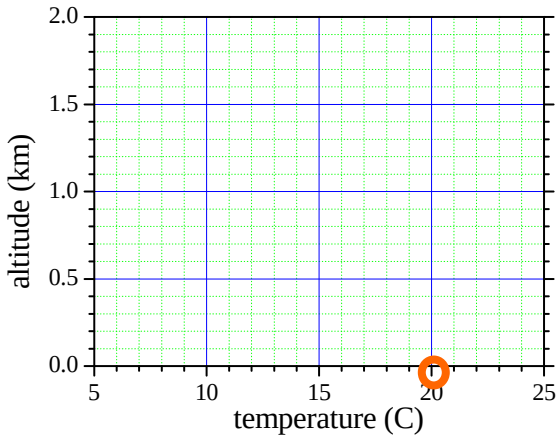
Atmospheric Stability

1. Draw the temperature curve that a balloon with a temperature of 20°C at the ground will follow if we lift it to 1.5 km altitude for two cases:

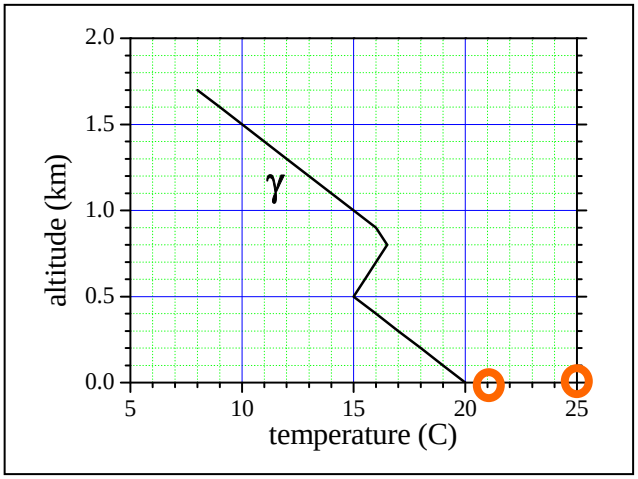
a) Assuming that the air is dry (without condensation), what is its temperature?

b) Assuming that the air contains water vapor (with condensation), what is its temperature?

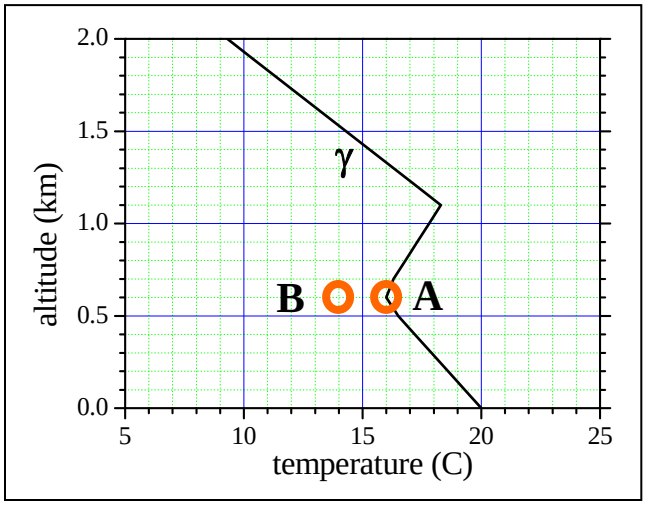
(hint: the "curve" is a straight line
note: dry adiabatic lapse rate Γ_a= 10 ℃/km; wet adiabatic lapse rate, Γ_w= 6 ℃/km)



2. By drawing the temperature curves describe what will happen to dry pollution plumes that we release with a temperature of 21°C and 25°C at the ground. The curve in the graph describes the environmental lapse rate. Describe in words the behavior of these pollution plumes.



3.Using the environmental lapse rate on the graph answer the following questions.



a) Calculate the lapse rates for each part of the curve. For each layer state whether the air is stable/neutral/unstable with respect to the dry adiabatic lapse rate.

b) If we push the dry air parcel "A" sitting at 0.6 km altitude with a temperature of 16°C up or down is it going to sink, rise, or remain at this altitude? Why?

c) Now let's cool off the dry air parcel sitting at 0.6 km by 2°C, down to 14°C. If we push this air parcel "B" up or down, what will happen? Why?

4. The temperature at the top of the inversion is 13°C. What is the minimum temperature a parcel must have at the surface to rise past the inversion if it rises at the wet adiabatic lapse rate (Γ_w) of 5°C/km?