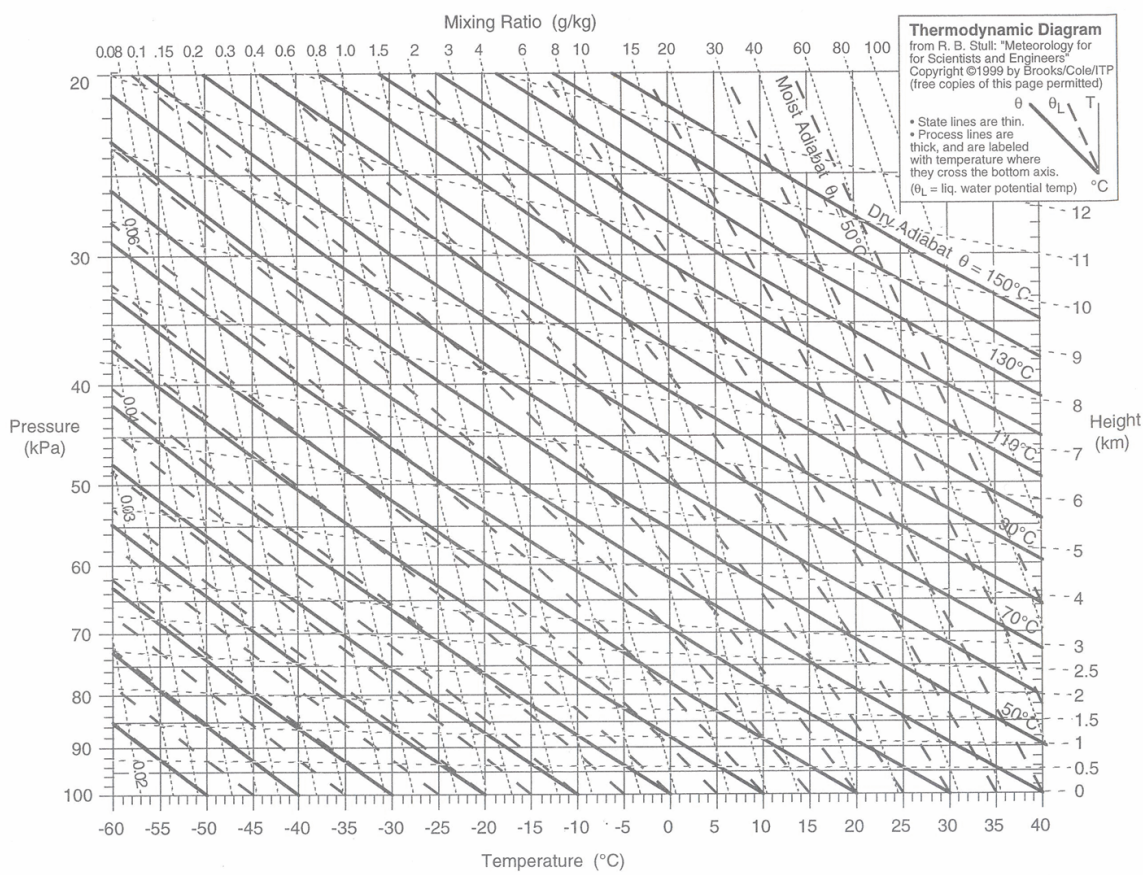




$T_s = 5^\circ\text{C}$
 $r_s = 10 \text{ g/kg}$
 Ο αέρας σε P_1 κ' T_1
 μπορεί να έχει $r_s = 10 \text{ g/kg}$
 υγρασίας (max)

$r = 5 \text{ g/kg}$
 $RH = \frac{r}{r_s} = \frac{5}{10} = 0,5 = 50\%$ υγρασία

$P_2 = 30 \text{ kPa}$ $T_2 = 24^\circ\text{C}$ $r_{s2} = 2 \text{ g/kg}$

Γ_g : υγρή αδιαβρατική 6°C/km

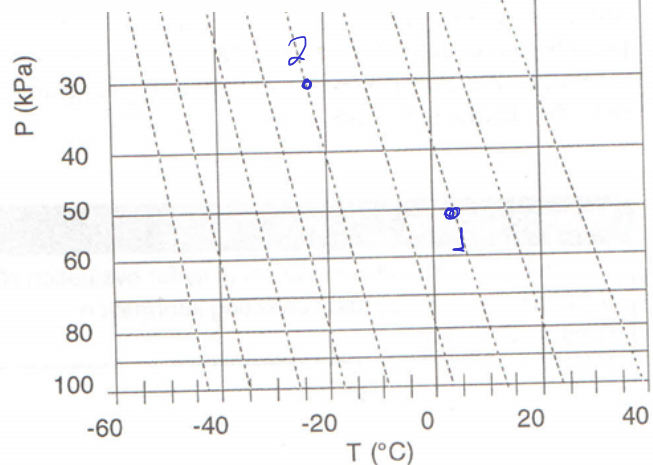
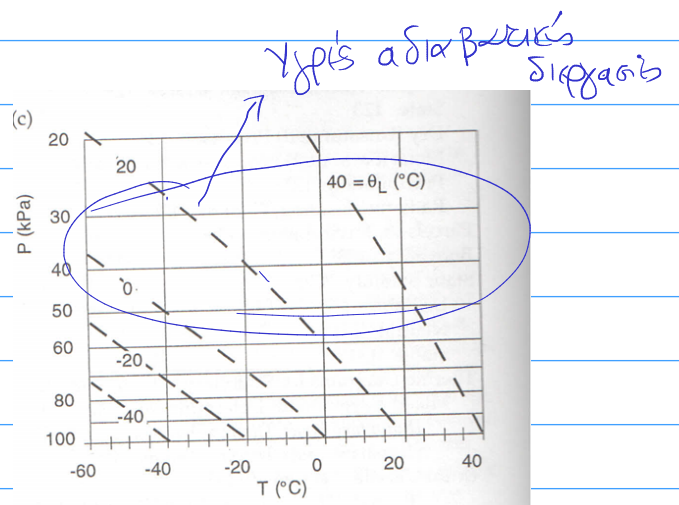


Figure 6.1



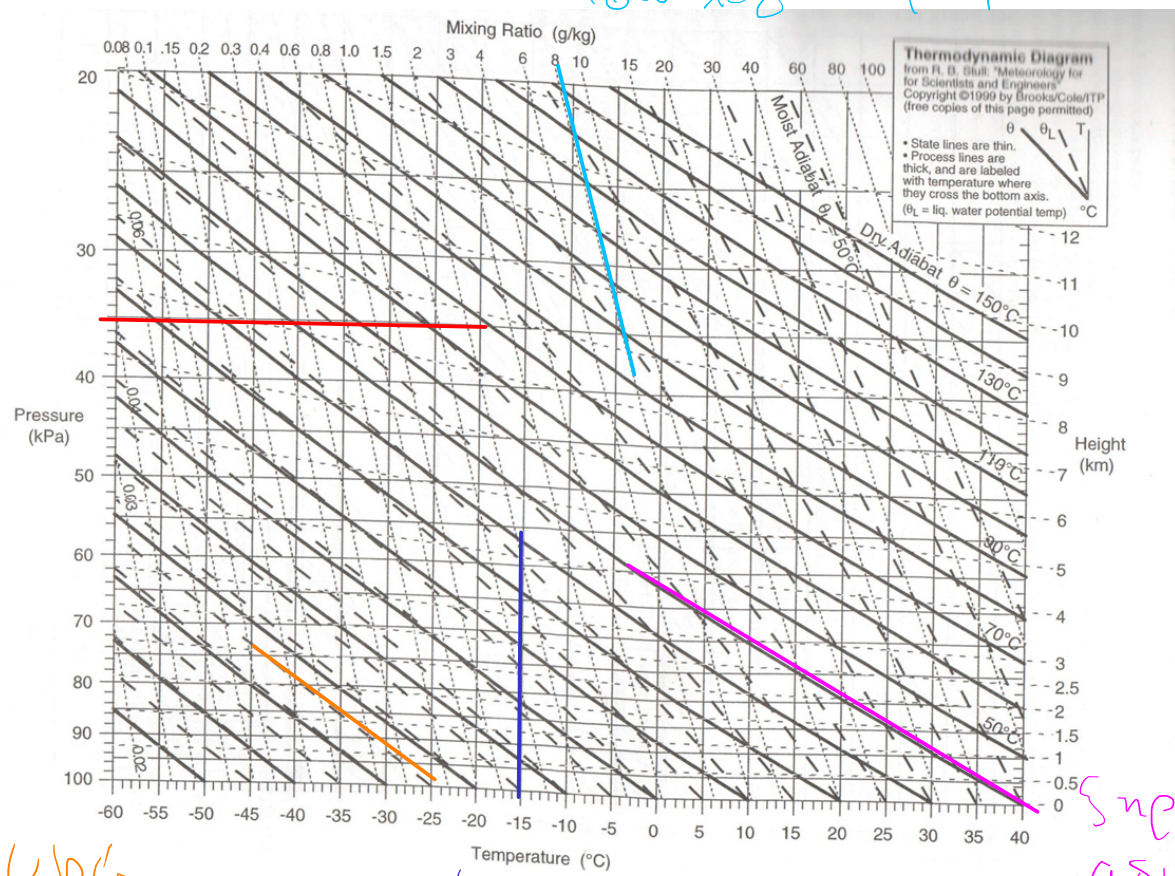
1600 20800 usparakis

1600 usparakis

usparakis
usparakis

1600 usparakis

usparakis
usparakis

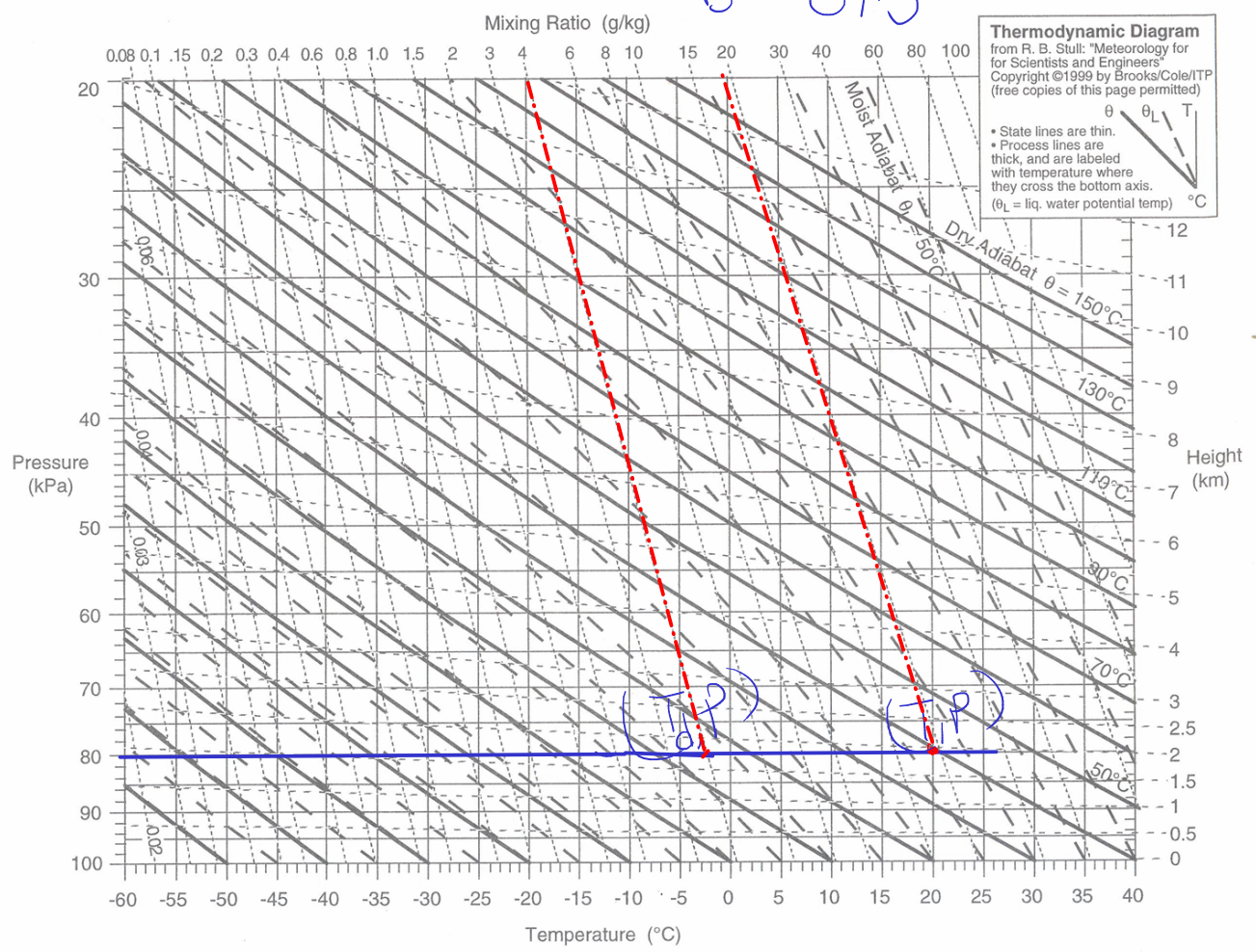


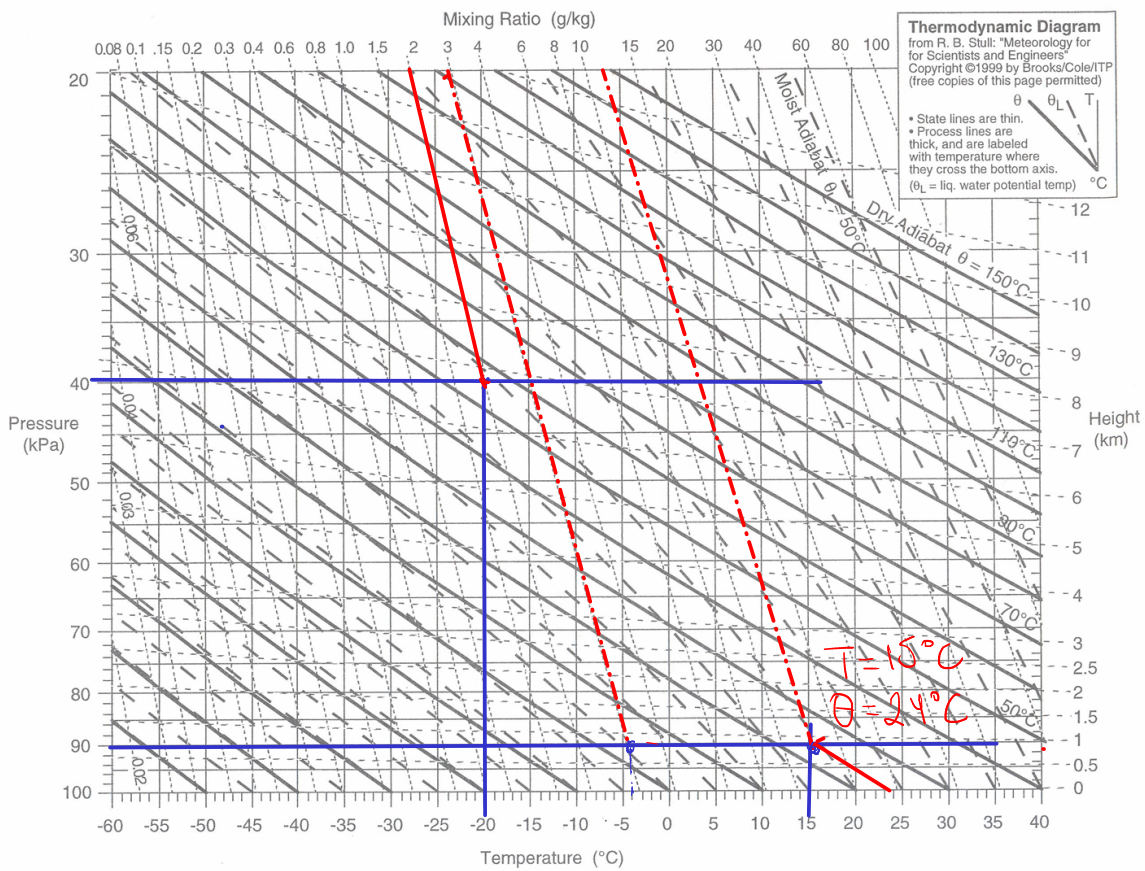
Thermodynamic Diagram

$r = 4 \text{ g/kg}$

$r_s = 19 \text{ g/kg}$

$2H = \frac{r}{g} = \frac{4}{19} = 0.21$
 $P = 80 \text{ kPa}$
 $T = 20^\circ\text{C}$
 $T_d = -25^\circ\text{C}$
 $R_H =$





7.2

$P = 90 \text{ kPa}$
 $T = 15^\circ \text{C}$
 $RH = 25\%$

$r = ?$
 $r_s = ?$
 $T_d = ?$

$r_s = 12 \text{ g/kg}$

$$RH = \frac{25}{100} = \frac{r}{r_s} \Rightarrow r = \frac{25}{100} \cdot 12 = 3 \text{ g/kg}$$

$$T_d = -4^\circ \text{C}$$

7.3

$P = 40 \text{ kPa}$
 $T = -20^\circ \text{C}$
 $RH = 100\%$

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

$r = r_s = 2 \text{ g/kg}$

Thermodynamic Diagram
 from R. B. Stull: "Meteorology for Scientists and Engineers"
 Copyright ©1999 by Brooks/Cole/ITP
 (free copies of this page permitted)

- State lines are thin.
- Process lines are thick, and are labeled with temperature where they cross the bottom axis.
- (θ_L = liq. water potential temp) °C

Top X-axis: Mixing Ratio (g/kg): 0.08, 0.1, 0.15, 0.2, 0.3, 0.4, 0.6, 0.8, 1.0, 1.5, 2, 3, 4, 6, 8, 10, 15, 20, 30, 40, 60, 80, 100

Bottom X-axis: Temperature (°C): -60, -55, -50, -45, -40, -35, -30, -25, -20, -15, -10, -5, 0, 5, 10, 15, 20, 25, 30, 35, 40

Left Y-axis: Pressure (kPa): 20, 30, 40, 50, 60, 70, 80, 90, 100

Right Y-axis: Height (km): 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2.5, 2, 1.5, 1, 0.5, 0

Key lines and labels:

- Dry Adiabats:** Solid lines labeled with temperature at the bottom (e.g., 50°C, 150°C, 130°C, 110°C, 90°C, 70°C, 50°C).
- Moist Adiabats:** Dashed lines.
- Mixing Ratio Lines:** Dotted lines labeled with values (e.g., 0.08, 0.1, 0.15, 0.2, 0.3, 0.4, 0.6, 0.8, 1.0, 1.5, 2, 3, 4, 6, 8, 10, 15, 20, 30, 40, 60, 80, 100).

Parcel Path:

- Ascent (Blue line):** Starts at 100 kPa, 20°C. Follows a dry adiabat to 80 kPa, -5°C. Then follows a moist adiabat to 80 kPa, -10°C.
- Descent (Red line):** Starts at 80 kPa, -10°C. Follows a moist adiabat to 100 kPa, 2°C.

Final State: At 100 kPa, 2°C, labeled $T = 2^\circ\text{C}$.

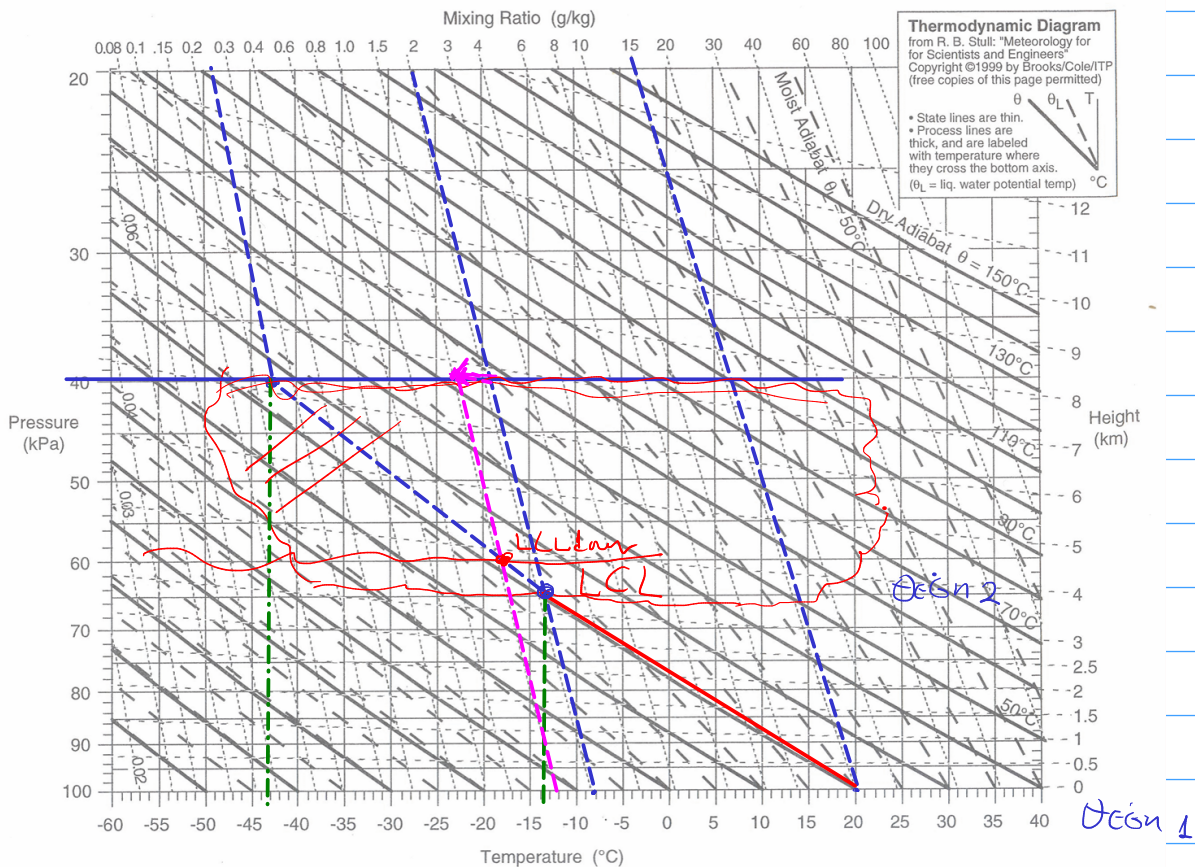
Θ₁: $\bar{r} = 15 \text{ g/kg}$ $\bar{r} = 2,6 \text{ g/kg}$
 $RH = \frac{2,6}{15} = 17,3\%$

Q2 : $r = 2,6 \text{ g/kg}$ $\theta = 20^\circ\text{C}$ $T = 2^\circ\text{C}$ $r_s = 5,5 \text{ g/kg}$

$RH = \frac{2,6}{5,5} = 47,3\%$

Αδριατικής Στεγανότητας:

Δεν υπάρχει ανεπαρκής θέρμανση & υγρασία
με το ΑΠΙ ΒΑΛΑΝ



LCL: Lift Condensation Level
Εννέδο συμπύκνωσης

$P = 100 \text{ kPa}$ $T = 20^\circ\text{C}$ $T_d = -8^\circ\text{C}$ ο αέρας ανεβαίνει αδιαπνευστά
Να φτάσει το LCL

Design 1: $r_s = 15 \text{ g/kg}$ $r = 2 \text{ g/kg}$ $RH = \frac{2}{15} = 13,3\%$

Design 2: LCL up $P = 65 \text{ kPa}$ $T = -14^\circ\text{C}$ $T_d = -14^\circ\text{C}$
 $RH = \frac{r = 2}{r_s = 2} = 100\%$
 $\theta = 20^\circ\text{C}$

Θέση 3: $P = 40 \text{ kPa}$

ανεβαίνουμε με υγρή αδιαβατική

$$r_T = r_s + r_L = 2 \text{ g/kg}$$

$$\phi_H = 100\%$$

$$T = T_d = -43^\circ \text{C}$$

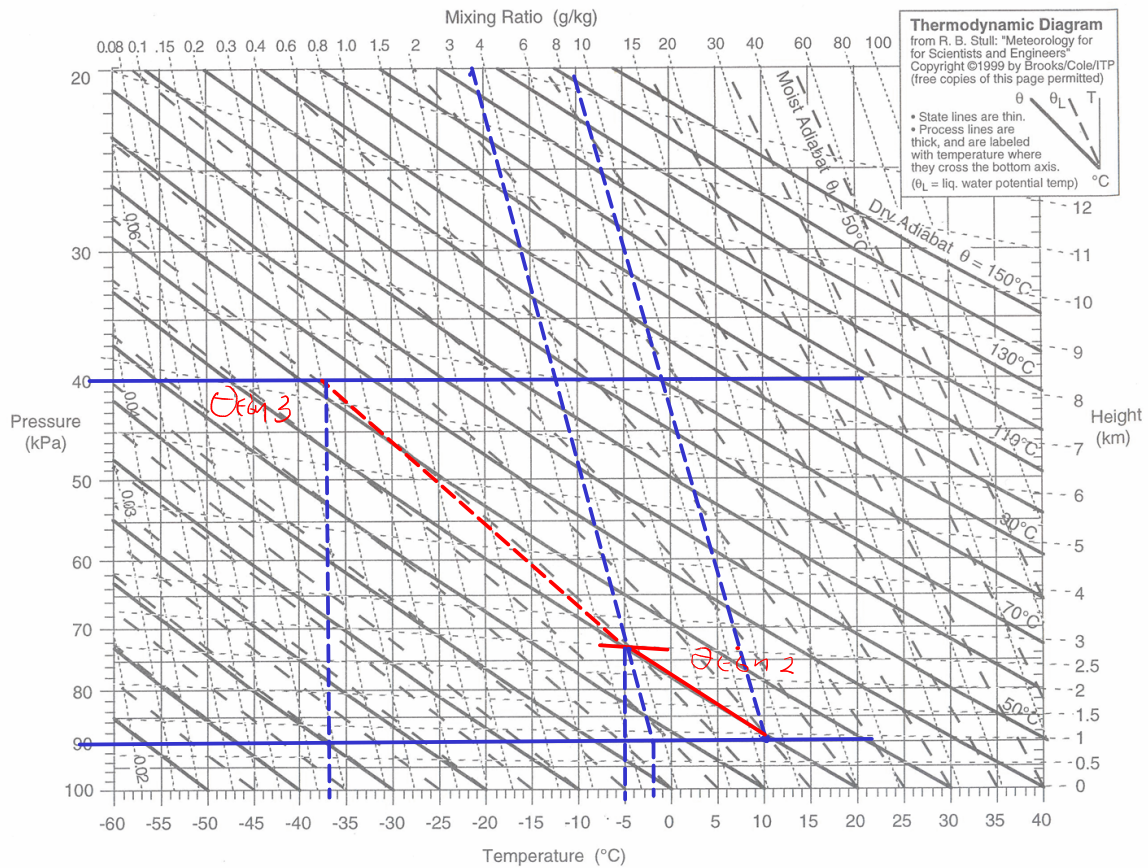
$$r_s = 0,25 \text{ g/kg}$$

$$r_L = 2 - 0,25 = 1,75 \text{ g/kg}$$

$$\theta = 20^\circ \text{C}$$

Ψυχρότητα: $0,5 \text{ g/kg}$

$$r_T = 1,5 \text{ g/kg}$$



$\theta_{eqn 1}$ $P = 90 \text{ kPa}$ $T = 10^\circ\text{C}$ $RH = 40\%$
 $r_s = 9 \text{ g/kg}$

$$RH = \frac{r}{r_s} \Rightarrow r = 40\% \cdot 9 = 3,6 \text{ g/kg}$$

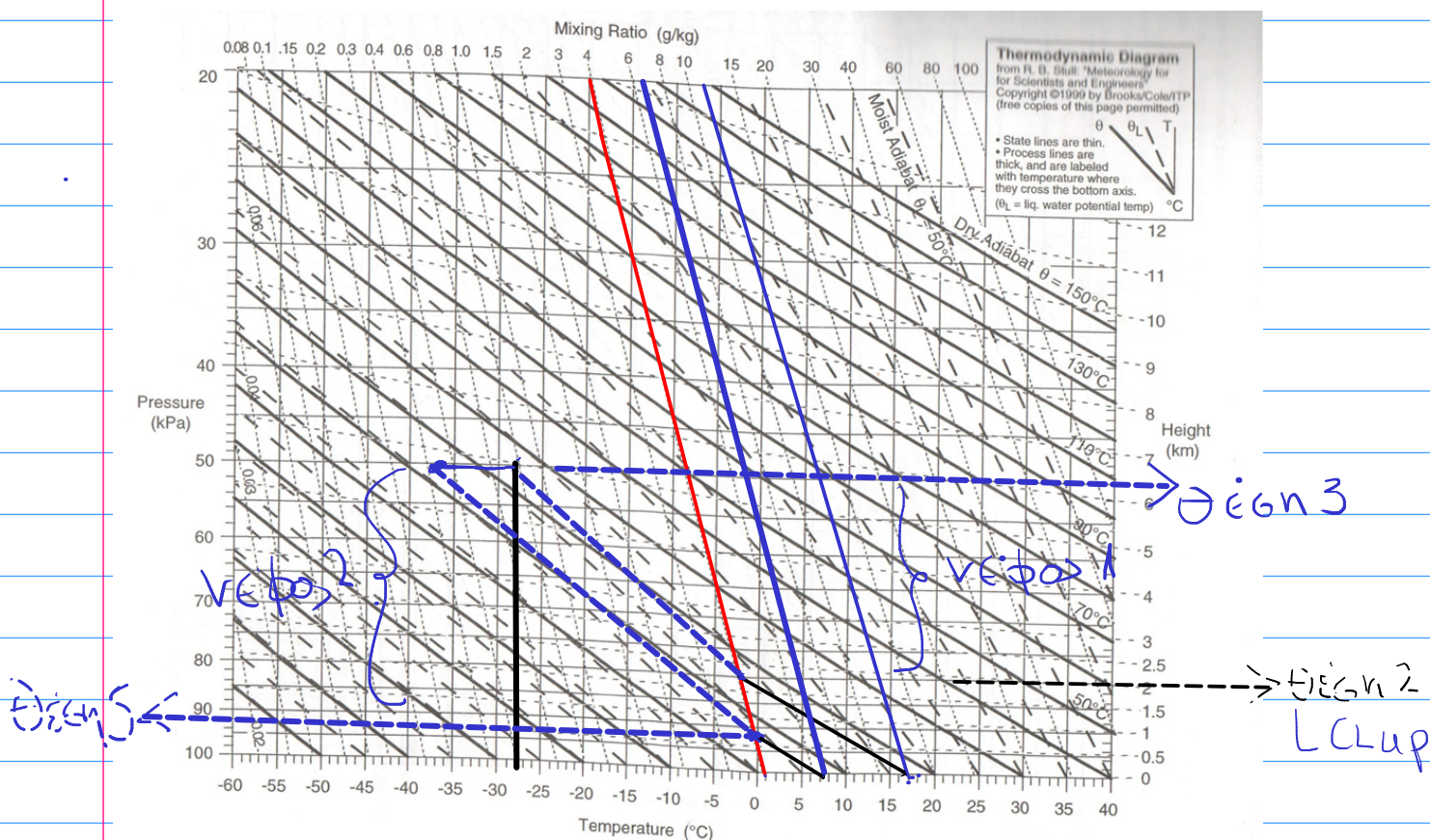
$$T_d = -2^\circ\text{C}$$

$\theta_{eqn 2}$: LCL_{up} $\rightarrow P = 74 \text{ kPa}$ $T = -5^\circ\text{C}$
 $T_d = -5^\circ\text{C}$

$$RH = 100\% \quad r = r_s = r_T = 3,6 \text{ g/kg}$$

$\theta_{eqn 3}$: $P = 40 \text{ kPa}$ $T = T_d = -37^\circ\text{C}$

$$r_T = 3,6 \text{ g/kg}$$



- Μάζα αέρα βρίσκεται σε πίεση 100kPa έχει θερμοκρασία 17°C και λόγο υδατμών 4 g/kg (Θέση 1).
 Ο αέρας ανεβαίνει αδιαβατικά μέχρι το επίπεδο συμπύκνωσης (Θέση 2-LCLup).
 Στη συνέχεια συνεχίζει την ανοδική του πορεία μέχρι τα 50 kPa (Θέση 4).
 Ο αέρας στη Θέση 3 ψύχεται λόγω ακτινοβολίας κατά 10 K (Θέση 4).
 Ο αέρας χάνει ύψος αδιαβατικά μέχρι το νέο επίπεδο συμπύκνωσης (Θέση 5 - LCLdown) και επιστρέφει στο έδαφος (Θέση 6).
1. Να βρεθεί η πίεση του αέρα και το ύψος στα επίπεδα συμπύκνωσης.
 2. Να υπολογιστούν η θερμοκρασία, η σχετική υγρασία, το σημείο δρόσου, ο λόγος υδατμών, ο λόγος κορεσμένων υδατμών, και η σχετική υγρασία για όλες τις θέσεις (1-6).

Θέση 1 : $P = 100 \text{ kPa}$ $T = 17^\circ \text{C}$ $T_d = 2^\circ \text{C}$

$$RH = \frac{r}{r_s}$$

$$RH = \frac{4}{12} = \frac{1}{3} = 33,3\%$$

$$r = 4 \text{ g/kg} \quad r_s = 12 \text{ g/kg}$$

Θέση 2 : $P = 80 \text{ kPa}$ $T = -2^\circ \text{C}$ $T_d = -2^\circ \text{C}$

$$r = 4 \text{ g/kg} \quad r_s = 4 \text{ g/kg}$$

$$RH = 100\%$$

$$\Theta \epsilon \text{6n } 3: P = 50 \text{ kPa} \quad T = -28^\circ \text{C} \quad T_d = -28^\circ \text{C}$$

$$RH = 100\%$$

$$r_s = 0,8 \text{ g/kg}$$

$$r_T = 4 \text{ g/kg}$$

$$r_L = 4 - 0,8 = 3,2 \text{ g/kg}$$

$$\Theta \epsilon \text{6n } 4: P = 50 \text{ kPa} \quad T = -38^\circ \text{C} \quad T_d = -38^\circ \text{C}$$

$$r_s = 0,35$$

$$r_T = 4 \text{ g/kg}$$

$$r_L = 4 - 0,35 = 3,65 \text{ g/kg}$$

$$\Theta \epsilon \text{6n } 5: P = 92 \text{ kPa} \quad T = T_d = -1^\circ \text{C}$$

$$RH = 100\%$$

$$r_T = 4 \text{ g/kg}$$

$$r_s = 4 \text{ g/kg}$$

$$\Theta \epsilon \text{6n } 6: P = 100 \text{ kPa} \quad T = 7^\circ \text{C} \quad T_d = 1^\circ \text{C}$$

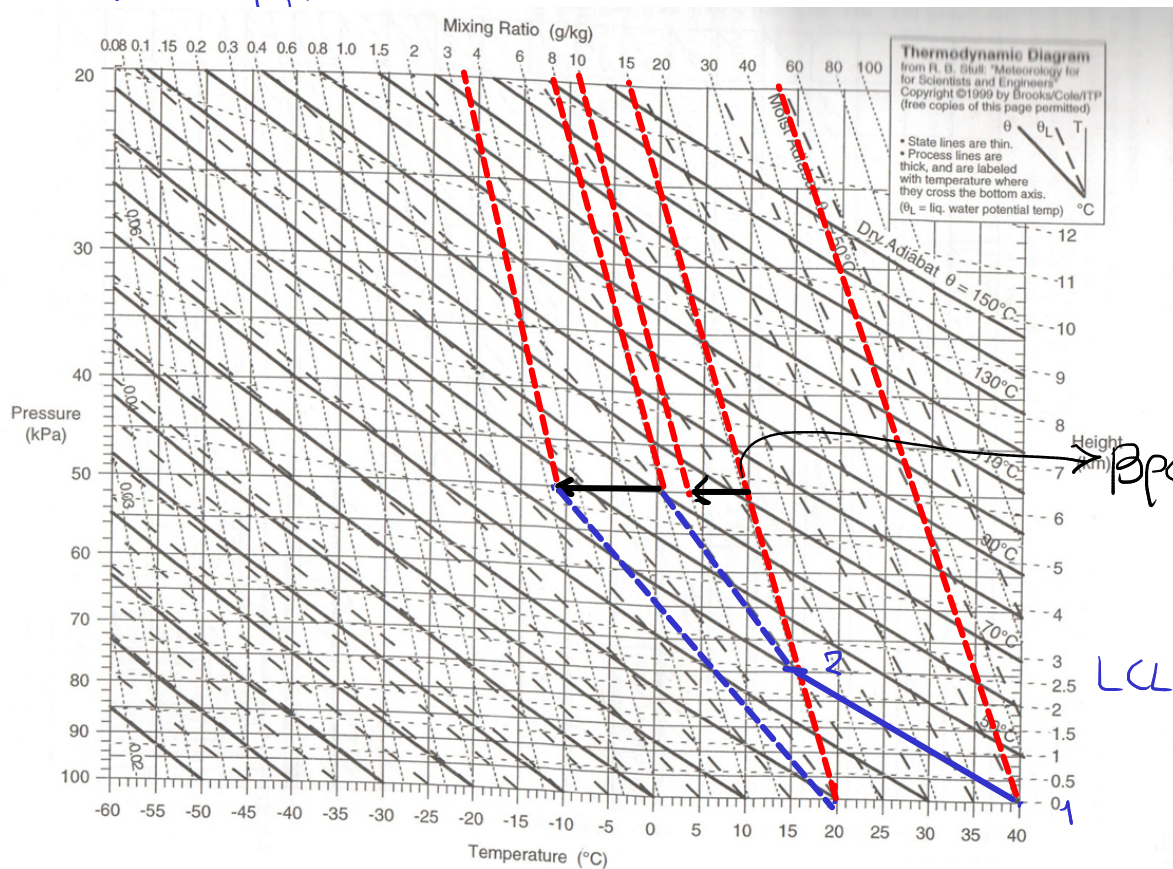
$$r_s = 6,8 \text{ g/kg}$$

$$R = \frac{4}{6,8} = 58,8\%$$

$$\Theta: \text{δυναμική θερμοκρασία} \quad \Theta_1 = \Theta_2 = \Theta_3 = T_{100 \text{ kPa}} =$$

$$17^\circ \text{C}$$

Παράδειγμα 5.



Θέση 1: $P = 100 \text{ kPa}$ $T = 40^\circ \text{C}$ $T_d = 20^\circ \text{C}$

$r = 15 \text{ g/kg}$ $r_s = 52 \text{ g/kg}$
 $RH = \frac{r}{r_s} = \frac{15}{52} \approx 28,8\%$

Θέση 2: $P = 75 \text{ kPa}$ $T = 15^\circ \text{C}$ $T_d = 15^\circ \text{C}$
 $RH = 100\%$ $r_T = 15 \text{ g/kg} = r_s$

Θέση 3 $P = 50 \text{ kPa}$ $T = T_d = 0^\circ \text{C}$
 $RH = 100\%$

$r_s = 8 \text{ g/kg}$ $r_T = 15 \text{ g/kg}$

$r_L = 15 - 8 = 7 \text{ g/kg}$

$r_i = 0$

Θεση 4: $P = 50 \text{ kPa}$ $T = -11^\circ\text{C}$ $T_d = -11^\circ\text{C}$

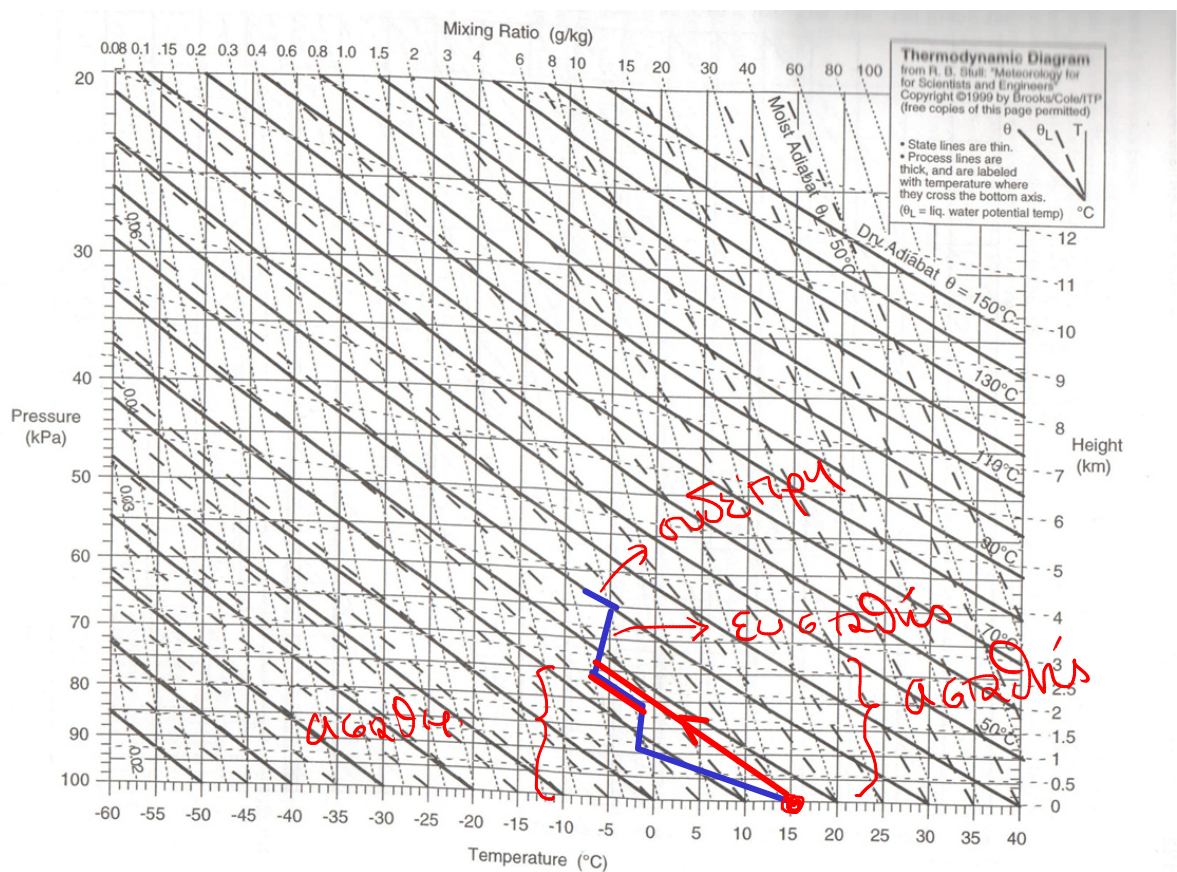
$$r_T = 15 - 5 = 10 \text{ g/kg} \quad \text{approx}$$

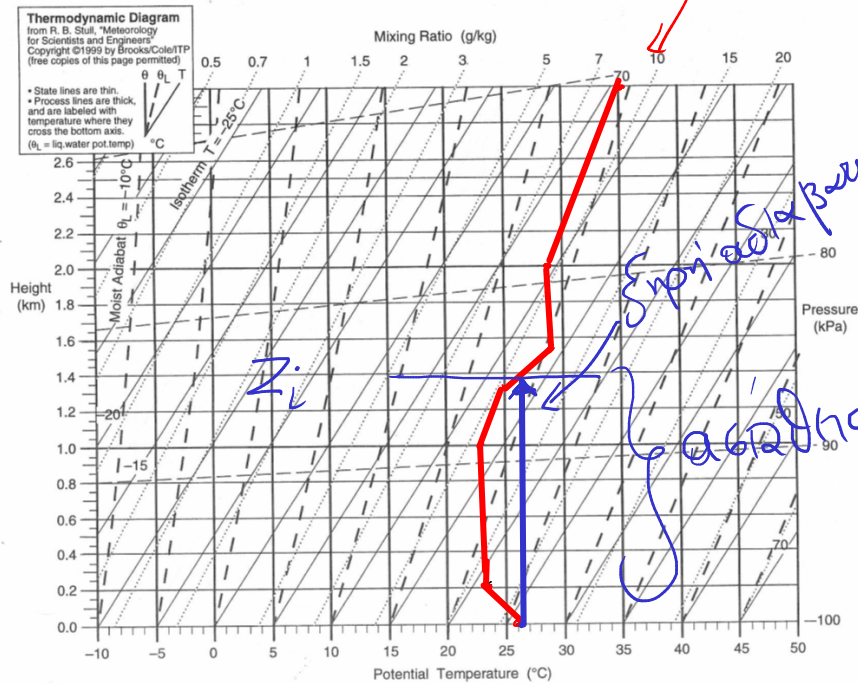
$$r_s = 3.5 \text{ g/kg}$$

$$r_L = 10 - 3.5 = 6.5 \text{ g/kg}$$

ΣΤΟ Εξάφως $RH = 100\%$

Ευκλεία





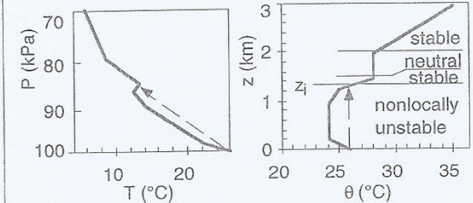
Solved Example (§)

Given the following potential temperature measurements. Plot them on the T vs. $\log P$ diagram, and on the θ vs. z diagram.

Indicate the static stability of each layer, and find the location of z_i .

z (km)	θ (°C)
3.0	35
2.0	28
1.5	28
1.3	25
1.0	24
0.2	24
0	26

Solution



$$z_i \approx 1.37 \text{ km}$$

Check: Physics OK. Sketch reasonable.

Discussion: θ vs. z is often easier to use than T vs. $\log(P)$. Note that z_i is not at the base of the subadiabatic region, but slightly above it due to nonlocal air-parcel rise.

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

$$\Gamma_d = 9.8^\circ\text{C}/\text{km}$$

z_i καθορίζεται από το ύψος του αεριοκλάσματος

$$z_i = 1.3 \text{ km}$$

θ (°C)	z (km)	T (z)
26	0	26
24	0.2	22.04 $\approx$ 22
24	1	14.2
25	1.3	12.26
28	1.5	13.3
28	2	8.4
35	3	5.6

