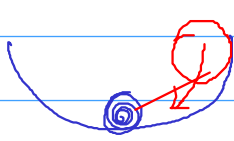
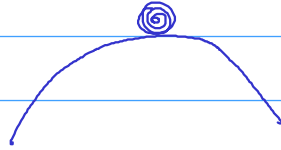


Atmospheric Boundary Layer (ABL) - Layer (ABL)

Z_i : βάθος (depth) ABL



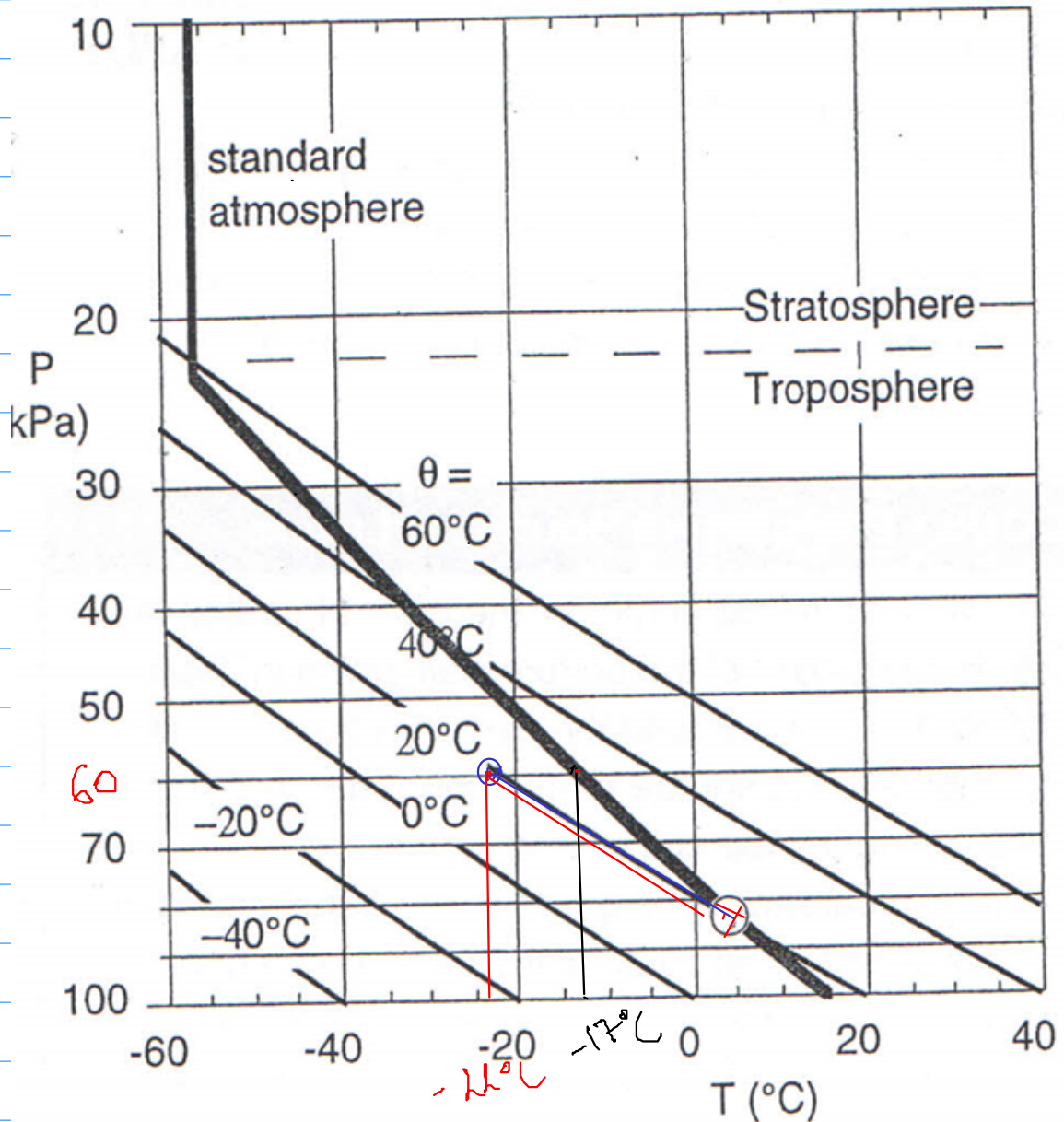
Convective layer



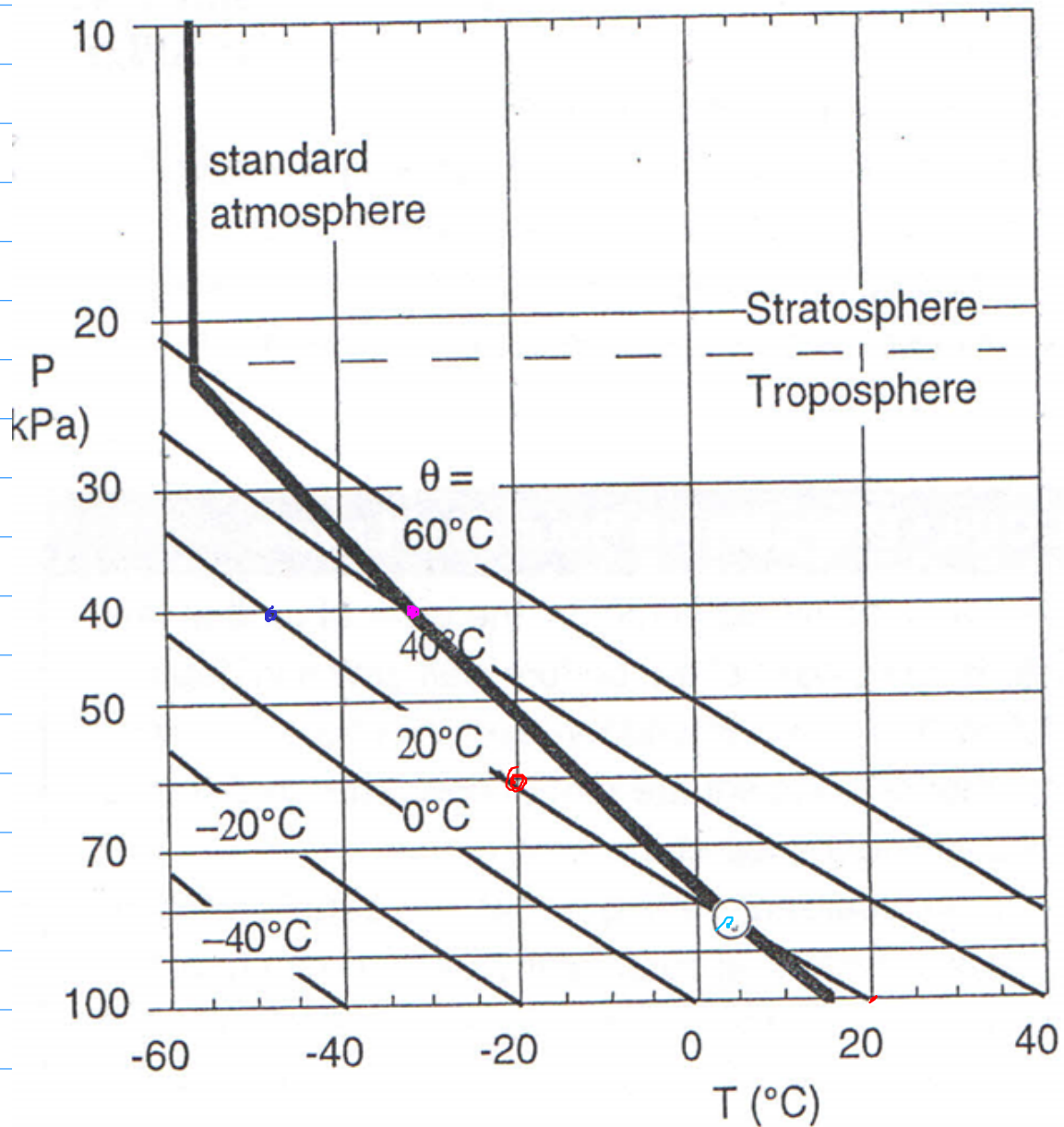
Adiabatic layer



Oxidation layer



$$\theta(z) = T(z) + \Gamma_d \cdot z$$



$$T = -20^\circ\text{C} \quad \theta = 20^\circ\text{C}$$

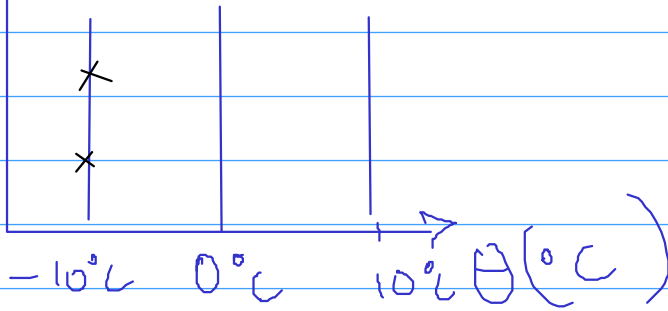
$$T = -45^\circ\text{C} \quad \theta = 20^\circ\text{C}$$

$$T = -30^\circ\text{C} \quad \theta = 40^\circ\text{C}$$

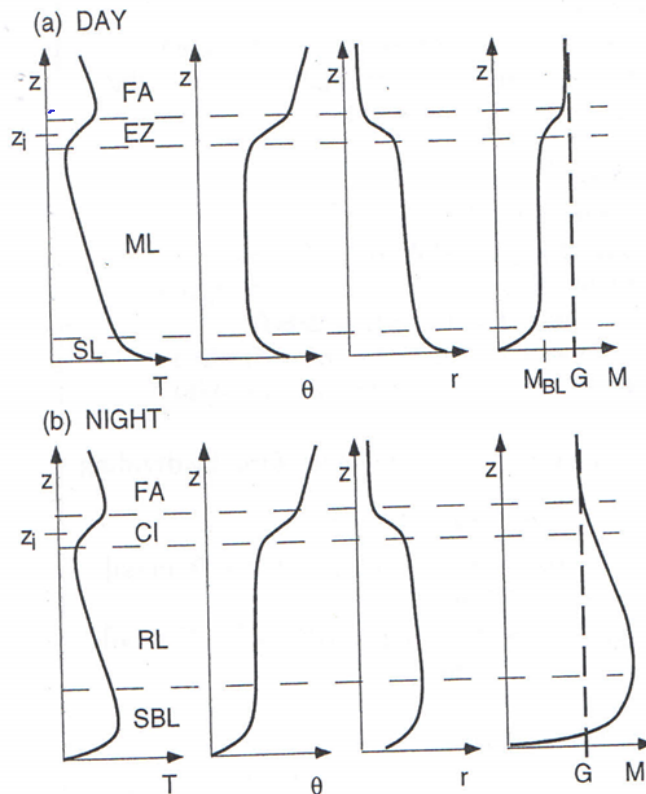
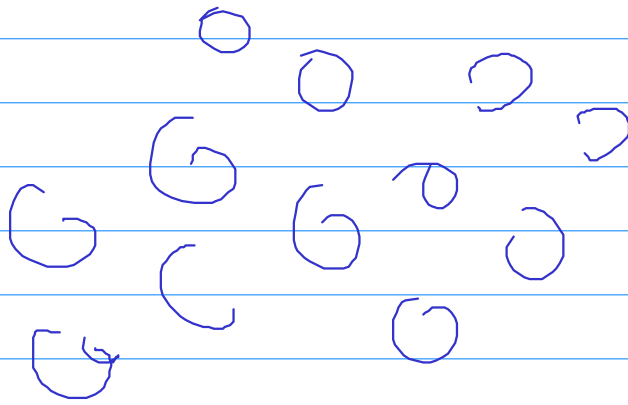
$$T = 5^\circ\text{C} \quad \theta = 20^\circ\text{C}$$

$z(m)$

Graph αναβατική
δίκτυα

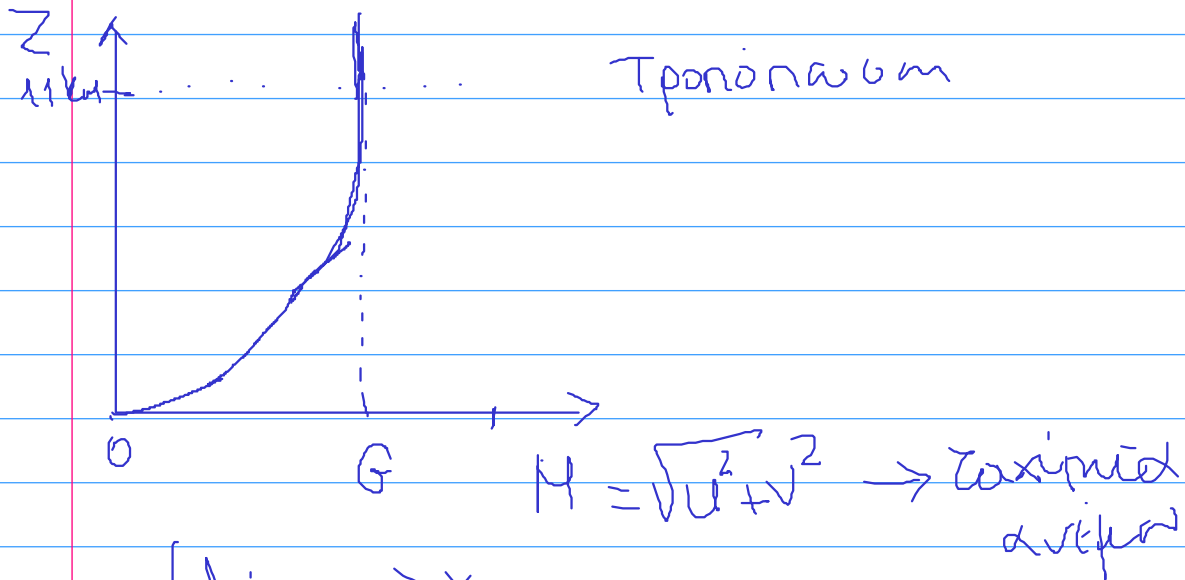


Θερμότητα
γιατί
αναβατική



Τεωρητικός άνεμος G :

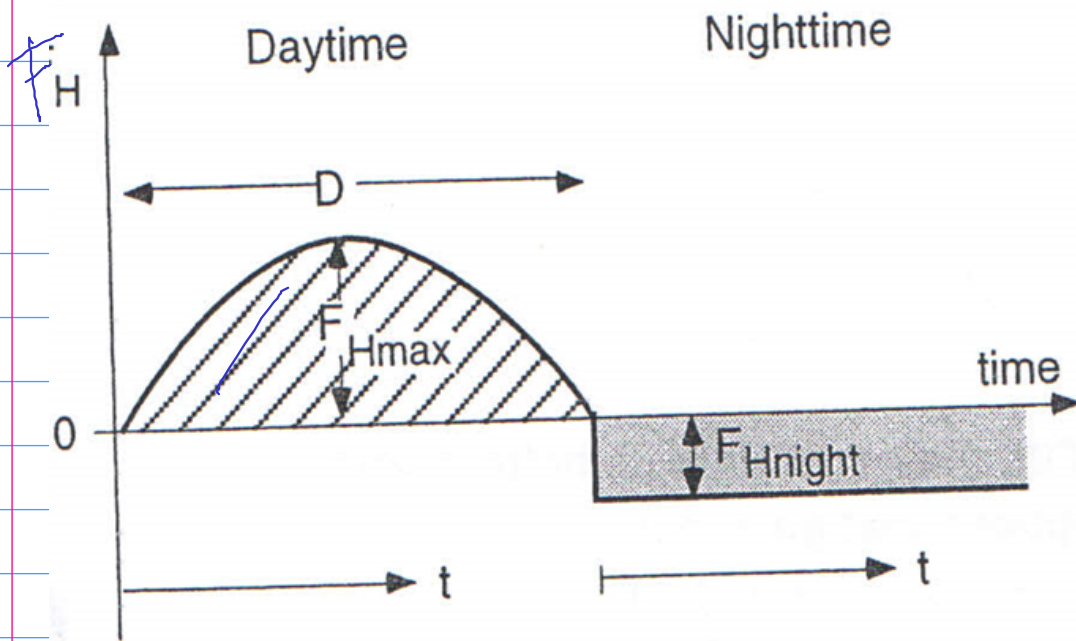
Άνεμος λόγω τριβής



$u \rightarrow x$

$v \rightarrow y$

$w \rightarrow z$



$$F_H = \frac{\dot{Q}_H}{A} \quad \text{komparatívni poň Dephaviors}$$

$$Q_{Ak} = F_{Hnight} \cdot t \quad Q_A = \int F_{Hnight} \cdot t$$

$$Q_{Ak} = \frac{F_{Hmax} \cdot D}{\eta} \left[1 - \cos\left(\frac{\pi t}{D}\right) \right]$$

$$Q_A = \frac{F_{Hmax} \cdot D}{\eta} \left[1 - \cos\left(\frac{\pi t}{D}\right) \right]$$

Ans Design: $Q_{A \text{ day}}$ $Q_{A \text{ day}}$

$$F_H = F_{H \max} \cdot \sin\left(\frac{\pi t}{D}\right) \quad (1)$$

$$Q_{AK} \equiv \int_{t=0}^t F_H dt = F_{H \max} \int_{t=0}^t \sin\left(\frac{\pi t}{D}\right) dt \quad (2)$$

$$\int \sin(ax) = -\frac{1}{a} \cos(ax)$$

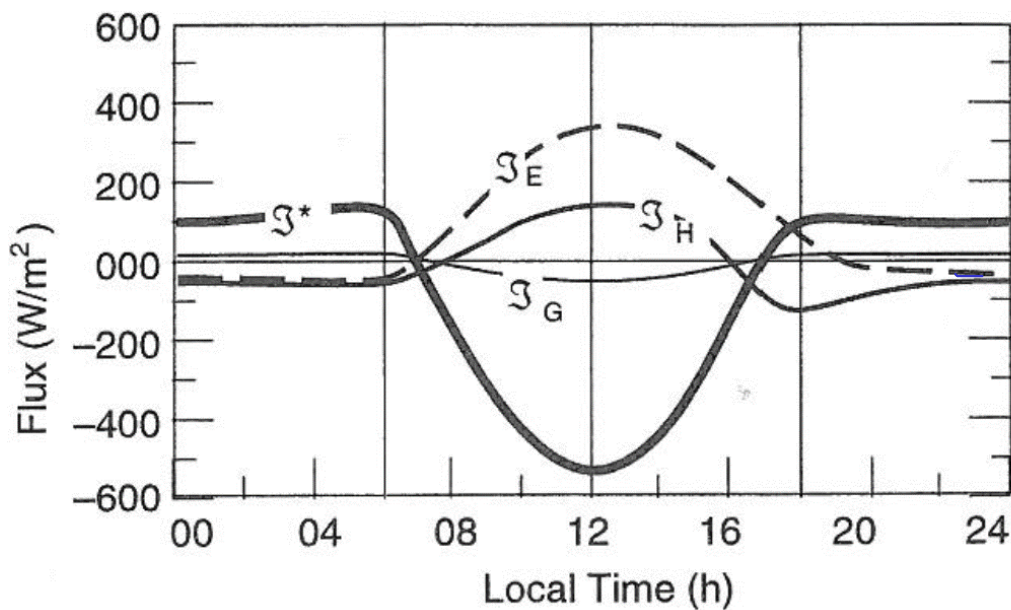
$$(2) \quad Q_{AK} = -\frac{F_H}{\left(\frac{\pi}{D}\right)} \cdot \cos\left(\frac{\pi t}{D}\right) \Big|_0^t =$$

$$= -\frac{F_H \cdot D}{\pi} \cdot \left[\cos\left(\frac{\pi t}{D}\right) - \cos(0) \right] =$$

$$= -\frac{F_H \cdot D}{\pi} \left[\cos\left(\frac{\pi t}{D}\right) - 1 \right] =$$

$$= \frac{F_H D}{\pi} \left[1 - \cos\left(\frac{\pi t}{D}\right) \right]$$

Задача 1. АОС



Дано: $S_{H_{max}} = 150 W/m^2$ $D = 8 h$
 Найти: $S_{H_{night}} = -50 W/m^2$

$$F_H = \frac{S_{H_{max}}}{\rho C_{pair}} = \frac{150 W/m^2}{1231 W/m^2 / km/s} = 0,122 \frac{km}{s} \left(^\circ C \cdot \frac{m}{s} \right)$$

$$F_{H_{night}} = \frac{S_{H_{night}}}{\rho C_{pair}} = -0,041 \frac{km}{s} \left(^\circ C \cdot \frac{m}{s} \right)$$

$$\text{Упра: } Q_{Ak} = \frac{F_{H_{max}} \cdot D}{\eta} \left[1 - \cos\left(\frac{\pi \cdot t}{D}\right) \right] =$$

$$= \frac{0,122 \text{ k} \cdot \frac{\text{m}}{\text{s}}}{3,14} \left(8\% \cdot \frac{3600 \text{ s}}{\text{h}} \right) [1 - \cos \pi]$$

$$= 2237 \text{ k} \cdot \text{m}$$

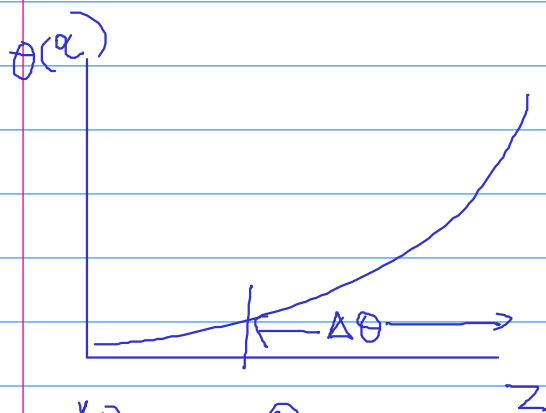
Nexta: $Q_{Ak} = F_{\text{night}} \cdot t =$

$$= -0,041 \cdot 16\% \cdot \frac{3600 \text{ s}}{\text{h}} =$$

$$= -2362 \text{ k} \cdot \text{m}$$

Agenda 2 AOS

θ vs z 12h vixta $M_1 = 10 \text{ m/s}$ $M_2 = 5 \text{ m/s}$



$$a = 0,15 \text{ m}^{1/4} \cdot s^{1/4} =$$

$$= 6 \pi a \theta$$

$$\Delta \theta_s = \frac{Q_{Ak}}{z}$$

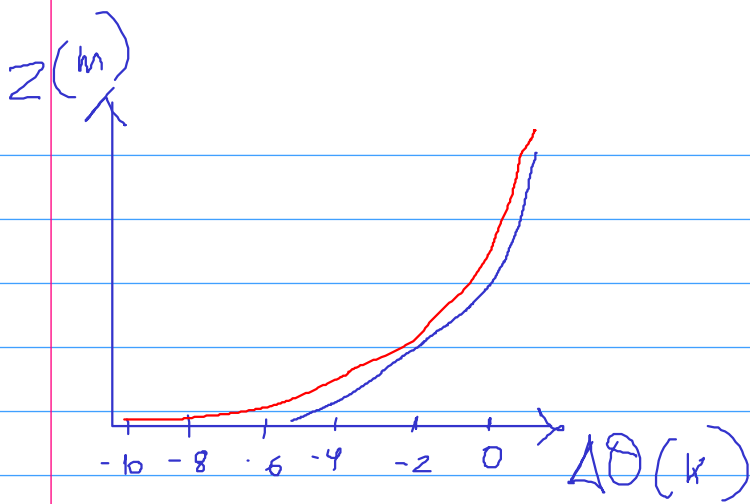
$$He_1 = a \cdot M_{KL_1}^{3/4} \cdot t^{1/2} = 0,15 \text{ m}^{1/4} \text{ s}^{1/4} \cdot \left(10 \frac{\text{m}}{\text{s}} \right)^{3/4} \cdot \left(12 \text{ h} \cdot \frac{3600 \text{ s}}{\text{h}} \right)^{1/2}$$

$$= 175 \text{ m}$$

$$He_2 = 104 \text{ m}$$

$$\Delta \theta_{s_1} = \frac{-1000 \text{ k} \cdot \text{m}}{175 \text{ m}} = -5,71^\circ \text{C (K)}$$

$$\Delta \theta_{s_2} = \frac{-1000 \text{ k} \cdot \text{m}}{104 \text{ m}} = -9,62^\circ \text{C (K)}$$



$\frac{\Delta\theta}{\Delta z}$	z
$\Delta\theta_s$	0
.	1

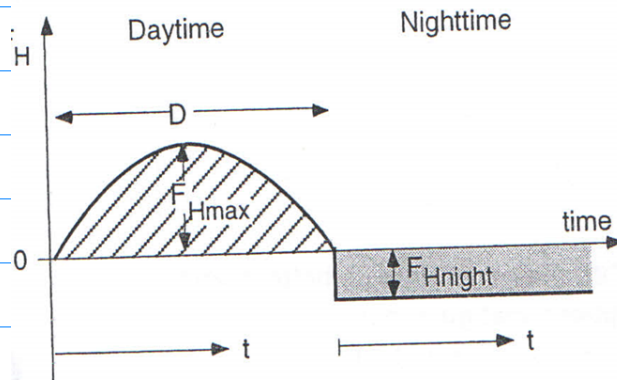
$$\Delta\theta(z) = \Delta\theta_s \cdot e^{-z/H_e}$$

$J_H \div$ Ποι θερμότητας (απόδοση)
 $J_E \div$.. (απορρόφηση)
 $F_H = \frac{J_H}{\rho C_{par}} \rightarrow ^\circ C \cdot m/s$

Άσκηση 4.3

$Q_{Ak, day}$

Q_{night}

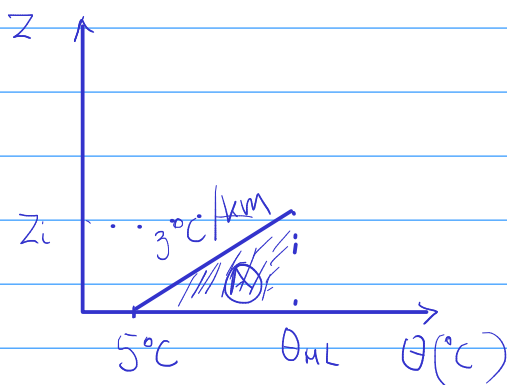


$$\theta = 5^\circ C$$

$$\frac{\Delta\theta}{\Delta z} = 3^\circ C/km \left(\frac{3K}{km} \right)$$

$$Q_{Ak} = 500 K \cdot m$$

$$\theta_{HL} = ; (10.00) \quad z_i = ; (10.00)$$



$$Q_{Ak} = \epsilon_H \rho \Delta\theta_A = 500 K \cdot m$$

$$\begin{aligned}
 \epsilon_H \rho \Delta\theta_A &= 0.5 \cdot (\theta_{HL} - 5^\circ C) \cdot z_i = \\
 &= 0.5 \frac{\Delta\theta}{\Delta z} \cdot z_i \cdot z_i = \\
 &= 0.5 \frac{\Delta\theta}{\Delta z} z_i^2
 \end{aligned}$$

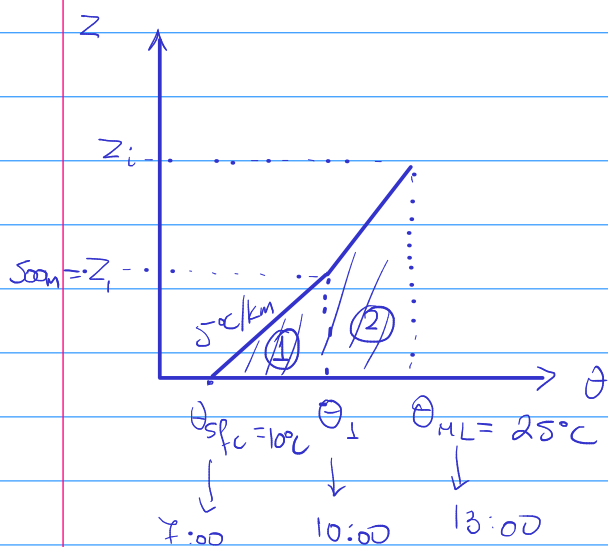
$$Q_{\text{ραδία}} = 500 \text{ k} \cdot \text{m} = Q_{\text{AK}}$$

$$500 \text{ k} \cdot \text{m} = 0,5 \cdot \frac{3 \text{ k}}{1000 \text{ m}} \cdot z_i^2$$

$$\boxed{z_i = 577 \text{ m}} \rightarrow \text{Βάθος σπείματος} \\ \text{δραμξής ΑΟΣ}$$

$$\theta_{\text{HL}} = 5^\circ \text{C} + \frac{\Delta \theta}{\Delta z} \cdot z_i = 5^\circ \text{C} + \frac{3 \text{ k}}{1000 \text{ m}} \cdot 577 \text{ m} \\ = 6,73^\circ \text{C}$$

Άσκηση 4.4



$$Q_{\text{AKnight}} = F_{\text{night}} \cdot t$$

$$t = 14 \text{ h}$$

$$F_{\text{night}} = \frac{J_{\text{night}}}{c_p \cdot p} = \\ = \frac{-100 \text{ W/m}^2}{1231 \left(\frac{\text{W/m}^2}{\text{km/s}} \right)} = \\ = -0,08123 \frac{\text{K} \cdot \text{m}}{\text{s}}$$

$$Q_{\text{AKnight}} = -0,08123 \text{ k} \cdot \frac{\text{m}}{\text{s}} \cdot 14 \text{ h} \cdot \frac{3600 \text{ s}}{\text{h}} = -4094,23 \text{ k} \cdot \text{m}$$

$$Q_{\text{AKday}} = 2 \cdot |Q_{\text{AKnight}}| = 8188,46 \text{ k} \cdot \text{m}$$

$$Q_{\text{AKday}} = Q_{\text{AK}_1} + Q_{\text{AK}_2} \quad (1)$$

$$\theta_1 = \frac{5^\circ \text{C}}{1000 \text{ m}} \cdot z_1 + \theta_{\text{spfc}} = 12,5^\circ \text{C}$$

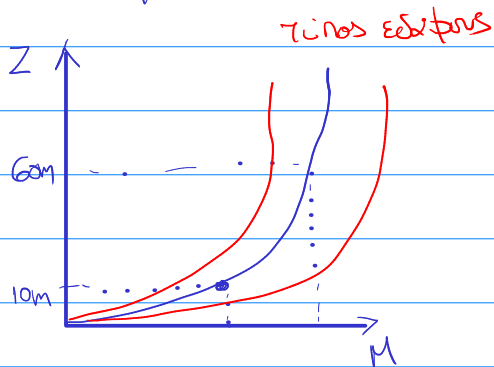
$$Q_{\text{AK}_1} = \frac{1}{2} (\theta_1 - \theta_{\text{spfc}}) \cdot z_1 = 625 \text{ k} \cdot \text{m}$$

$$Q_{Ak2} = 8188,46 \text{ k} \cdot \text{m} - 625 \text{ k} \cdot \text{m} = 7563,46 \text{ k} \cdot \text{m}$$

$$Q_{Ak2} = \underbrace{\frac{z_i + z_1}{2} \cdot (\theta_{ML} - \theta_1)}_{\text{Εμβαδόν Τραπεζίου}}$$

$$z_i = 1012 \text{ m}$$

Άνεμος ΓΤΟ Α.Ο.Σ



Άνευόμετρο
Άνευοδείκτος

Άσκηση 4.5

$$C_D = \frac{k^2}{\ln^2(z_R/z_0)} = \frac{0.4^2}{\ln^2(\frac{10}{1})} = 0.030 \text{ για χωρά}$$

$$C_D = 0.0047 \text{ για απείριστα } (z_0 = 0.03 \text{ m})$$

$$u_*^2 = C_D \cdot u_{x0}^2 = 0.03 \cdot 5^2 \frac{\text{m}^2}{\text{s}^2} = 0.75 \frac{\text{m}^2}{\text{s}^2}$$

$$u_* = 0.87 \text{ m/s} \text{ για χωρά}$$

$$u_* = 0.34 \text{ m/s} \text{ για απείριστα}$$

$$u_*^2 = \left| \tau / \rho \right|$$

$$\tau = u_*^2 \cdot \rho = 0.9 \text{ kg/m/s}^2 =$$

$$= 0.9 \text{ Pa} \text{ για χωρά}$$

$$\tau = 0.14 \text{ για απείριστα}$$

Άσκ. 4.6

$$M_1 = 5 \text{ m/s} \quad z_1 = 10 \text{ m}$$

$$M_2 = ? \quad \text{σε} \quad z_2 = 25 \text{ m}$$

$$z_0 = 95 \text{ m}$$

$$M_2 = M_1 \cdot \frac{\ln(z_2/z_0)}{\ln(z_1/z_0)} = 6,53 \text{ m/s}$$

Άσκηση 4.8

$k = 0,4$ γιὰ τὴν Von Karman

$$M_2 = M_1 \cdot \frac{\ln(z_2 / z_0)}{\ln(z_1 / z_0)}$$

$$u_* = \frac{k \cdot M_{10}}{\ln[z_R / z_0]}$$

Δίνεται η μέτρηση της μέσης ταχύτητας του ανέμου στο Πολυτεχνείο Κρήτης και σε ύψος 10m από το έδαφος ίση με 3m/s. Να υπολογιστεί η ταχύτητα του ανέμου σε ύψος 40m θεωρώντας ουδέτερη ατμόσφαιρα. Να υπολογιστεί η ταχύτητα τριβής στη συγκεκριμένη θέση και να συγκριθεί με την ταχύτητα τριβής στην πόλη των Χανίων. Δίνονται οι κατηγορίες τραχύτητας στον Πίνακα 1. Αναφέρατε τις παραδοχές που κάνετε για τους υπολογισμούς σας.

Πίνακας 1. Κατηγορία τραχύτητας

Κατηγορία τραχύτητας	Τύπος εδάφους	Μήκος τραχύτητας (m)
1	Επίπεδο έδαφος	0.021
2	Περιστικές περιοχές με χαμηλή βλάστηση	1.2
3	Πόλεις-Αστικά κέντρα	2