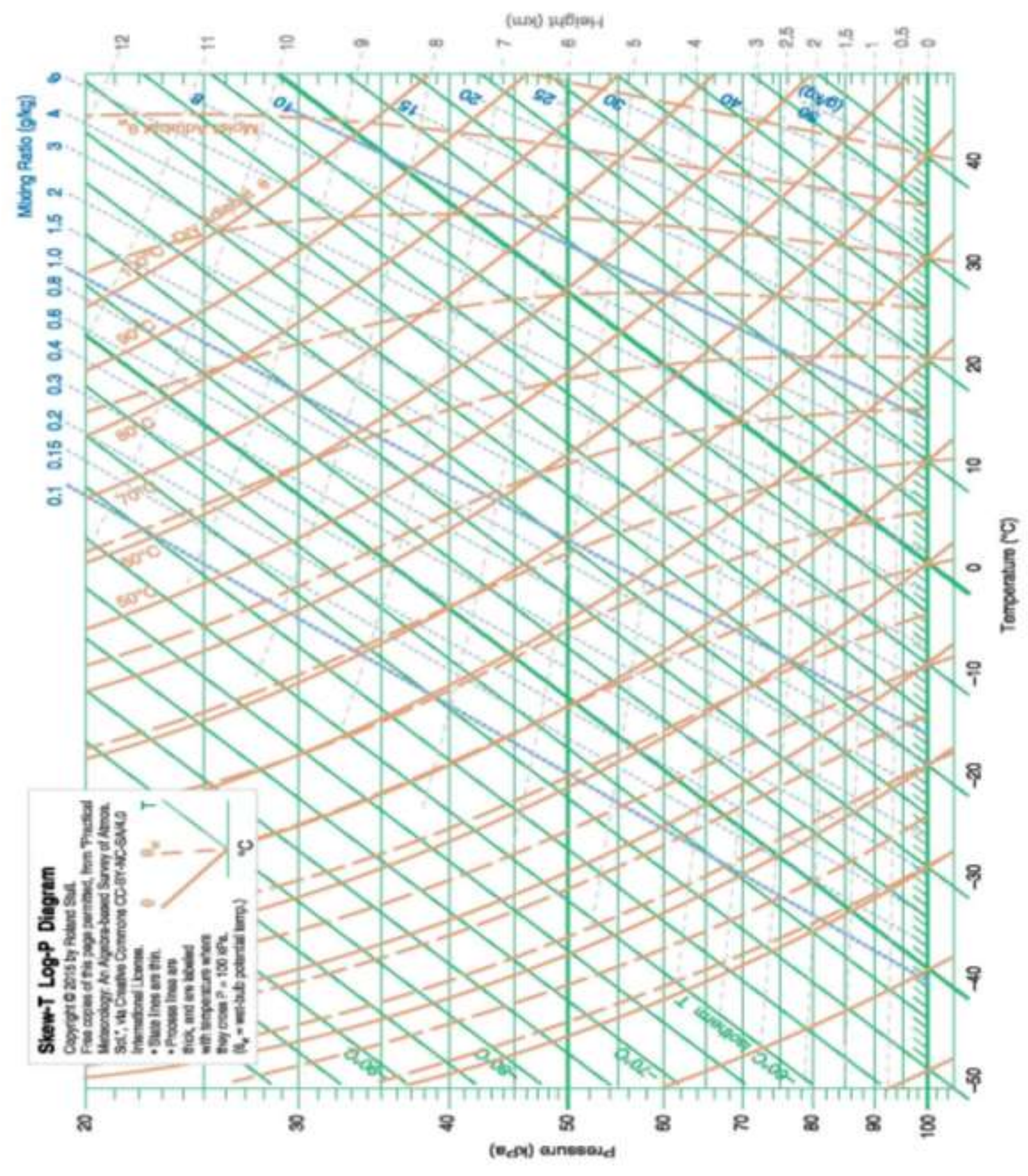
The Second Experiment the skew-T/log-P thermodynamic diagram

The Objective of the experiment:

To introduce the skew-T/log-P thermodynamic diagram in order to use it in some meteorological calculations.

Materials:

Skew-T/log-P thermodynamic diagram



Introduction:

The skew-T/log-P thermodynamic diagram

- It is used to plot vertical profiles of atmospheric temperature, moisture, and wind.
- It has been used for many decades to assess a variety of meteorological conditions, most notably atmospheric stability.
- Data for the vertical atmospheric profiles, also known as sounding plots, come from numerous sources such as radiosondes, dropsondes, NWP model output, and satellite sounders.
- Since pressure decreases logarithmically with increasing height in the atmosphere, the skew-T diagram has lines of constant pressure (isobars) spaced logarithmically. This leads to the skewed appearance of lines of constant temperature (isotherms). Thus, the diagram is called a skew-T/log-P diagram.

1. The lines on the skew-T/log-P diagram

The skew-T/log-P diagram has mainly five lines as illustrated in Fig. (1); they comprise:

Isobars:

- Lines of constant pressure.
- They are horizontal lines decreases with height.
- The spacing between pressure lines increases as you go towards the top of the chart because the spacing of the lines is determined by the natural logarithm of the pressure, from about 1050 hPa at the bottom to 100 hPa at the top.
- They are plotted every 50 hPa on the left-hand side of the diagram.
- There is also a height scale to the right of the diagram, and you can find the value of height for each corresponding pressure level in Table (1).

Pressure vs. Height
in a Standard Atmosphere

Pressure (hPa)	Height (m)	Height (ft)
100	16,180	53,083
150	13,608	44,647
200	11,784	38,662
250	10,363	33,999
300	9164	30,065
350	8117	26,631
400	7185	23,574
450	6344	20,812
500	5574	18,289
550	4865	15,962
600	4206	13,801
650	3591	11,780
700	3012	9882
750	2466	8091
800	1949	6394
850	1457	4781
900	988	3243
950	540	1773
1000	111	364

Table (1): Pressure levels vs. Height

Isotherms:

- Lines of constant temperature.
- They are straight, solid lines, runs at a 45° angle sloping from the lower left to upper right.
- Temperature decreases as you go to the left and towards the top and the temperature increases as you go to the right and towards the bottom.

Dry adiabats:

- Lines of constant potential temperature.
- They are the slightly-curved, solid lines sloping from the lower right to upper left.
- They indicate the rate of temperature change in a parcel of dry air rising or descending adiabatically, i.e., with no loss or gain of heat by the parcel.
- The dry adiabat for each multiple of 10°C shares a label with the isotherms, with the Celsius temperature value of its point of intersection with the 1000-hPa isobar.

Moist adiabats:

- Also known as Saturation adiabats or saturation pseudo-adiabats.
- Represent lines of constant equivalent potential temperature.
- They are the slightly curved lines.
- The slope and spacing of the lines vary significantly with height and temperature, particularly at lower levels.
- They indicate the rate of temperature change in a rising parcel of saturated air (assuming that all the condensed water vapor is liquid and falls out immediately as the parcel rises—the pseudo-adiabatic assumption).
- Note that the saturation adiabats become parallel to the dry adiabats at low values of moisture, temperature, and pressure.

Saturation mixing ratio lines (ws):

- Also known as humidity mixing ratio lines.
- They represent constant values of water vapor capacity—specifically, the number of grams of water required to saturate one kilogram of dry air at a particular temperature and pressure.
- The lines are the slightly-curved, dashed lines sloping from the lower left to upper right.
- They are labeled at the bottom of the diagram for a range of 0.1 to 40.0 grams per kilogram; i.e., in parts of water vapor per 1000 parts of

dry air. Note that since the vapor capacity of air varies non-linearly with temperature, the labeling interval for ws lines is not uniform.

Combining the isobars, isotherms, dry adiabats, saturation adiabats, and saturation mixing ratio lines onto a single diagram creates the skew-T:

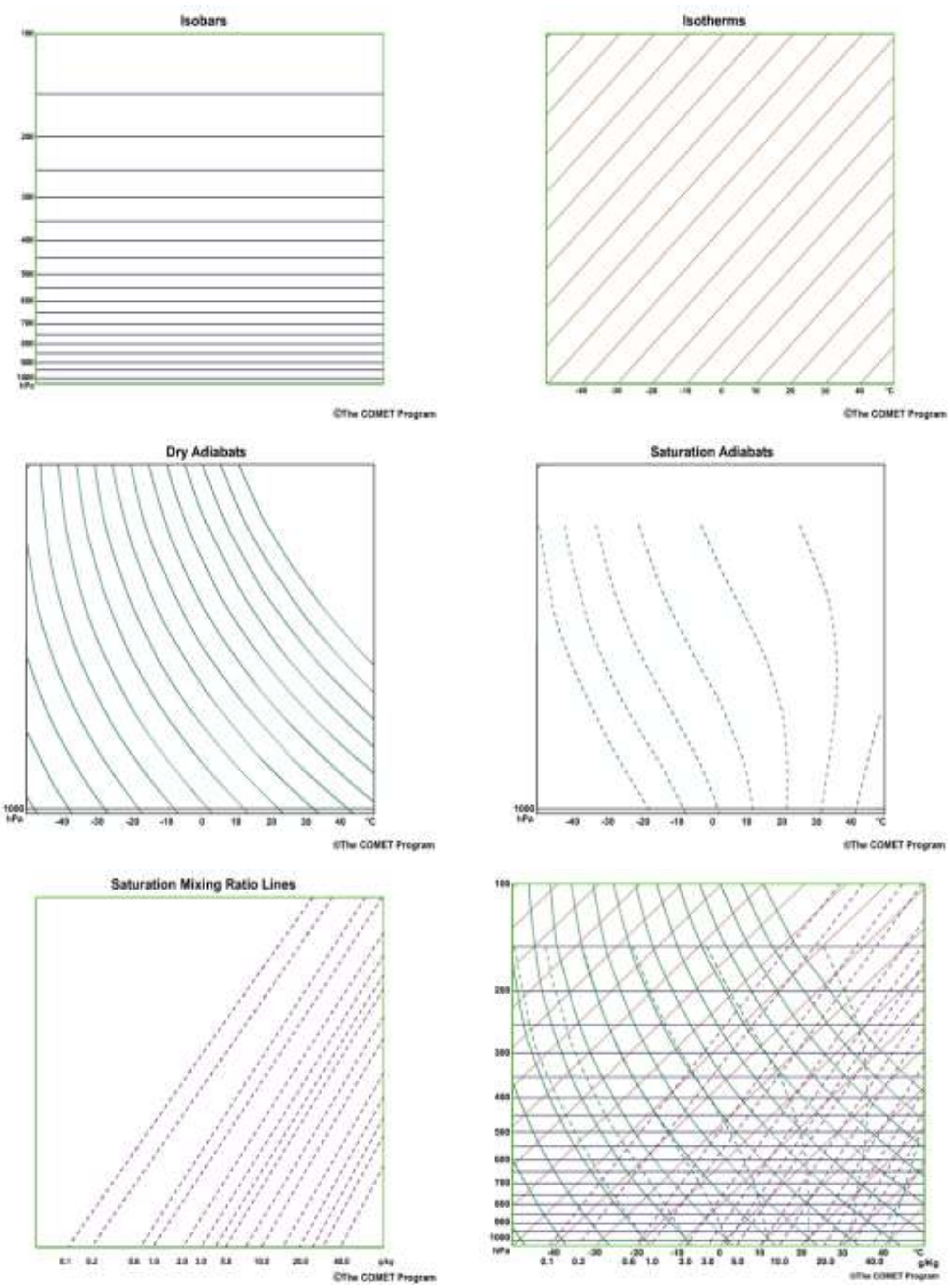
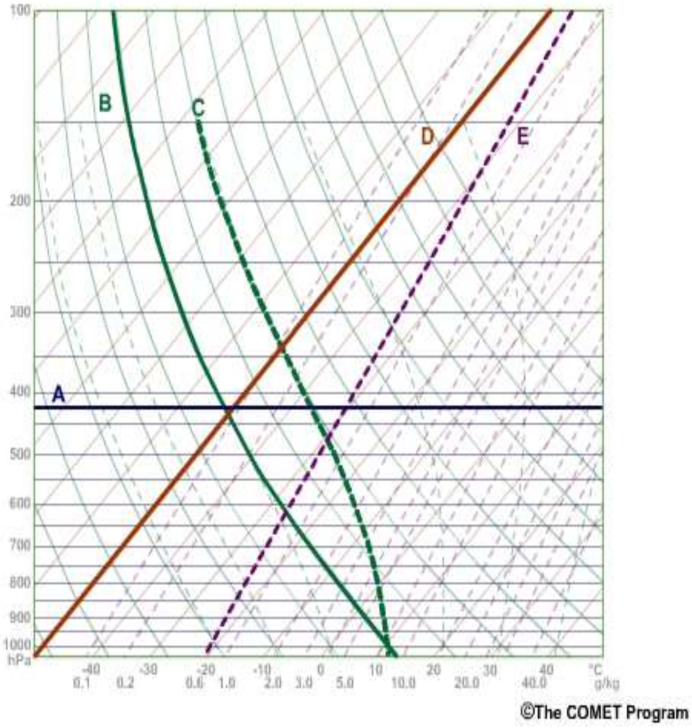


Fig (1): skew-T log-P diagram

Exercise

On this blank skew-T diagram, certain lines have been highlighted and labeled. identify each of the labeled lines.

The label of the line	The type of the line
A	
B	
C	
D	
E	



P (hpa)	920	882	780	635	540	490
T (c)	3.6	12.2	17.5	22.4	25.7	23
H (m)						
re(kg\g)						
Ɵ (c)						
Ɵw (c)						