

Some answers that were not as good as I had hoped.

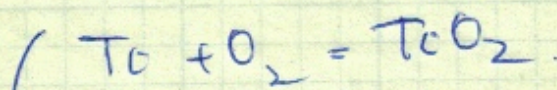
1 All excellent

2. Equilibrium is given by

$$\Delta G_{\text{JAVAF}} + RT \frac{1}{P_{O_2}} = 0$$

Why does ΔG_{JAVAF} have a positive slope?

$$\Delta G_{\text{JAVAF}} = \Delta H - T \Delta S$$

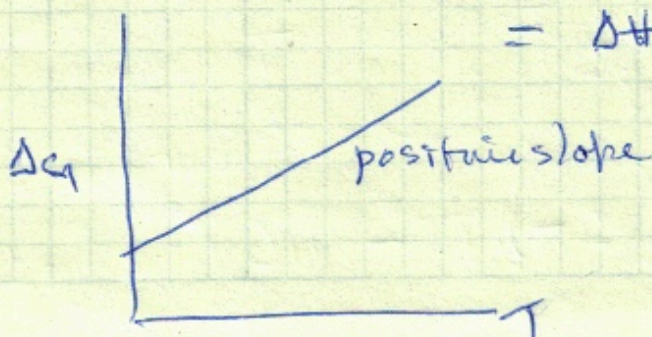


$$\Delta H - T \left(\Delta S_{\text{TiO}_2} - \Delta S_{\text{Ti}} - \Delta S_{\text{O}_2} \right)$$

~~ΔS~~
ΔS

Now ΔS is negative because O_2 has a higher entropy than both TiO_2 & Ti since O_2 is a gas.

$$\begin{aligned} \therefore \Delta G_2 &= \Delta H - T (-\Delta S_{\text{O}_2}) \\ &= \Delta H + T |\Delta S_{\text{O}_2}| \end{aligned}$$



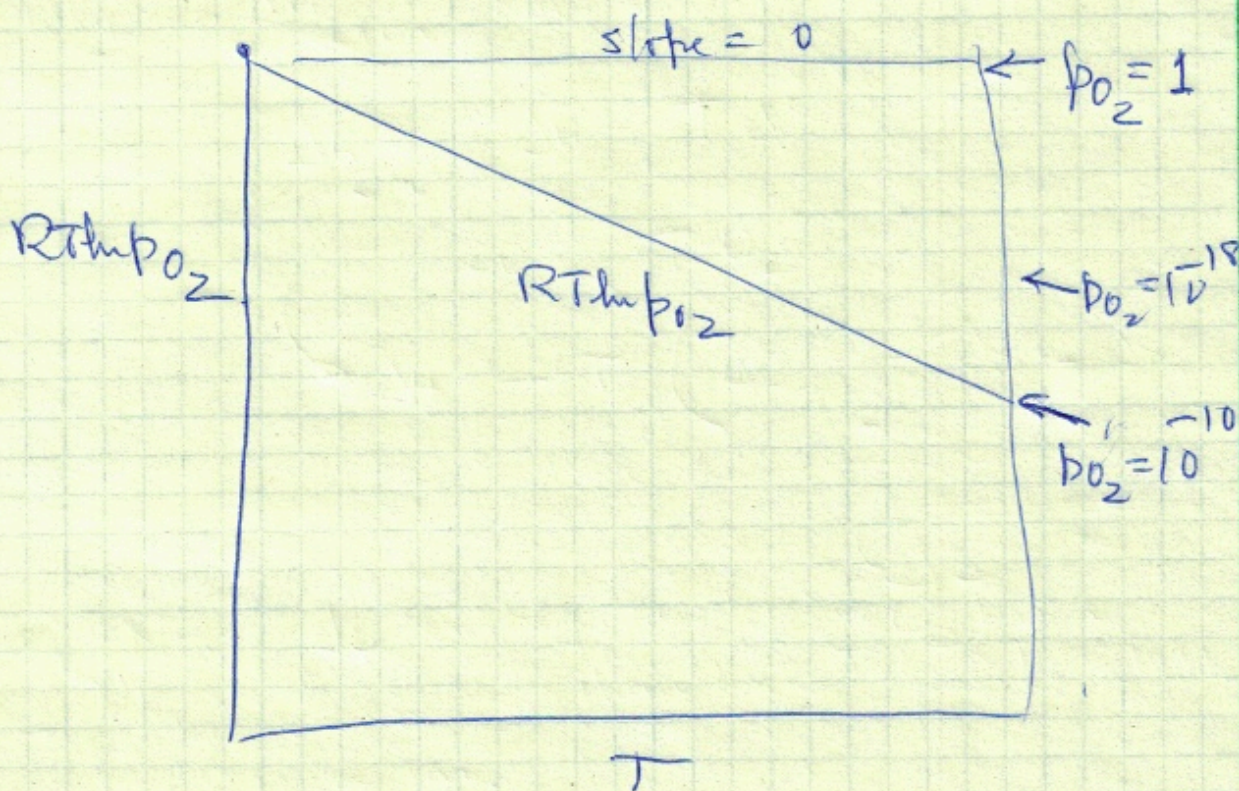
$$RT \frac{1}{p_{O_2}} = -RT \ln p_{O_2}$$

∴ Equilibrium when

$$\Delta G_{JANU} = RT \ln p_{O_2}$$

New peak $p_{O_2} \rightarrow$ say 10^{-10} min min

$$\therefore \Delta G_{JANU} = -RT (\ln 10^{10})$$



3. A common mistake

C_A has units of $\#/m^3$

it is the volumetric concentration

X_A is the molar concentration
(dimensionless)

$$\therefore C_A \propto X_A$$

$$\text{but } C_A \neq X_A$$

$$\text{Hence } \frac{dX_A}{X_A} = \frac{dC_A}{C_A} \quad \leftarrow \text{Wrong!}$$

4. I think you did fine on this one.

$$A \equiv O_2 \quad \begin{aligned} \rightarrow J_A &= \frac{C_A D_A}{k_B T} \cdot \frac{d\Delta\mu_A}{dx} \\ &= \frac{C_A D_A}{k_B T} \cdot \frac{\Delta\mu_A}{h} \end{aligned}$$

flux of O_2 molecules

one $A \rightarrow m \text{ SiO}_2$

\therefore ~~flux~~ ^{growth} $\text{SiO}_2 = \text{flux of } O_2$.

$$\therefore \frac{dh}{dt} = J_A \Omega \quad \leftarrow \text{check unit}$$

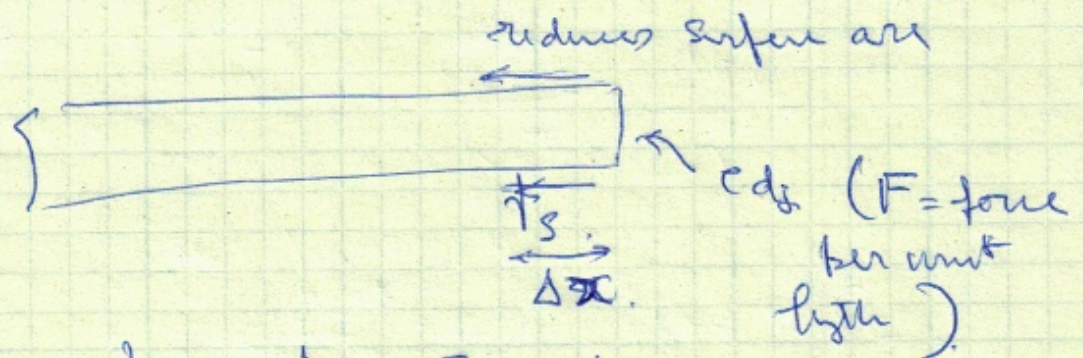
5. Okay.

6. Surface Energy \rightarrow per unit area

~~\rightarrow $\frac{E}{V}$~~

\rightarrow Causes spheroidization
i.e. shapes to assume a
uniform radius and the
the radius to change (precipitate
shrinkage) to decrease
the total surface energy.

Surface Tension \rightarrow Force per unit
area exerted on the
edge of a surface which
causes the surface to
shrink.



$$2\gamma_s \cdot \Delta x \cdot 1 = F \times 1$$

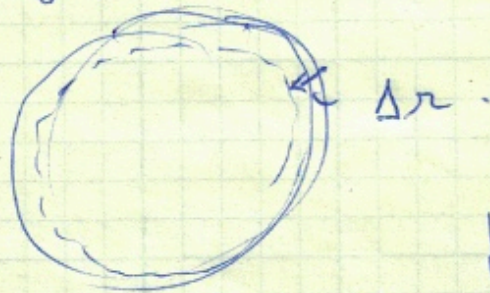
$$\therefore F = 2\gamma_s$$

\uparrow length normal to the bar

7.



By principle of virtual work.



$$\text{work done} = p_H \times 4\pi r^2 \times \Delta r$$

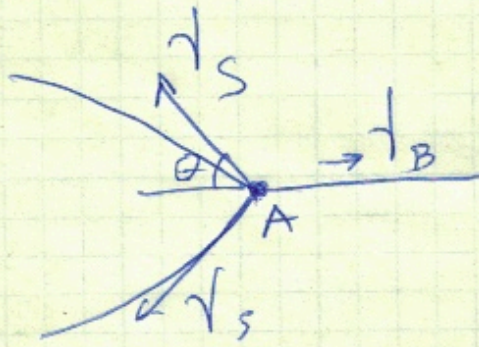
↑ force per unit area.

$$\begin{aligned} \text{Change in surf} \\ \text{Energ} &= \Delta [4\pi r^2 \gamma_s] \\ &= 8\pi r \gamma_s \times \Delta r \end{aligned}$$

$$p_H \times 2\pi r^2 \times \Delta r = 8\pi r \gamma_s \Delta r$$

$$p_H = \frac{2\gamma_s}{r}$$

8.



At A which is now a line the surface tension forces exerted on the edge must balance.

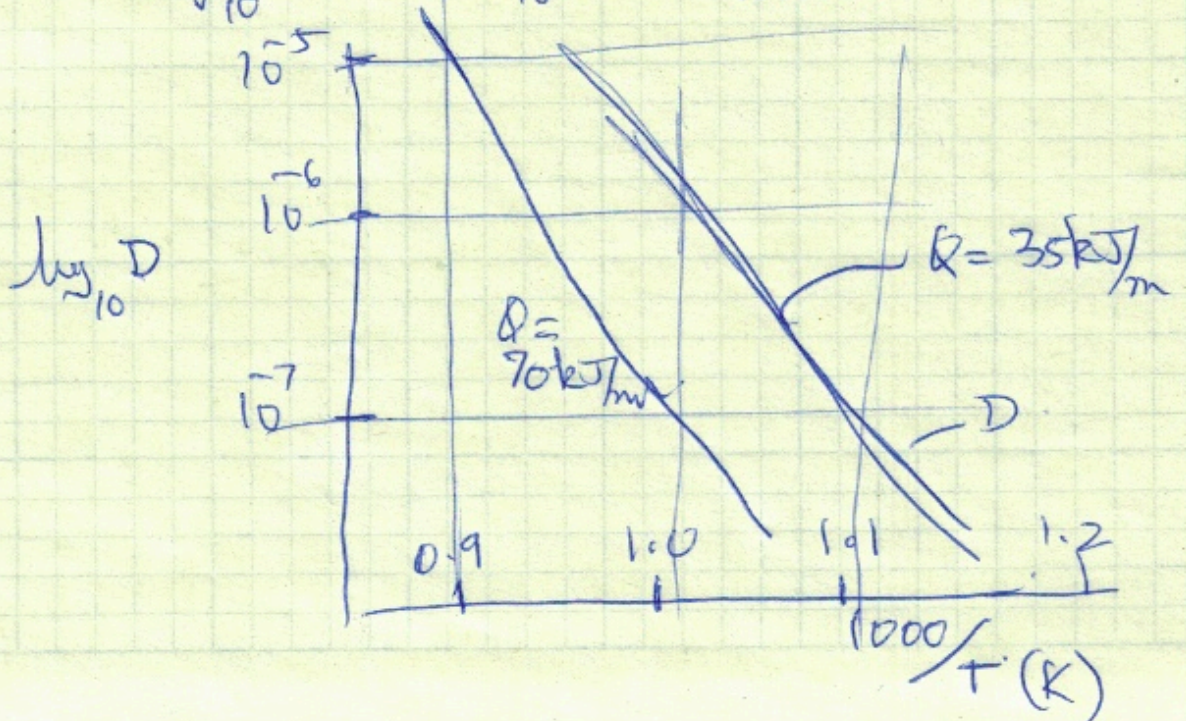
$$2\gamma_s \cos \theta = \gamma_B$$

9. okay

10. Arrhenius: ~~Graph~~ Graph.

$$D = D_0 e^{-\frac{Q}{RT}} \quad 2.3 = \ln 10$$

$$\log_{10} D = \log_{10} D_0 - \frac{Q \times 2.3}{1000R} \times \frac{1000}{T}$$



Consider the slope.

$$\Delta \log_{10} D = -\frac{2.3Q}{1000R} \times \Delta \left(\frac{1000}{T(K)} \right)$$

Slope as shown in the graph

$$\Delta \log_{10} D = 1 \quad (\text{one unit of magnitude})$$

$$\Delta \left(\frac{1000}{T(K)} \right) = 0.1,$$

$$\therefore \frac{2.3Q}{1000R} = \frac{1}{0.1}$$

$$\therefore Q = \frac{1000 \times 8.31 \times 10}{2.3} \text{ J/mol}$$

$$\approx 35 \text{ kJ/mol}.$$

LEARN TO UNDERSTAND THIS GRAPH
AND TO ANALYZE QUICKLY BY
INSPECTION.

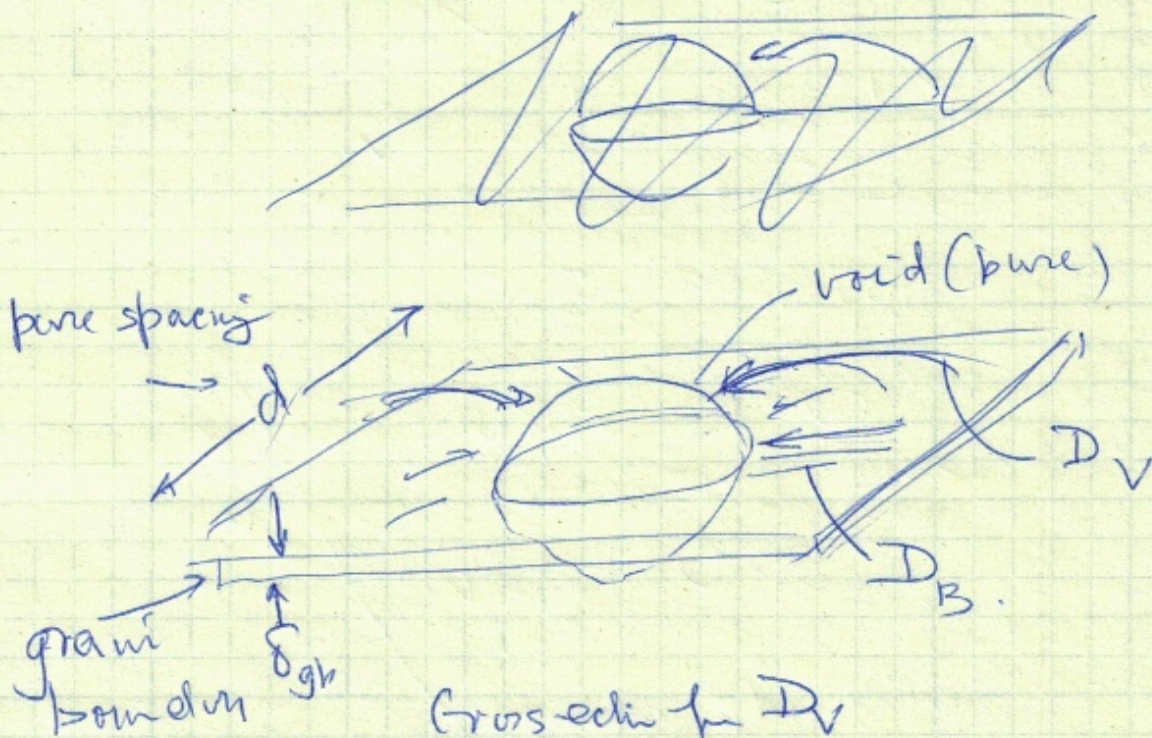
Change D_0 simply shifts the curve.
without changing their slope

11.

$$D_{\#} = D_V + \alpha \frac{\delta_{gb} D_B}{d}$$

$$= \frac{1}{d} \left[d D_V + \alpha \delta_{gb} D_B \right]$$

different cross section of diffn.



Cross section for D_V

$$= d^2 D_V$$

for Boundary

$$= d \delta_{gb} D_B$$

They are additive