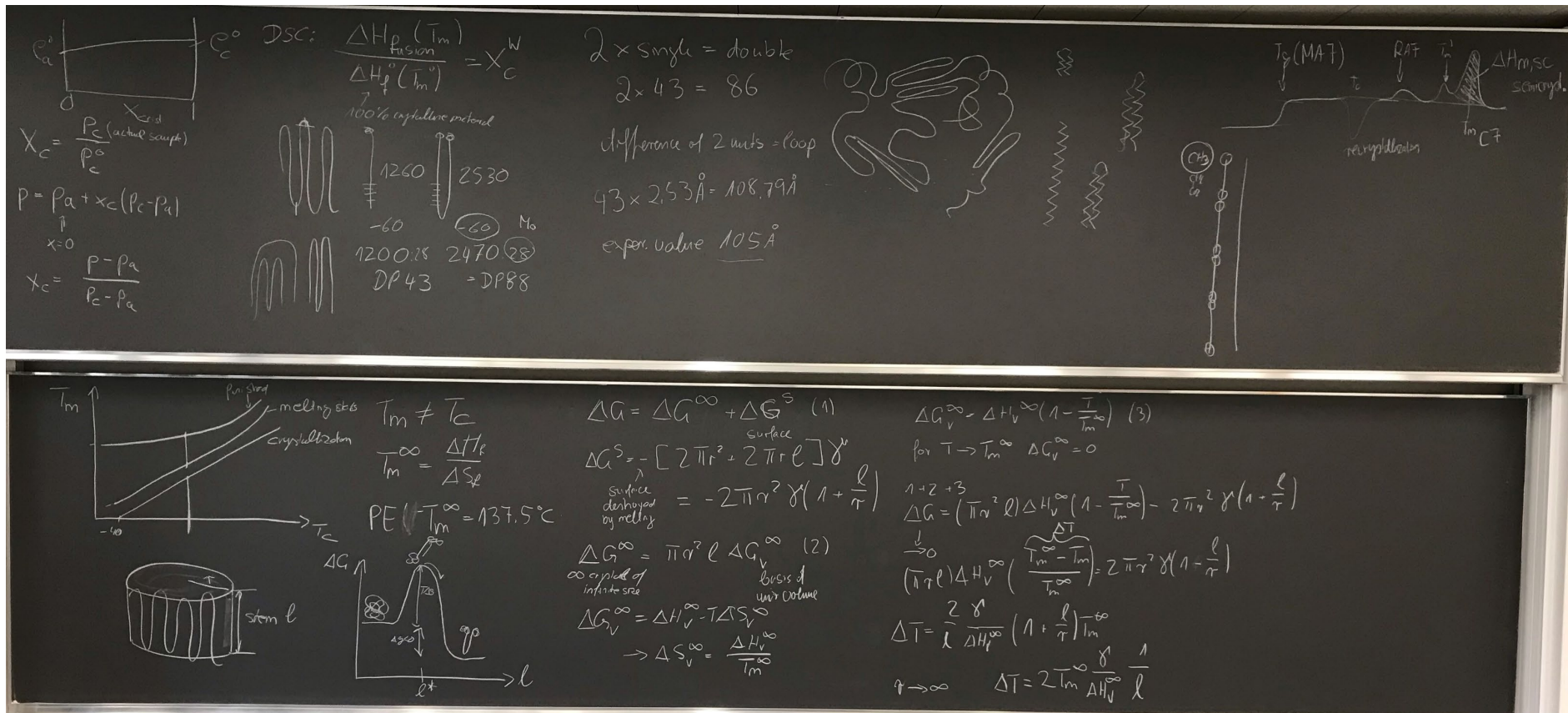


## Exercise 5.3

## Discussion of RAF



## Derivation of Thomson Gibbs equation

# Avrami equation

heterogeneous nucl.



radial growth is

point  $x$  is reached  $\dot{r}t$

number of nuclei in plane  $N$  per unit area



average number of fronts

$$\bar{F} = \pi (\dot{r}t)^2 N$$

distribution of  $F$   $P(\bar{F}) = \frac{e^{-\bar{F}} \bar{F}^{\bar{F}}}{\bar{F}!}$

if  $F=0$   $P(0) = \exp(-\bar{F})$

$\hat{=}$  pure athermal part

$$x_a = 1 - x_c$$

$$1 - x_c = P(0) = \exp(-\bar{F})$$

$$\ln \frac{1}{1-x_c} = \bar{F} = \pi \dot{r}^2 N t^2$$

$$x_c = 1 - \exp(-\pi \dot{r}^2 N t^2)$$

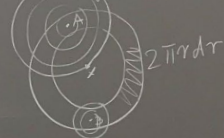
short  $t$ :  $x_c = 0$

long  $t$   $x_c = 1$

$$x_c = 1 - \exp(-K t^m)$$

$\ln \left( \ln \frac{1}{1-x_c} \right) = \ln K + m \ln t$  general Avrami eqn

homogeneous nucl.



frequency of spontaneous nucl.  $\dot{N}$

rate of formation  $\dot{N} 2\pi r dr$

radial growth  $\dot{r}$

$$1) d\bar{F} = (\dot{N} 2\pi r dr) \left( t - \frac{r}{\dot{r}} \right)$$

$$2) \bar{F} = 2\pi \dot{N} \int_0^{\dot{r}t} r \left( t - \frac{r}{\dot{r}} \right) dr$$

$$\int_0^{\dot{r}t} d\bar{F} = \bar{F} = \frac{\pi}{3} \dot{N} \dot{r}^2 t^3 \quad \bar{F} = \ln \left( \frac{1}{1-x_c} \right)$$

$$\ln \left( \frac{1}{1-x_c} \right) = \frac{\pi}{3} \dot{N} \dot{r}^2 t^3 \rightarrow x_c = 1 - \exp \left( -\frac{\pi}{3} \dot{N} \dot{r}^2 t^3 \right)$$