

BASIC RADIOLOGICAL PHYSICS COURSE

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

YEAR: _____
(2004, 2005 ...)

Objective:

After completing this study guide, the students should understand the medical use of radiation and the nature of radiation, in particular electromagnetic radiation.

Study Guide #1: Radiation (Part 1 of 2)

Read Sections: Foundation of Radiological Physics Textbook (Author – C.B. Saw)
Chapter 1 – Radiation

Sections: First Page to 1.4

Suggested Reference: Faiz Khan's text – Chapter 1

Assignments: Answer all questions as directed in this handout.

Clinical Rotation Assignment: A patient says that he/she is treated on a linac or a cobalt unit. What is a linac or a cobalt unit?

Study Guide

- 1.1 In your own words, define the following terms:
- | | |
|---------------------|--|
| (a) PET | (b) SPECT |
| (c) radiation | (d) corpuscular or particulate radiation |
| (e) x-rays | (f) gamma rays |
| (g) teletherapy | (h) brachytherapy |
| (i) laser | (j) ionization |
| (k) excitation | (l) photon |
| (m) quanta | (n) scientific notation |
| (o) de Broglie wave | (p) relativistic mass |
- 1.2 Identify four types of electromagnetic radiation used in medical imaging.
- 1.3 Identify three types of benign disease treated with ionizing radiation.
- 1.4 Identify two types of particulate radiation used in medicine.
- 1.5 List two properties that differentiate between particulate and electromagnetic radiation.

- 1.6 Classify the following types of radiation — alpha particle, beta particle, gamma ray, proton and neutron — as either ionizing or non-ionizing radiation and either directly or indirectly ionizing radiation.
- 1.7 Identify two types of non-ionizing radiation.
- 1.8 What is the difference between a 100 keV x-ray and a 100 keV gamma ray?
- 1.9 Identify the difference between 6.4 MHz radiowaves and 6.4 MHz ultrasound waves.
- 1.10 Arrange in order the components of electromagnetic wave spectrum according to their approximate frequencies.
- 1.11 What is an angstrom?

Problems

- 1.1 Compute the wavelength in Å of ultraviolet light whose frequency is 3×10^{16} Hz.
- 1.2 What is the frequency of radiowaves if the wavelength is 3×10^3 m?
- 1.3 The wavelength range of visible light is from $4000 \text{ Å} - 7000 \text{ Å}$. What is the energy in eV of green light whose wavelength is 5000 Å ?
- 1.4 Write the measured values of 3.1×10^6 Hz and 5.0×10^{-6} m using prefixes.
- 1.5 Compute the speed and mass of a 100 keV photon.
- 1.6 Calculate the wavelength in Å of photons whose energies are (a) 1 eV, (b) 1 keV, and (c) 1 MeV.
- 1.7 Calculate the frequency in Hz of photons whose energies are (a) 1 eV, (b) 1 keV, and (c) 1 MeV.
- 1.8 Calculate the momentum of a particle whose wavelength is 1 angstrom.

Multiple Choice Questions

Choose one correct answer.

- 1.1 Which modality does not utilize electromagnetic radiation in the formation of images?
 - a) radiography
 - b) ultrasound imaging
 - c) magnetic resonance imaging
 - d) positron emission tomography
 - e) none of the above

- 1.2 Which statement is NOT true of photons?
- a) photons have no charge
 - b) photons have no mass
 - c) photon energy is given as $E = hv$ where v is the frequency
 - d) photons travel at the speed of light
 - e) none of the above
- 1.3 A **fermi** (1.0×10^{-15} m) is a unit commonly used in nuclear physics to express the size of the mass. The SI unit prefix is
- a) kilometer
 - b) millimeter
 - c) micrometer
 - d) nanometer
 - e) femtometer
- 1.4 Express 161.5 cm in scientific notation
- a) 16.15×10^1 cm
 - b) 1.615×10^2 cm
 - c) 16.15×10^3 m
 - d) 1.615×10^4 m
 - e) 0.1615×10^5 m
- 1.5 Which of the following is not a particulate radiation?
- a) proton
 - b) neutron
 - c) β particle
 - d) α particle
 - e) none of the above
- 1.6 Which of the following statements is NOT true about corpuscular radiation?
- a) corpuscular radiation is particle radiation
 - b) neutron is an example of non-charged particle radiation
 - c) charged particles are alpha particles, beta particles, and protons
 - d) charged particles can cause ionization and excitation of target atoms
 - e) none of the above
- 1.7 What is the speed of a photon whose wavelength is 4×10^{-8} m compared to the speed of light, c ?
- a) speed is less than c
 - b) speed is equal to c
 - c) speed is more than c
 - d) speed is c/λ
 - e) none of the above

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