5. Is it possible for Xe-133 to decay to I-133?

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**Multiple Choice Questions**

Select the one correct answer.

- 7.9 What is the average binding energy per nucleon of  $^{11}\text{B}$ ?
- a) 0.7621 MeV
  - b) 7.621 MeV
  - c) 76.21 MeV
  - d) 762.1 MeV
  - e) 7621 MeV
- 7.10 Which nuclear model is used to describe the excited states of nuclei?
- a) liquid drop model
  - b) shell model
  - c) collective model
  - d) atomic model
  - e) none of the above

CBS: 3/97

Revised: 6/14/04