

(8.8) A direct reading condenser chamber (pen dosimeter) is charged from a battery pack so that the full scale (100) is obtained at 20 V. When completely discharged, the accumulated dose is 5.00 mGy. The gas volume is 4 cm³ at (STP). What is the capacitance of the condenser chamber?

Because we will need to calculate the charge produced in air, Röntgen is a suitable unit:

$$1 \text{ R} = 2.58 \cdot 10^{-4} \text{ C/kg air} = 8.8 \cdot 10^{-3} \text{ J/kg} = 8.8 \cdot 10^{-3} \text{ Gy}$$

$$\text{Roentgen} := 2.58 \cdot 10^{-4} \cdot \frac{\text{coul}}{\text{kg}} \qquad \text{Gy} := \frac{\text{joule}}{\text{kg}}$$

The following values are given:

$$v := 4 \cdot \text{cm}^3 \qquad \rho := 1.293 \cdot 10^{-3} \cdot \frac{\text{gm}}{\text{cm}^3} \qquad U := 20 \cdot \text{volt} \qquad D := 5.00 \cdot 10^{-3} \cdot \text{Gy}$$

$$D_R := \frac{D}{8.8 \cdot 10^{-3} \cdot \text{Gy}} \cdot \text{Roentgen} \qquad \text{Here we convert the dose from Gy to Roentgen}$$

$$Q := \rho \cdot v \cdot D_R \qquad Q = 7.582 \cdot 10^{-10} \cdot \text{coul}$$

$$C := \frac{Q}{U} \qquad C = 3.791 \cdot 10^{-11} \cdot \text{farad} \qquad C = 37.908 \cdot \text{pF}$$