(9.3) In order to determine the lead content of a color pigment, 8.9871 g was dissolved in conc. HNO_3, and 5.00 ml ^{210}Pb solution added. After excess acid had been removed through evaporation, excess 1 M NaCl was added, the solution heated and filtered. After cooling and crystallization, the $PbCl_2$ was washed and recrystallized. 0.3276 g of the crystals was measured in a scintillation counter, giving 185160 counts in 5 min. 1.000 ml of the original ^{210}Pb solution gave 57000 cpm. The background was 362 cpm. Calculate the lead content (%) of the pigment.

First the usual definitions:

$Bq := sec^{-1}$ $cpm := min^{-1}$

and the molecular weights needed:

$M_{wPb} := 207.19 \cdot \frac{gm}{mole}$ $M_{wCl} := 35.45 \cdot \frac{gm}{mole}$ $m_{PbCl2} := 0.3276 \cdot gm$

$M_{wPbCl2} := M_{wPb} + 2 \cdot M_{wCl}$

Then the data given in the text:

$m_{sample} := 8.9871 \cdot gm$ $R_{sample} := \frac{185160}{5 \cdot min}$ $R_{bg} := \frac{362}{1 \cdot min}$ $R_0 := \frac{57000}{1 \cdot min}$

$v_0 := 1 \cdot mL$

Now we can calulate the amount of lead the isolated lead chloride sample:

$m_{Pb} := m_{PbCl2} \cdot \frac{M_{wPb}}{M_{wPbCl2}}$

and the specific activity of the ^{210} Pb solution and the activity of the isolated sample:

$R_{0net} := R_0 - R_{bg}$ $S_0 := \frac{R_{0net}}{v_0}$ $v := 5 \cdot mL$

$R_{samplenet} := R_{sample} - R_{bg}$

Assume the amount of added lead can be neglected in comparison to the amount of lead in the sample. Then calculate the precipitation yield and correct the lead mass.

$yield := \frac{R_{samplenet}}{v \cdot S_0}$ $yield = 0.129$

$m_{Pbinsample} := \frac{m_{Pb}}{yield}$ $Pbcontent := \frac{m_{Pbinsample}}{m_{sample}}$

$Pbcontent = 0.21$

or

$Pbcontent = 21.0 \cdot \%$