BASIC RADIOLOGICAL PHYSICS COURSE

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

YEAR: _____
(2004, 2005 …)

Objective:

Study Guide #9 is a continuation on the atomic structure topic. After completing this study guide, the students should understand (a) how electrons are being arranged in atoms, (b) the properties of periodic table, (c) how x-rays and Auger electrons are emitted from atoms. In addition, there are sections discussing on molecules and lasers.

Study Guide #9:	Atomic Structure (Part 2 of 2)
Read Sections:	Foundation of Radiological Physics (CBSaw) **Sections 6.7 to 6.12**
Suggested Reference:	Faiz Khan's text – Chapter 1
Assignments:	Answer all questions as directed in this handout
Clinical Rotation Assignment:	Can you explain why inert gases are radioactive?

Study Guide

6.1 Define in your own words the following terms:

(k) atomic fine structure
(l) inert gas
(m) halogens
(n) ionization potential
(o) binding energy
(p) excitation
(q) de-excitation
(r) characteristic radiation
(s) Auger electrons

6.12 State the Pauli's exclusion principle and its relationship to the organization of the electrons in the shell structure.

6.13 Discuss the arrangement of elements in the periodic table based on orbital shells.

6.14 Explain why the noble gases are chemically inactive.

6.15 What is the binding energy of a K-shell electron in a (a) hydrogen atom, (b) tungsten atom, and (c) lead atom?

6.16 Why is the binding energy larger for a high Z atom compared to the hydrogen atom?

6.17 Define and differentiate between anions and cations.

Problems

6.5 How many electrons can fill the n=3 shell? Of these electrons, how many are used to fill the ℓ=0, ℓ=1, and ℓ=2 sub-shells?

6.6 Write the electronic configuration for phosphorus-32, which has 15 electrons using the appropriate s, p, d, and f notations.

6.7 An unusual atom has three energy states: K-shell = –69 keV; L-shell = –12 keV; and M-shell= –3 keV. Identify the entire possible characteristic x-rays emitted during de-excitation. Can a photon with 72 keV come from this atom?

6.8 An Auger electron is ejected when an electron makes the transition from the n=3 shell to n=2 shell of an atom. Can this Auger electron come from the n=1 shell?

6.9 Assume that an electron drops from the n=5 shell to the n=1 shell of a hydrogen atom. What is the kinetic energy of an Auger electron (if available) ejected from the n=10 shell due to the excess energy?

Multiple Choice Questions
Choose one correct answer.

6.6 A line spectrum series resulting from the transitions to the final state of n=1 in a hydrogen atom is called
a) Lyman series.
b) Balmer series.
c) Paschen series.
d) Brackett series.
e) none of the above.

6.7 Noble gases are chemically inactive because
a) they have an extra electron in their outer shell.
b) they have two extra electrons in their outer shell.
c) they have completely filled shells and sub-shells.
d) they have partially filled shells.
e) none of the above.

6.8 The amount of energy required to remove a valence electron is called
a) ionization potential.
b) binding energy.
c) excitation energy.
d) de-excitation energy.
e) transitional energy.

6.9 A sample has two types of atoms with the following binding energies:

Atom A: K= –30 eV; L= –5 eV; M= –0.5 eV

Atom B: K= –35 eV; L= –5 eV; M= –1.5 eV

Two characteristic x-rays with energies of 33.5 eV and 3.7 eV from the sample were detected using an energy detector: Which of the following relationship is true?

a) both x-rays belong to atom A
b) both x-rays belong to atom B
c) both x-rays are not from atoms A or B
d) one of the x-rays is from atom A
e) one of the x-rays is from atom B

6.10 Calculate the wavelength of the emitted photon during the transition from the n=3 to n=1 energy-state in a hydrogen atom.

a) 1.023×10^{-7} m
b) 1.023×10^{-8} m
c) 1.023×10^{-9} m
d) 1.023×10^{-10} m
e) none of the above

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