Answer on Question 68933, Physics, Atomic and Nuclear Physics

Question:

What is the total number of neutrons in 10 g of D_2O?

Solution:

Let's first find the molar mass of the deuterium oxide:

$$M_{D_2O} = M_{D_2} + M_O = 2 \cdot (2\ g \cdot mol^{-1}) + 16\ g \cdot mol^{-1} = 20\ g \cdot mol^{-1}.$$

Then, we can find the number of moles of deuterium oxide molecules in 10 g of D_2O:

$$n = \frac{m_{D_2O}}{M_{D_2O}},$$

here, m_{D_2O} is the mass of D_2O, M_{D_2O} is the molar mass of the deuterium oxide.

Then, we get:

$$n = \frac{m_{D_2O}}{M_{D_2O}} = \frac{10\ g}{20\ g \cdot mol^{-1}} = 0.5\ mol.$$

Also, we need to find the number of neutrons in one molecule of D_2O:

$$N_n = N_n(D_2) + N_n(O) = 2 \cdot 1\ n + 8\ n = 10\ n.$$

Finally, we can find the total number of neutrons in 10 g of D_2O:

$$N_{n(total)} = n \cdot N_A \cdot N_n,$$

here, $N_A = 6.02 \cdot 10^{23}\ mol^{-1}$ is the Avogadro constant.

Then, we get:

$$N_{n(total)} = n \cdot N_A \cdot N_n = 0.5\ mol \cdot 6.02 \cdot 10^{23}\ mol^{-1} \cdot 10\ neutrons = \\ = 3.01 \cdot 10^{24}\ neutrons.$$

Answer:

$N_{n(total)} = 3.01 \cdot 10^{24}\ neutrons.$