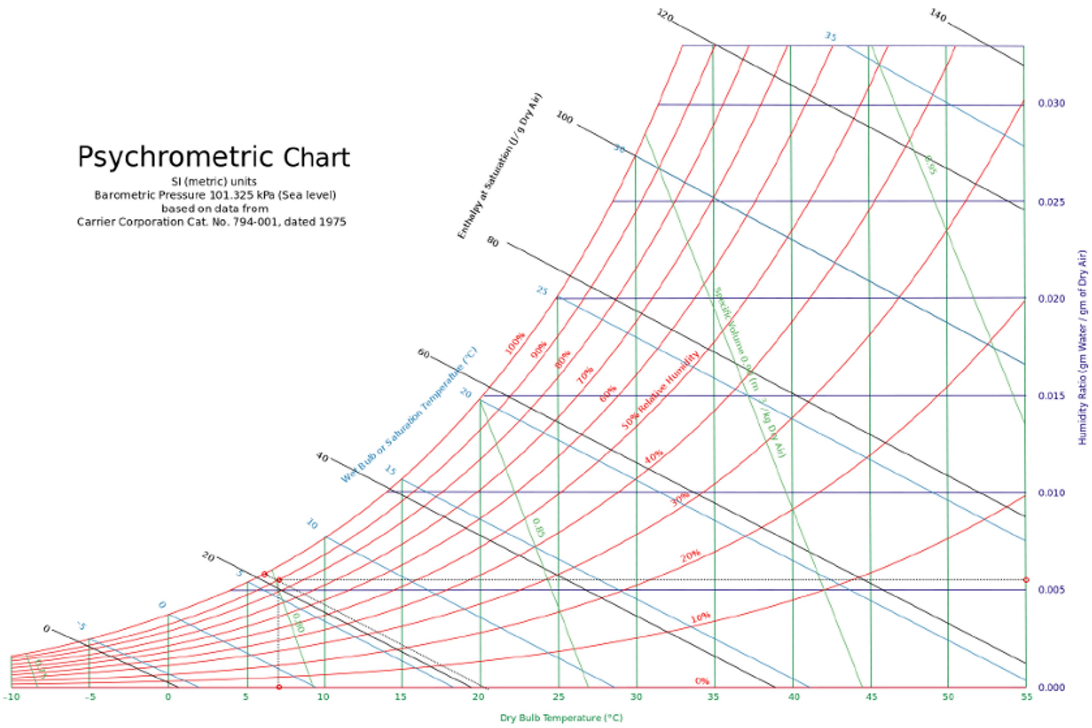
Task 1

The time now is 20:00, from the data given in the website https://www.meteo-oggi.it/italia/regione-emilia-romagna/tempo-piacenza/

umidità: 90%, i.e., the relative humidity
ϕ
=90%;

pressione atmosferica: 1019 hPa, i.e., the total air pressure P =101.9 kPa;

temperatura effttiva: 7
°C
, i.e., the temperature in Kelvin temperature scale T =230 K



Utilize the psychrometric chart, we can see,

the humidity ratio, i.e., the absolute humidity
ω
= 0.0055

the web-bulb temperature
Twb = *6* °C

$\because \omega=0.622\frac{P_v}{P_a}=0.622\frac{P_v}{P-P_v}=0.0055$, introduce $P=101.9$ kPa into this equation, and solve it,

$P_v \approx 0.893$ kPa

autem, $\phi=\frac{m_v}{m_g}=90\%$......(1)

for any ideal gas, $m=\frac{PV}{R_{sp.}T}$, during the class we were told that for water vapour, $R_{sp.}=0.4615$

introduce the pressure of water vapor
$P_v=0.893$ kPa*, and define the volume of aula A is V, here we have:*

$m_v=\frac{0.893V}{0.4615*230} \approx 8.41\times10^{-3}V$

subodinate this value to equotion (1), calculate the maximun water vapour m_g,

$m_g=\frac{m_v}{90\%}\approx 9.34 \times10^{-3}V$

Task 2

Internal gains,

Calculate the sensibile cooling load from internal gains,

$q_{ig,\ s}=136+2.2A_{cf}+22N_{oc}=136+2.2*200+22*2=620$ W

Calculate the latent cooling load from internal gains,

$q_{ig,\ l}=20+0.22A_{cf}+12N_{oc}=20+0.22*200+12*2=88$ W

Infiltration,

for a house with a good construction quality, unit leakage area
$A_{ul}=1.4 cm^2/m^2$

and the exposed surface
$A_{es}=A_{wall}+A_{roof}=200+144=344\ m^2$

thus,
$A_L=A_{es}*A_{ul}=344*1.4=481.6\ cm^2$

Define the cooling temperature $T_{cooling}$ *=24 °C,*
and heating temperature $T_{heating}$ *=20 °C*

in Brindisi,
[Equazione]

$\Delta T_{cooling} = 31.1\ °C - 24\ °C = 7.1\ °C = 7.1\ K$

$\Delta T_{heating} = 20\ °C - (-4.1\ °C) = 24.1\ °C = 24.1\ K$

$DR = 7.1\ °C = 7.1\ K$

Given that $IDF_{heating} = 0.073 \frac{L}{s*cm^2}$,

$IDF_{cooling} = 0.033 \frac{L}{s*cm^2}$,

Calculate infiltration airflow rate,

$Q_{i,\ heating} = A_L * IDF_{heating} = 481.6 * 0.073 \approx 35.157 \frac{L}{s}$

$Q_{i,\ cooling} = A_L * IDF_{cooling} = 481.6 * 0.033 \approx 15.893 \frac{L}{s}$

The required miminum whole-building vetilation rate is

$Q_v = 0.05 A_{cf} + 3.5(N_{br}+1) = 0.05*200 + 3.5*(1+1) = 17 \frac{L}{s}$

thus,

$Q_{i-v,heating} = Q_{i,\ heating} + Q_v \approx 35.157 + 17 = 52.157 \frac{L}{s}$

$Q_{i-v,\ cooling} = Q_{i,\ cooling} + Q_v \approx 15.893 + 17 = 32.893 \frac{L}{s}$

Given that
$C_{sensible} = 1.23$, $C_{latent} = 3010$, $\Delta\omega_{Cooling} = 0.0039$

$q_{.inf-ventilation\,cooling\,sensible} = C_{sensible} Q_{i-v,\ cooling}\ \ \Delta T_{Cooling} \approx 1.23 * 32.893 * 7.1 \approx 287.25\ W$

$q_{.inf-ventilation\,cooling\,latent} = C_{latent} Q_{i-v,\ cooling}\ \ \Delta\omega_{Cooling} \approx 3010 * 32.893 * 0.0039 \approx 386.13\ W$

$q_{.inf-ventilation\,heatingg\,sensible} = C_{sensible} Q_{i-v,\ heating}\ \ \Delta T_{heating} \approx 1.23 * 52.157 * 24.1 \approx 1546.09\ W$