4. Calculate the number of molecules in 1 g of water (H2O). What is the number of H and O atoms in 1 g of water.

1

5. Calculate the number density of H_2O (molecules/cm^3)

2

7. Calculate the energy released in the following nuclear reaction:

$$_1H^2 + _1H^2 = _1H^3 + _1p^1$$

Mass of H^2 = 2.014102 u

Mass of H^3 = 3.016050 u

Mass of proton = 1.007825 u

3

Tutorial # C

INTERACTION OF RADIATION WITH MATTER

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1. Determine the number of ion pairs produced by 100 alpha particles of 5.3 MeV energy.

2. Calculate the thickness of lead (ρ = 11.4 g/cm^3)necessary to stop 4 MeV alpha particles.

3

3. ^{24}Na is often used in medicine as a radioactive tracer . It emits beta rays with a maximum energy of 1.39 MeV.

What is the maximum range of these beta rays in aluminum?

4

4. Find the thickness of aluminum absorber necessary to absorb 99% of the 5.3 MeV maximum beta particles striking it.

5

5. Compute the maximum thickness of aluminum window in a G.M. tube to permit counting of 2.7 MeV beta particles.

6

6. Calculate :

(a) the half value thickness

(**b**) the mean free path, and

(**c**) the mass attenuation coefficient for Co-60 gamma rays (1.17 MeV and 1.33 MeV energy) in lead from the following data: 4.5 cm thickness of lead reduces the radiation intensity by 95%.

7

7. The linear attenuation coefficient of lead for 1 MeV gamma rays is 0.74 cm^{-1} Calculate:

(**a**) half value thickness and

(**b**) thickness of lead necessary to reduce the intensity of the gamma rays to 1/100 of its original value.

8

8. A 5 cm thick shield of lead is used to attenuate the gamma rays from Co-60. What fraction of the initial radiation penetrates the shield?

9

9. What thickness of Al is needed to reduce the intensity of a beam of thermal neutrons to 1/100 of its initial value? Neutron absorption cross section in aluminum for thermal neutrons is 0.23 barn. Density of Al is 2.7 g/cm^3.

10

10. Cadmium has a neutron absorption cross section of 20,000 barns for thermal neutrons. What fraction of the thermal neutrons will be transmitted by a 0.3 mm foil of cadmium of density 8.6 g/cm3?

11

11. Calculate the mean free path of thermal neutrons in:

(**a**) water for which σ=0.33 barn and ρ= 1 g/cm^3, and

(**b**) graphite for which σ=2.6 barns and ρ=2250 kg/m^3.

12

12. A 0.1 cm thick Fe sheet (ρ=7.8 g/cm^3) reduces a beam of 10 4 neutrons by 10%. Calculate:

(a) macroscopic cross section of Fe, and

(b) mean free path.

13

13. A 2 MeV neutron collides head-on with an ^{16}O nucleus.

Calculate the energy loss of the neutron.

14

1. Find the activity in dps of 1 g of Ra-226 (Half-life = 1622 y).

1

2. The activity of a radioisotope decays to 1/10 of its original value in 42 min. What is its half life?

2

3. If the present activity of a sample of Ag-102 is 1000 Bq, What will be its activity after 3 half-lives in dps?

3

4. A researcher desires to have 10 mCi of I-131 which has an 8-day half-life. If it takes 16 days for the shipment to reach its destination then the quantity which must be shipped is:

a) 20 mCi
b) 60 mCi
c) 40 mCi
d) 80 mCi
e) 100 m Ci

4

5. If the initial activity of a radionuclide is 3.7×10^{10} d/sec what is its approximate activity in 2.3 mean lives?

a) 3.7 Ci

b) 10 Ci

c) 1 Ci

d) 0.1 Ci

e) None of the above

5

6. For a radionuclide with a disintegration constant 0.693 min^{-1} the fraction of atoms that decays in one minute is expected to be:

a) 0.693

b) 0.069

c) 0.500

d) 0.307

e) None of the above

6

7. Find the activity of 2 g of Co-60. Given its $T_{1/2}$ = 5.2 years.

7

8. Cs-137 has $t_{1/2}$ = 30.2 years. (a) How long will it take a sample of this isotope to decay to 1% of its original activity? (b) What is the mean life of the Cs-137 atoms.

8