(18.10) 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precipitates. 0.50 ml $^{24}Na_2SO_4$ (specific activity $3.2*10^8$ cpm ml^{-1}) is added to the tank, and 10 ml withdrawn after 2 h of settling; measurements yield a net value (background subtracted) of 500 counts in 10 min.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.

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

$S := \frac{A}{v_m}$ $S = 9.142 \cdot 10^4 \cdot m^{-3} \cdot sec^{-1}$ $V := \frac{V_0 \cdot S_0}{S}$ $V = 29.168 \cdot m^3$

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

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