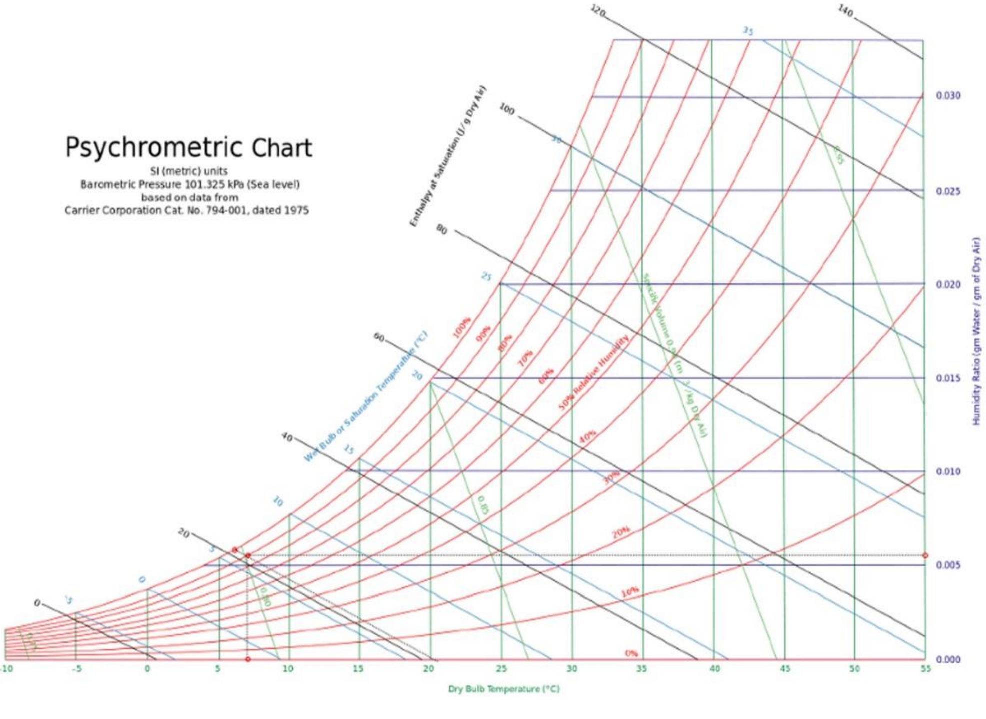
Task 1

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:*

$m_v = \frac{0.893V}{0.4615 * 230} \approx 8.41 \times 10^{-3} V$

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

$m_g = \frac{m_v}{90\%} \approx 9.34 \times 10^{-3} V$

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

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

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

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