Medical Physics

Options and applications · 4 questions · step-by-step answers at the end

Name: Date: Score: / 4

USEFUL EQUATIONS

$I = I_0 e^{-\mu x}$ $x_{½} = \ln 2 / \mu$ $Z = \rho c$ $I_r / I_0 = (Z_2 - Z_1)^2 / (Z_2 + Z_1)^2$

Questions

Show your working in the space under each question.

1. Air has Z = 430 and skin Z = 1.6×10^6 (kg m^{-2} s^{-1}). What fraction of ultrasound is reflected at an air–skin boundary?

2. Soft tissue has an attenuation coefficient of 0.20 cm^{-1} for a particular X-ray beam. What fraction of the beam passes through 5.0 cm, and what is the half-value thickness?

3. How many half-value thicknesses reduce an X-ray beam to 1/8 of its intensity?

4. In PET, what is the energy of each gamma photon produced when a positron and an electron annihilate? (electron rest energy 0.511 MeV)

Step-by-step answers

Medical Physics

1. $((1.6 \times 10^6 - 430)/(1.6 \times 10^6 + 430))^2 =$ **0.999**: almost all of it, which is why gel is needed.

2. 1. $I/I_0 = e^{-\mu x} = e^{-0.20 \times 5.0} = e^{-1} =$ **0.37** (37%).
   2. $x_{½} = \ln 2/\mu = 0.693/0.20 =$ **3.5 cm**.
   Answer: 37%; 3.5 cm

3. **Three**.

4. The total rest energy 1.022 MeV is shared equally: **0.511 MeV** each.