Problem 1 [Poston Prob. 1.9]

A certain X-ray machine provides an output of 60 R/min at 1m. Estimate the exposure at 75 cm from the target and the approximate does in rads and grays.

Problem 2 [Turner. 12.1]

a) What is the average absorbed dose in a 40 cm^3 region of a body organ (density=0.93 gcm^-1) that absorbs 3. 10^5 MeV of energy from a radiation field?

b) If the energy is deposited by ionizing particles with an LET of 10 keV/μ in water, what is the dose equivalent?

c) Express the answers to (a) and (b) in both rads and rems as well as Gy and Sv.

Problem 3 [Turner. 12.2]

A portion of the body receives 0.15 mGy from radiation with a quality factor Q=6 and 0.72 mGy from radiation with Q=10.

a) What is the total dose?

b) What is the total dose equivalent?

Problem 4 [Turner. 12.29]

What is the average whole-body dose rate in 22 g mouse that contains 1.85×10^5 Bq of ^{14}C distributed in this body?

Problem 5 [Turner. 12.3]

A beam of X rays produces 4 esu of charge per second in 0.08 g of air. What is the exposure rate in (a) mR/s and (b) SI units?

Problem 6 [Turner. 12.30]

A patient receives an injection of 1.11×10^8 Bq of ^{131}I, 30% of which goes to the thyroid having a mass of 20 g. What is the average dose rate in the organ?

Problem 7 [Turner. 12.31]

Tritium often gets into body water following an exposure and quickly becomes distributed uniformly throughout the body. What uniform concentration of ^3H, in Bq/g, would give a dose-equivalent rate of 1 mSv/wk?

Problem 8 [Turner. 12.32]

A 36 g mouse is to be injected with ^{32}P (half-time=14.3d; average beta energy=0.7MeV, no gamma). Assume that the ^{32}P distributes itself almost instantaneously throughout the body following injection and that none is lost from the body for the first few hours thereafter. What activity of ^{32}P needs to be administred in order to give the mouse a dose of 10 mGy in the first hour?

Problem 9 [Turner. 12.33]

A 75 μA parallel beam of 4 MeV electrons passes normally through the flat surface of a sample of soft tissue in the shape of a disc. The diameter of the disc is 2 cm and its thikness is 0.5 cm. Calculate the average absorbed dose rate in the disc.

Problem 10 [Turner. 12.34]

A soft tissue disc with radius of 0.5 cm and thickness of 1 mm is irradiated normally on its flat surface by 6 μA beam of 100 MeV protons. Calculate the average dose rate in the sample.

Problem 11 [Turner. 12.35]

An experiment is planned in which bean roots are to be placed in a tank of water at a depth of 2.2 cm and irradiated by a parallel beam of 10 MeV electrons incident on the surface of the water. What fluence rate would be needed to expose the roots at a dose rate of 10 Gy/min?

Problem 12 [Turner. 12.36]

A worker inadvertently puts his hand at right angles into a uniform, parallel beam of 50 MeV protons with a fluence rate of 4.6×10^10 protons cm^-2s^-1. His hand was momentarily exposed for an estimated 0.5s.

a) Estimate the dose that the worker received to skin of his hand.

b) If the beam covered an area of 2.7 cm^2, what was the beam current?

Problem 13 [Turner. 12.38]

When ^{38}S decays, a single 1.88 MeV gamma photon is emitted in 95% of the transformations. Estimate the exposure rate at a distance of 3 m from a point source of ^{38}S having an activity of 2.7×10^{12} Bq.

Problem 14 [Turner. 12.4]

If all of the ion pairs collected in the last example, what is the current?

Problem 15 [Turner. 12.40]

What is the activity of an unshielded point source of ^{60}Co if the exposure rate at 20 m is 6 R/min?

Problem 16 [Turner. 12.41]

A worker accidently strayed into a room in which a small, bare vial containing 23 Ci of ^{131}I was being used to expose a sample. He remained in the room aproximately 10 min, standing at a lab bench 5 m away from the source. Estimate the dose that the worker received.

Problem 17 [Turner. 12.42]

A point source consists of a mixture of 4.2 Ci of ^{42}K and 1.8 Ci of ^{24}Na. Estimate the exposure rate at a distance of 40 cm.

Problem 18 [Turner. 12.43]

A parallel beam of monoenergetic photons emerged from a source when the shielding was removed for a short time. The photon energy hν and the total fluence φ of photons are known.

a) Write a formula from which one can calculate the absorbed dose in air in rad from $h\nu$, expressed in MeV, and φ , expressed in cm^{-2}.

b) Write a formula for calculating the exposure in R.

Problem 19 Absorbed dose in lungs [January 2015]

Exposure to ambients in which ^{222}Rn concentration is high produces an uniform deposition of ^{218}Po on the lining if the bronchi (bronchial epithelium) of the human lung. If in a person staying in one of these ambients, the activity of ^{218}Po is 100 pCi/cm^2:

a) what is the flux of α-particles (in α/cm^2·min)coming from the ^{218}Po penetrating into the bronchial epithelium? Assume the density of bronchial epithelium of 1 gr/cm^3

b) what is the range of these α particles in the bronchial epithelium?

c) what is the absorbed dose (in Gy/h) produced by these α particles in the bronchial epithelium?