(9.10) One wants to determine the residual liquid volume of a closed sedimentation tank (nominal volume 80 $m^3$), which has been in use for many years, and in which $CaSO_4$ precipitates. 0.50 ml $^{24}Na_2SO_4$ (specific activity $3.2*10^8$ cpm $ml^{-1}$) is added to the tank, and 10 ml withdrawn after 2 h of settling; measurements yield a net value (background subtracted) of 500 counts in 10 min. Calculate the free volume in the tank.

Use relation $V_0*S_0=(V+V_0)*S$: $V_0 := 0.5\cdot mL$ $S_0 := 3.2\cdot 10^8\cdot min^{-1}\cdot mL^{-1}$

$t_m := 10\cdot min$ $N_m := 500$ counts $v_m := 10\cdot mL$

$R_m := \frac{N_m}{t_m}$ This value must be decay-corrected back 2 hours, assuming measurement shortly after withdrawal of sample.

$t_{half} := 14.96\cdot hr$ $\Delta t := 2\cdot hr$ $A := R_m\cdot 2^{\frac{\Delta t}{t_{half}}}$

$S := \frac{A}{v_m}$ $S = 9.142\cdot 10^4\cdot m^{-3}\cdot sec^{-1}$ $V := \frac{V_0\cdot S_0}{S}$ $V = 29\cdot m^3$

Remember: In cases where $V_0$ can not be neglected in comparison with $V$ we should use:

$$V = \frac{V_0\left(S_0 - S\right)}{S}$$