Related Problems

Q Calculate the total number of electrons present in one mole of methane.

Find (a) the total number and (b) the total mass of neutrons in 7 mg of ^{14}C. (Assume that mass of a neutron = 1.675×10^{-27} kg).

Find (a) the total number and (b) the total mass of protons in 34 mg of NH_3 at STP. Will the answer change if the temperature and pressure are changed?

Ans :

(i) Number of electrons present in 1 molecule of methane (CH_4)

$\{1(6) + 4(1)\} = 10$

Number of electrons present in 1 mole i.e., 6.023×10^{23} molecules of methane

$= 6.022 \times 10^{23} \times 10 = 6.022 \times 10^{24}$

(ii)(a) Number of atoms of ^{14}C in 1 mole= 6.023×10^{23}

Since 1 atom of ^{14}C contains (14 – 6) i.e., 8 neutrons, the number of neutrons in 14 g of ^{14}C is $(6.023 \times 10^{23}) \times 8$. Or, 14 g of ^{14}C contains $(6.022 \times 10^{23} \times 8)$ neutrons.

Number of neutrons in 7 mg

$$= \frac{6.022 \times 10^{23} \times 8 \times 7 \text{ mg}}{1400 \text{ mg}}$$

$= 2.4092 \times 10^{21}$

(b) Mass of one neutron = 1.67493×10^{-27} kg

Mass of total neutrons in 7 g of ^{14}C

$= (2.4092 \times 10^{21})\ (1.67493 \times 10^{-27}\ kg)$

$= 4.0352 \times 10^{-6}$ kg

(iii) (a) 1 mole of $NH_3 = \{1(14) + 3(1)\}$ g of NH_3

= 17 g of NH_3

$= 6.022 \times 10^{23}$ molecules of NH_3

Total number of protons present in 1 molecule of NH_3

$= \{1(7) + 3(1)\}$

= 10

Number of protons in 6.023×10^{23} molecules of NH_3

$= (6.023 \times 10^{23})\ (10)$

$= 6.023 \times 10^{24}$

⇒ 17 g of NH_3 contains (6.023×10^{24}) protons. Number of protons in 34 mg of NH^3

$$= \frac{6.022 \times 10^{24} \times 34 \text{ mg}}{17000 \text{ mg}}$$

$= 1.2046 \times 10^{22}$

(b) Mass of one proton = 1.67493×10^{-27} kg

Total mass of protons in 34 mg of NH_3

$= (1.67493 \times 10^{-27}\ kg)\ (1.2046 \times 10^{22})$

$= 2.0176 \times 10^{-5}$ kg