

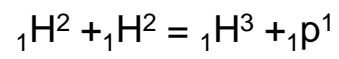
4. Calculate the number of molecules in 1 g of water (H_2O). What is the number of H and O atoms in 1 g of water.

1

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

2

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



Mass of $\text{H}^2 = 2.014102 \text{ u}$

Mass of $\text{H}^3 = 3.016050 \text{ u}$

Mass of proton = 1.007825 u

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

2. Calculate the thickness of lead ($\rho = 11.4 \text{ g/cm}^3$) 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 $\sigma=0.33$ barn and $\rho= 1$ g/cm³, and
(b) graphite for which $\sigma=2.6$ barns and $\rho=2250$ kg/m³.

12

12. A 0.1 cm thick Fe sheet ($\rho=7.8$ g/cm³) 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 ¹⁶O 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