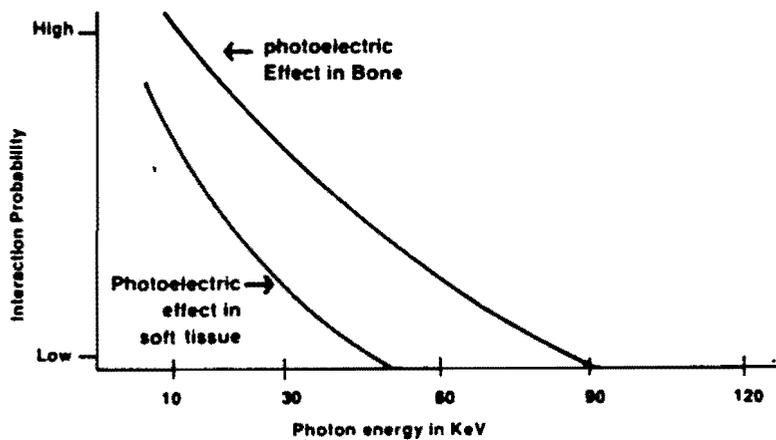


Interactions of Radiation with Matter

Chapter 3

1. The reduction in the number and energy of photons as radiation passes through matter is termed: 4:170
 - A. Irradiation
 - B. Deflection
 - C. Photoelectrolysis
 - D. Attenuation
2. The use of linear attenuation coefficients are applied for use with: 8:68
 - A. Monochromatic radiations
 - B. Polychromatic radiations
 - C. Both of the above
 - D. Neither of the above

Pertaining to the diagram of the photoelectric probability curve, answer questions 3 and 4.

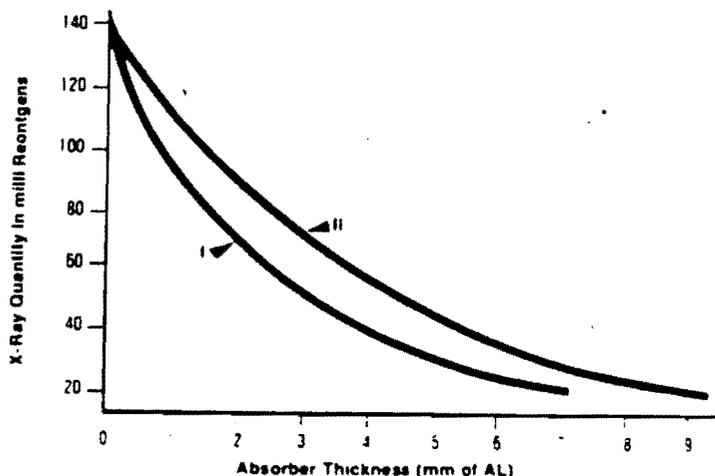


3. According to the diagram, the probability of a photoelectric interaction increases as:
 1. Atomic number increases
 2. Photon energy increases
 3. Atomic number decreases
 - A. 1 only
 - B. 2 only
 - C. 3 only
 - D. 1, 2, & 38:75
4. According to the diagram the probability of a photoelectric interaction in soft tissue approaches zero with photon energies: 8:75
 - A. Below 10 keV
 - B. About 30 keV
 - C. Above 60 keV
 - D. Above 90 keV
5. The production of scattered radiation when x-radiation strikes an object principally results from the: 8:77
 - A. Compton event
 - B. Bremsstrahlung event
 - C. Characteristic event
 - D. Photoelectric event
6. The general formula for obtaining the half-value layer thickness for an absorber is $HVL = \frac{0.693}{\mu}$: 8:70
 - A. $.693 \times \mu$
 - B. $\frac{.693}{\mu}$
 - C. $2 \times .693$
 - D. None of the above
7. At photon energies of 100 keV to 1 MeV, radiation is absorbed in soft tissue mainly by: 8:77
 - A. Pair production
 - B. Compton effect
 - C. Photoelectric effect
 - D. Coherent scattering

8. The thickness of absorbing material necessary to reduce the x-ray intensity to half of its original value is called: 4:175
- A. Half-life
B. Half-wave reduction
C. Half-penetration value
D. Half-value layer
9. The concept of mass attenuation coefficients is employed to describe the attenuation of materials independent of its: 8:72
- A. Density
B. Atomic number
C. Both of the above
D. Neither of the above
10. During a Compton interaction, the maximum energy of a photon scattered backwards at a 180 angle will be: 8:80
- A. .03 MeV
B. .18 MeV
C. .255 MeV
D. 1.3 MeV
11. At photon energies above 1.022 MeV., the creation of a negatron and positron may occur in an event termed: 8:82
- A. Photo disintegration
B. Pair production
C. Annihilation reaction
D. Van de Graff production
12. During a photoelectric interaction, the incident photon is _____ by the electron of the target atom. 8:75
- A. Partially absorbed
B. Totally absorbed
C. Partially deflected
D. Totally deflected
13. The interaction of x-rays with matter that is most common in the energy range between 150 keV and 3 MeV is (the): 8:77
- A. Photoelectric effect
B. Pair production
C. Compton scatter
D. Triplet production
14. The emission from an unstable nucleus with the highest ionization potential is: 4:49
- A. Alpha
B. Beta
C. Gamma
D. X-ray
15. The discontinuities on a graph of the photoelectric probability of lead at 15 and 88 keV are the result of:
1. Variable barrier thresholds 2. Back scatter buildup 3. Absorption edges of lead
- A. 1 only
B. 2 only
C. 3 only
D. 1, 2, & 3
16. Which of the following interactions of x-ray in matter results in ionization of the target atom? 8:82
- A. Pair production
B. Thomson scattering
C. Compton scattering
D. All of the above
17. The linear attenuation coefficient of a monochromatic beam will tend to _____ as the energy of the radiation increases. 8:68
- A. Increase
B. Decrease
C. Remain the same
18. The formation of positive and negative ions (ion pair) when radiation strikes matter requires 34 eV. What is the maximum number of ion pairs that could be formed by a 102 keV photon?
- A. 2000
B. 3000
C. 3468
D. 4468

19. As the atomic number of an attenuator increases, the linear attenuation coefficient will tend to: 8:70
 A. Increase C. Remain the same
 B. Decrease
20. The major reason for the higher mass attenuation coefficient of tin in the 29 and 88 keV energy range is the: 5:78
 A. Mass density C. K-edge gradient
 B. High atomic number D. High electron density
21. The interaction of an x-ray photon and an orbital electron, which results in a partial transfer of energy, and ionization of the orbital electron is called: 8:77
 A. Photoelectric effect C. Compton effect
 B. Pair production D. Thomson effect
22. Pair production is a common reaction occurring in the photon energy range of: 8:82
 A. 30-100 keV C. 500-900 keV
 B. 150-300 keV D. 1-10 MeV

Pertaining to the diagram of the intensity curves, answer questions 23 and 24.

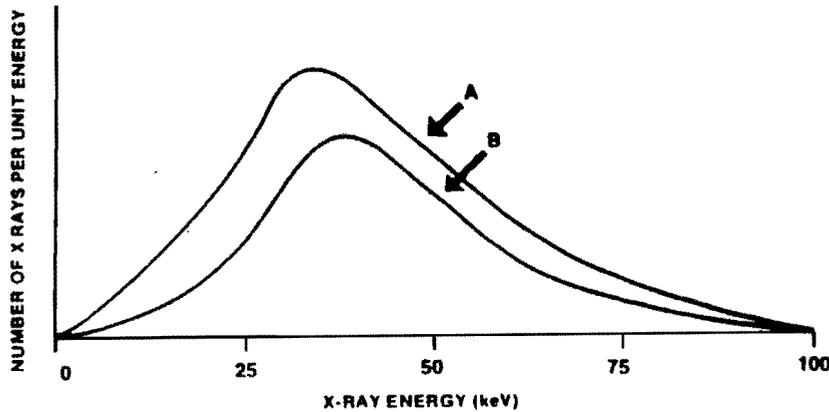


23. In order to reduce the intensity of Curve 1 to 25% of its original value, it will require about:
 A. 1 mm Al C. 5mm Al
 B. 3 mm Al D. 7mm Al
24. Comparing curves I and II, which would represent the beam with the lowest intensity?
 A. Curve I C. Unable to determine
 B. Curve II
25. An incident x-ray photon of 37 keV strikes an electron with a 40 keV binding energy. A scattered photon results with 37 keV of energy. This describes a: 8:74
 A. Compton event C. Photoelectric event
 B. Bremsstrahlung event D. None of the above
26. If a 60 keV electron strikes an inner shell electron with a binding energy of 26 keV, the resulting photoelectron will have a: 8:76
 A. 60 keV C. 32 keV
 B. 34 keV D. 26 keV

27. An incoming photon of 1 MeV interacts with an orbital electron causing ionization of the atom and a .9 MeV scattered photon. This describes an event called: 8:78
- A. Pair production C. Compton scattering
 B. Photoelectric interaction D. None of the above
28. A photon beam has an intensity of 100 mR/min. unfiltered. If the addition of 3mm Cu reduces this to a level of 25 mR/min., the half-value layer thickness is about: 4:23
- A. 1.5 mm Cu C. 7.5 mm Cu
 B. 2.5 mm Cu D. 12 mm Cu
29. The number of Compton interactions is primarily dependent upon the _____ of the target atom.
1. Atomic number 2. Angle of interaction 3. Electron density
- A. 1 only C. 3 only 8:80
 B. 2 only D. 1, 2, & 3
30. A 100 mR/hr. x-ray source has a half-value layer of 1mm Cu. How many half-value layers are required to reduce the beam intensity to 12.5 mR/hr.? 4:23
- A. 1 HVL C. 3 HVL
 B. 2 HVL D. 4 HVL
31. At energies above 10 MeV, x-ray photons may interact directly with the atomic nucleus causing the emission of nuclear fragments in a process termed: 8:31
- A. Photodisintegration C. Triplet production
 B. Annihilation reaction D. Magnetic resonance
32. The mass-energy equivalency of a positron or electron at rest velocity is: 8:4
- A. .255 MeV C. 1.0 MeV
 B. .511 MeV D. 1.022 MeV
33. When mass is converted into energy, which of the following equations is used to express their convertible natures? 8:4
- A. $E = \gamma h$ C. $\lambda = 12.4$
 B. $E = mc^2$ D. $C = v\lambda$
34. Which of the following members of the electromagnetic spectrum will possess the greatest mass-energy equivalency? 8:4
- A. 20 MeV x-ray photon C. 700 eV ultraviolet photon
 B. 3 MeV gamma photon D. 100 eV microwave
35. The actual attenuation coefficient for a specific material is dependent upon the 17:107
1. Photon energy employed 2. Density of the material 3. Atomic number of the material
- A. 1 & 2 only C. 2 & 3 only
 B. 1 & 3 only D. 1, 2, & 3
36. The half-value layer thickness of a given material is 12cm. What is its linear attenuation coefficient? 8:70
- A. .058 cm⁻¹ C. 5.8 cm⁻¹
 B. .58 cm⁻¹ D. 58 cm⁻¹
37. The half-value layer thickness of a given material is 23cm. What is its linear attenuation coefficient? 8:70
- A. .01 cm⁻¹ C. .03 cm⁻¹
 B. .02 cm⁻¹ D. .06 cm⁻¹

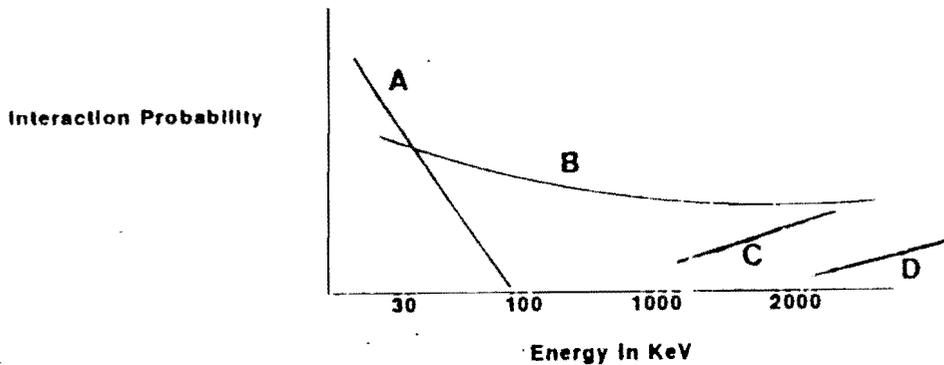
38. The half-value layer of a 180 keV gamma ray in a given material is .3 cm. What percentage of the gamma rays is transmitted through a 1.5 cm thickness of this material? 8:70
- A. 3% C. 12%
B. 6% D. 25%
39. Pertaining to the question above, what percentage of gamma rays has been attenuated? 8:70
- A. 70% C. 90%
B. 60% D. 97%
40. A given material has a $.14 \text{ cm}^{-1}$ linear attenuation coefficient for a 2 MeV monochromatic beam. What is the HVL of this material?
- A. 2 cm C. 5 cm
B. 3 cm D. 7 cm
41. The range of any charged particle is normally defined as the _____ thickness of a material for which they are able to penetrate. 4:27
- A. Minimum C. Maximum
B. Average D. None of the above
42. The term that is applied to neutrons with an energy range of .5 eV to 10 keV are called _____ neutrons. 4:28
- A. Thermal C. Fast
B. Intermediate D. Relativistic
43. The unit most often utilized to denote the cross-section area (10^{-24} cm^2) of a material is the: 8:32
- A. Farad C. Watt
B. Barn D. Seivert
44. Which of the following particles will have the longest range in a given tissue? 17:18
- A. 200 keV Neutron C. 200 keV e^-
B. 200 keV e^- D. 200 keV alpha
45. An increase in the specific ionization of a particle at the end of its path is referred to as the: 4:28
- A. Bragg peak C. Meson peak
B. Cerenkov peak D. Barn peak
46. The rate of energy loss during an inelastic collision of a beta- particle and an orbital electron is principally related to the material's: 8:301
1. Electron density 2. Atomic number 3. Mass density
- A. 1 only C. 3 only
B. 2 only D. 1, 2, & 3
47. The principal method by which slow neutrons are attenuated is. 17:18
- A. Electron capture C. Nuclear fusion
B. Spontaneous fission D. Nuclear collisions
48. Neutrons possessing low energies (.025 Ev) are often referred to as 8:29
- A. Thermal neutrons C. Relativistic neutrons
B. Fast neutrons D. None of the above

Pertaining to the diagram of the x ray energy, answer question 49.



49. If the x ray emission spectra above were produced using the same mAs and kV, which of the curve most likely represents a beam possessing the greatest amount of filtration? 5:30
- A. Curve A C. Unable to determine
 B. Curve B
50. Which of the following charged particles will have the shortest range in a given tissue? 17:10
- A. 10 keV e- C. 10 keV p+
 B. 10 keV e+ D. 10 keV alpha

Pertaining to the diagram of the photoelectric probability curve, answer questions 51 and 52.



51. The curves represent the four interactions which occur at different energies in bone tissue. Curve A represents the:
- A. Photoelectric event C. Pair production 4:31
 B. Compton's event D. Triplet production
52. Which of the following interactions predominates in the energy region between 150-900 keV? 4:31
1. Photoelectric event 2. Compton's event 3. Pair production
- A. 1 only C. 3 only
 B. 2 only D. 2 & 3 only

53. The capture of a slow neutron without a secondary particle ejection from the nucleus is described as:
- | | | |
|----------------------|----------------------|------|
| A. n, alpha reaction | C. n, gamma reaction | 8:30 |
| B. n, beta reaction | D. None of the above | |
54. The production of Bremsstrahlung radiation is most likely to occur from the interaction with a 100 keV:
- | | | |
|-----------|-------------|------|
| A. Alpha | C. Neutron | 8:41 |
| B. Proton | D. Electron | |
55. The annihilation of a positron is most commonly seen near the _____ of its range in a medium.
- | | | |
|--------------|-----------------------------|------|
| A. Beginning | C. End | 8:83 |
| B. Middle | D. All of the above equally | |
56. Collisions of radiation with matter that result in no change of internal or kinetic energy of the collided pair is termed a/an:
- | | | |
|-------------------------|----------------------|------|
| A. Deflection collision | C. Elastic collision | 4:27 |
| B. Plastic collision | D. Strip collision | |
57. The principal result from an interaction between charged particles that result in an ionization or excitation is called a/an:
- | | | |
|------------------------|------------------------|-------|
| A. Elastic collision | C. Transient collision | 8:299 |
| B. Inelastic collision | D. Binding collision | |
58. A narrow beam of monoenergetic radiation from a point source strikes a water phantom at a SSD of 50cm. The HVL for this beam in water is 7cm. At a depth of 21cm, what percentage of the surface dose is being received?
- | | | |
|----------|--------|------|
| A. 12.5% | C. 50% | 8:45 |
| B. 25% | D. 75% | |
59. The inelastic collisions of beta- and beta+ particles with orbital electrons are primarily the result of:
- | | | |
|-------------------------------|--------------------------|-------|
| A. Coulombic interactions | C. Magnetic interactions | 8 299 |
| B. Gravitational interactions | D. Decay interactions | |
60. Which of the following radiations are considered to have a relative straight line path in matter?
- | | | | |
|--------------|--------------|----------|------|
| 1. Electrons | 2. Positrons | 3. Alpha | 5:27 |
| A. 1 only | C. 3 only | | |
| B. 2 only | D. 1, 2, & 3 | | |
61. An ionized orbital electron that receives a surplus energy following an inelastic collision is termed a/an:
- | | | |
|--------------|--------------|-------|
| A. Eddy ray | C. Omega ray | 8:300 |
| B. Delta ray | D. Theta ray | |
62. If it is desired to increase the amount of primary beam attenuation, the material used for the filter should have a _____ than the material it replaces.
- | | | |
|----------------------------|---------------------------|------|
| A. Higher atomic number | C. Lower atomic number | 4:23 |
| B. Higher electron density | D. Lower electron density | |
63. Which of the following particles will have the longest range in a given tissue?
- | | | |
|---------------|--------------|------|
| A. 10 keV e- | C. 1 MeV e- | 4:27 |
| B. 100 keV e+ | D. 10 MeV e+ | |

64. A high energy gamma source requires 4mm of copper to reduce the original intensity by 50%. This source has a half-value layer of: 4:23
- A. 20mm copper
 - B. 15mm copper
 - C. 8mm copper
 - D. 4mm copper
65. The use of additional filtration in a therapeutic x-ray machine is primarily intended to: 4:25
- A. Increase beam quality
 - B. Reduce anode heel effect
 - C. Increase skin exposures
 - D. Reduce auger electron emissions