BASIC RADIOLOGICAL PHYSICS COURSE

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

YEAR: _____
(2004, 2005 …)

Objective:

After completing this Study Guide #8, the students should be able to (a) understand the early development of atom, (b) explain the concept of atom, and (c) Bohr's hydrogen atom. Lastly, the students are expected to understand and explain the current concept of atom and the atomic structure based on quantum mechanics.

Study Guide #8:	Atomic Structure (Part 1 of 2)
Read Sections:	Foundation of Radiological Physics (CBSaw) **Sections 6.1 to 6.6**
Suggested Reference:	Faiz Khan's text – 1-1, 1-4, 1-5
Assignments:	Answer all questions as directed in this handout
Clinical Rotation Assignment:	1. Do you think that a patient becomes radioactive after receiving his/her external beam treatment? 2. Do you think that a patient taking Sr89 for bone pain is radioactive after receiving the dosage?

Study Guide

6.1 In your own words, define the following terms:

(a) matter	(b) substance
(c) mixture	(d) compound
(e) element	(f) atom
(g) subatomic particle	(h) Bohr radius
(i) quantum mechanics	(j) Zeeman effect

6.2 Name the three physical states of matter.

6.3 Identify the contributions of (a) Dalton, (b) Avogadro, (c) Mendeleev, and (d) Arrhenius to the development of the concept of the atom.

6.4 Identify evidences used to support the proposal of the (a) Thomson model and (b) Bohr model.

6.5 Identify the experimental evidence that supports Rutherford's thinking that an atom consists of electrons revolving around a massive center just like the planetary system.

6.6 State the Bohr postulations.

6.7 Give the approximate size of an atom and a nucleus.

6.8 Compare the masses and charges of a proton and a neutron to an electron.

6.9 Review the energy level diagram for a hydrogen atom as shown in Figure 6.3. Locate the zero energy position, n=1 state, and n=100 state on the energy level diagram. Is there any energy state above the zero energy level?

6.10 Identify the spectral line series and its associated final state transitions, e.g., Balmer … spectral lines.

6.11 List the four quantum numbers used to describe the atomic structure. What are the restrictions imposed on these quantum numbers?

Problems

6.1 Compute the radii of the n=2 and n=10 orbits in the hydrogen atom.

6.2 Compute the energies of the n=2 and n=10 energy-states in the hydrogen atom.

6.3 Compute the wavelength of the photon emitted during the transition from the n=10 to n=2 energy-states of the hydrogen atom.

6.4 Determine the energy that must be absorbed by a hydrogen atom for an electron in the n=2 shell to be ionized.

Multiple Choice Questions
Choose one correct answer.

6.1 The radius of the Bohr's orbit is 0.53×10^{-10} m. What is the radius of the n=5 orbit of a hydrogen atom?
a) 0.106×10^{-10} m
b) 0.53×10^{-10} m
c) 2.65×10^{-10} m
d) 13.25×10^{-10} m
e) none of the above

6.2 The energy level of the Bohr's orbit is –13.6 eV. What is the n=5 energy level in a hydrogen atom?
a) – 0.544 eV
b) – 2.72 eV
c) – 13.6 eV
d) – 68.0 eV
e) none of the above

6.3 In his experiment involving the bombardment of alpha particles onto gold foils, Rutherford observed that
a) a vast majority of the alpha particles were unaffected by the gold foil.
b) an alpha particle is actually a helium atom.
c) an atom has a large empty space.
d) an atom has a massive center.
e) none of the above.

6.4 Which of the following statements is NOT consistent with the Bohr Model?
a) Electrons revolve around the nucleus in definite orbits.
b) Whenever an electron jumps from a higher energy-state to a lower energy-state, a photon with energy equal to the energy difference between the two states is emitted.
c) So long as the electrons revolve in definite orbits around a nucleus there is no radiation.
d) Energy absorption occurs when an electron jumps from a lower energy-state to a higher energy-state of an atom.
e) none of the above.

6.5 Which of the following is not an appropriate electronic configuration of an atom?
a) $1s^2 2s^2$
b) $1s^2 2s^2 2p^4$
c) $1s^2 2s^2 2p^3 3s^2$
d) $1s^2 2s^2 2p^6 3s^2 3p^6$
e) none of the above

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