# Vapor Pressure!

## Thermodynamics
## Spring 2021
### College of the Atlantic.



| $T$ (°C) | $P_v$ (bar) | $L$ (kJ/mol) |
|---|---|---|
| −40 | 0.00013 | 51.16 |
| −20 | 0.00103 | 51.13 |
| 0 | 0.00611 | 51.07 |
| 0.01 | 0.00612 | 45.05 |
| 25 | 0.0317 | 43.99 |
| 50 | 0.1234 | 42.92 |
| 100 | 1.013 | 40.66 |
| 150 | 4.757 | 38.09 |
| 200 | 15.54 | 34.96 |
| 250 | 39.74 | 30.90 |
| 300 | 85.84 | 25.30 |
| 350 | 165.2 | 16.09 |
| 374 | 220.6 | 0.00 |

**Figure 5.11.** Phase diagram for $H_2O$ (not to scale). The table gives the vapor pressure and molar latent heat for the solid-gas transformation (first three entries) and the liquid-gas transformation (remaining entries). Data from Keenan et al. (1978) and Lide (1994).
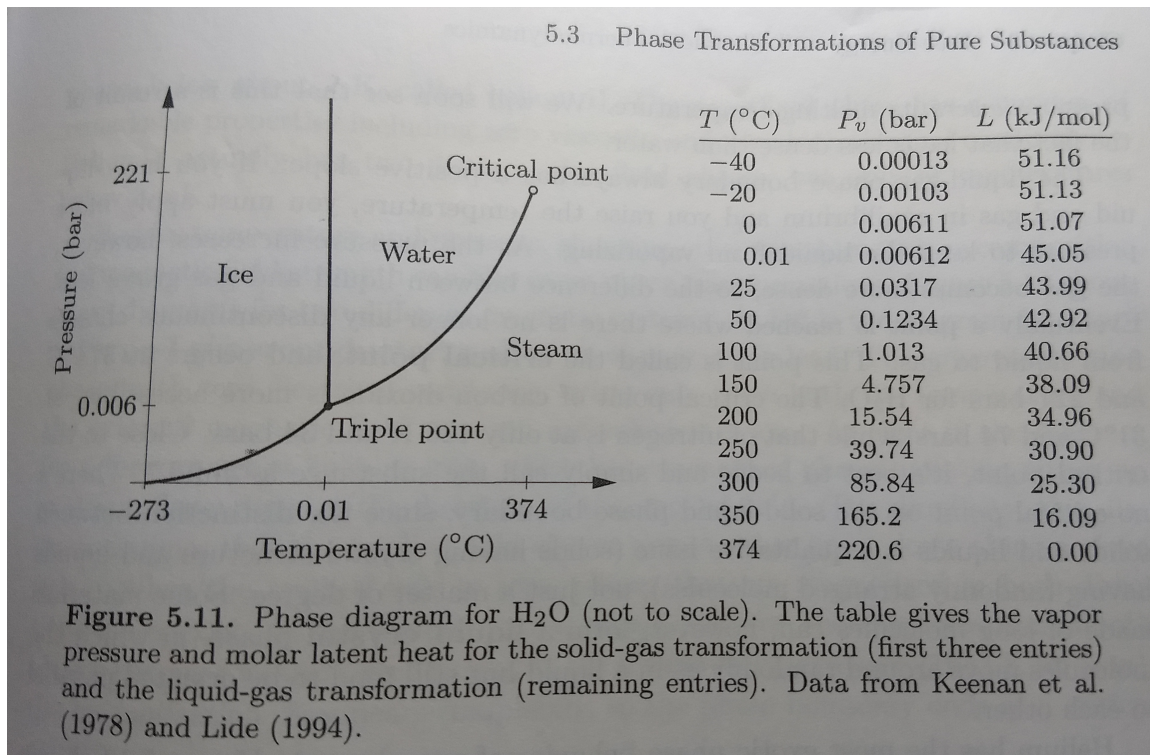
Figure 1: Figure from Daniel V. Schroeder, *Thermal Physics*, Addison Wesley, 2000.

Figure 2 shows a plot of the vapor pressure for water as a function of temperature. To make this plot I used the vapor pressure equation:

$$P(t) = P_0 e^{-L/RT} \ . \tag{1}$$

To determine numerical values, used data for from the table in Fig. 1. I used the value for the latent heat $L$ at 25 C and then I used the fact that the vapor pressure of water at 25C is 0.0317 to solve for $P_0$. I ended up with

$$P = 1.62 \times 10^6 e^{5290/T} \ . \tag{2}$$

I used python to plot this equation. The result of doing so is shown in Fig. 2.
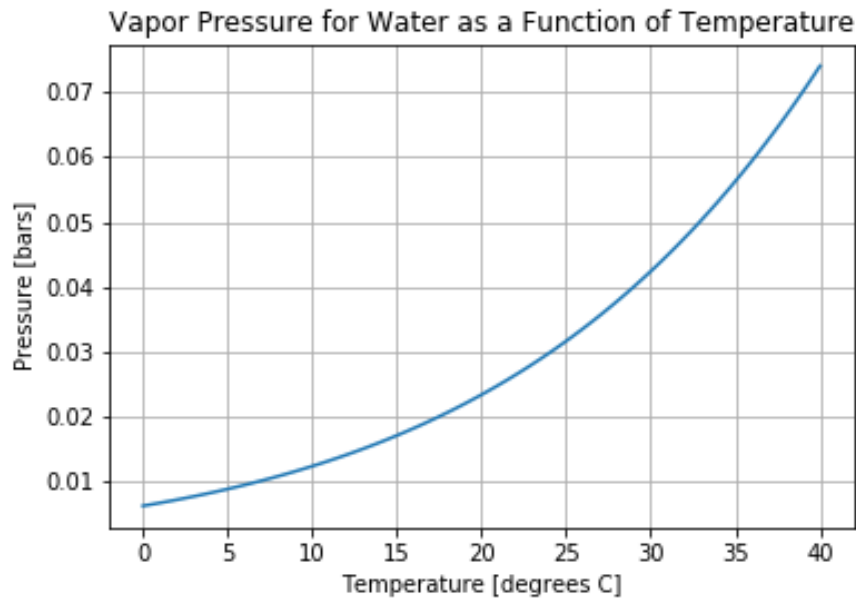
Figure 2: Plot of vapor pressure as a function of temperature.

1. The temperature on a hot summer day is 30 C and the relative humidity is 90%. What is the dew point?

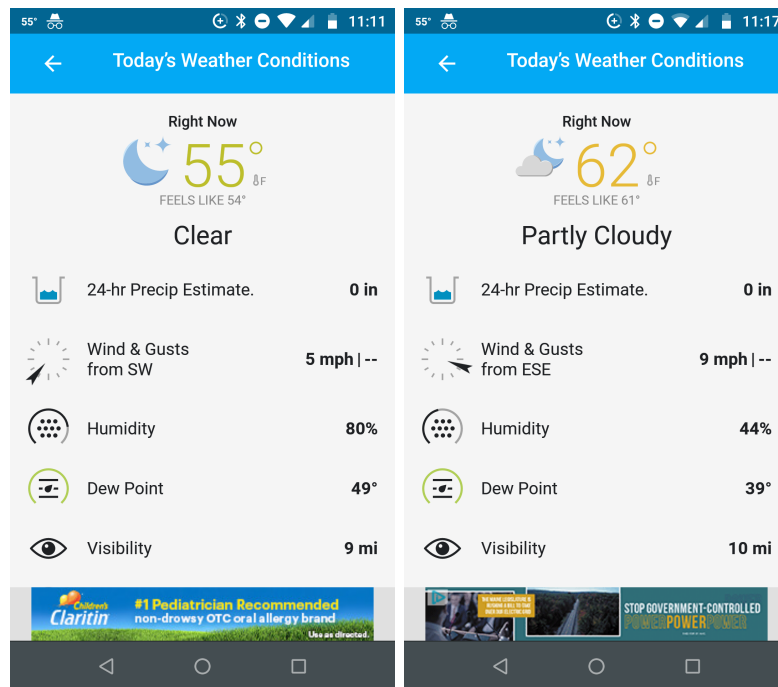2. Check the dew points for the two weather conditions shown in Fig. 3.



Figure 3: Current conditions in Bar Harbor, ME (left) and Santa Fe, NM (right).