

(9.7) Assume that 10^9 alcohol molecules are dissociated per discharge in a GM tube of 100 cm^3 filled with 90% Ar and 10% ethyl alcohol vapor at a pressure of 100 mmHg ($25 \text{ }^\circ\text{C}$). What is the lifetime of the tube in terms of total counts assuming that this coincides with the dissociation of 95% of the alcohol molecules?

Standard constants:

$$R_{gas} := 0.08206 \cdot \text{liter} \cdot \text{atm} \cdot \text{mole}^{-1} \cdot \text{K}^{-1}$$

$$N_A := 6.022 \cdot 10^{23} \cdot \text{mole}^{-1}$$

Given data:

$$V := 100 \cdot \text{mL}$$

$$p := \frac{100}{760} \cdot \text{atm}$$

$$T := (273.15 + 25) \cdot \text{K}$$

Calculations:

$$n_{tot} := \frac{p \cdot V}{R_{gas} \cdot T}$$

$$n_{ethanol} := \frac{10}{100} \cdot n_{tot}$$

$$n_{destr} := 10^9$$

$$N := \frac{n_{ethanol} \cdot N_A}{n_{destr}} \cdot 0.95$$

$$N = 3.077 \cdot 10^{10} \quad \text{pulses}$$