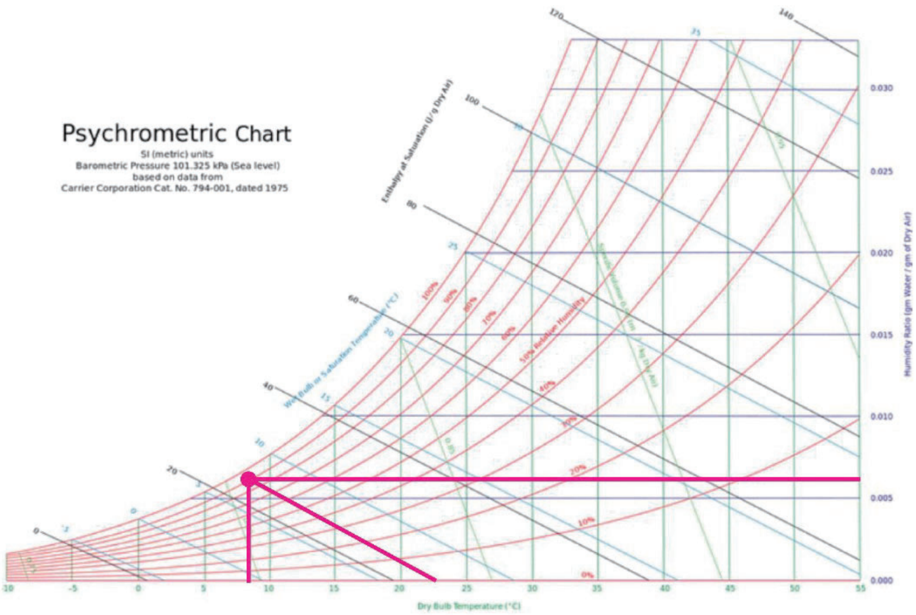
Task 1

Use a weather forecast website, and utilize the psychrometric chart and the formula we went through in the class to determine the absoloute humidity, the wet-bulb temperature and the mass of water vapour in the air in ClassRoom A (Aula A) of Piacenza campus in the moment that you are solving this exercise (provide the inputs that you utilized)

Humidity: 90% = Relative humidity: φ = 90%

Pressione atmosferica: 1019 hPa = total air pressure P = 101.9 kPa

Effective temperature: 7C° = 230 K



Utilizing the psychometric chart, we can notice that

-The absolute humidity $\omega = 0.0055$

-Twb = 6℃

$$\omega = \frac{0.622\,P_v}{P_a} = \frac{0.622\,P_v}{P - P_v} = 0.0055$$

$P_v = 0.893$ circa

$$\phi = \frac{m_v}{m_g} = 90\%$$

m (for gasses in general) $\frac{P_v}{R_{sp,}\,T}$

for water vapor $R_{sp} = 0.4615$

P_v(pressure of water vapor) = 0.893 k Pa

Volume(V) of classroom, where

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

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

Task 2

Utilize the same methodology we went through in the class and determine the sensible and latent load corresponding to internal gains, the ventilation, and the infiltration in a house with a *good* construction quality and with the same geometry as that of the example which is located in Brindisi, Italy

BRINDISI, Italy WMO#: **163200**

Lat: **40.65N** Long: **17.95E** Elev: **10** StdP: **101.2** Time Zone: **1.00 (EUW)** Period: **86-10** WBAN: **99999**

Annual Heating and Humidification Design Conditions

	Coldest Month	Heating DB		Humidification DP/MCDB and HR						Coldest month WS/MCDB				MCWS/PCWD to 99.6% DB		
				99.6%			99%			0.4%		1%				
		99.6%	99%	DP	HR	MCDB	DP	HR	MCDB	WS	MCDB	WS	MCDB	MCWS	PCWD	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	
(1)	2	2.9	4.1	-5.1	2.5	7.2	-3.0	3.0	7.4	13.4	10.2	12.4	10.6	3.4	250	(1)

Annual Cooling, Dehumidification, and Enthalpy Design Conditions

	Hottest Month	Hottest Month DB Range	Cooling DB/MCWB						Evaporation WB/MCDB						MCWS/PCWD to 0.4% DB		
			0.4%		1%		2%		0.4%		1%		2%				
			DB	MCWB	DB	MCWB	DB	MCWB	WB	MCDB	WB	MCDB	WB	MCDB	MCWS	PCWD	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	
(2)	8	7.1	32.8	23.6	31.1	24.3	29.9	24.3	27.2	29.7	26.3	29.0	25.6	28.3	4.2	180	(2)

	Dehumidification DP/MCDB and HR									Enthalpy/MCDB						Hours 8 to 4 & 12.8/20.6	
	0.4%			1%			2%			0.4%		1%		2%			
	DP	HR	MCDB	DP	HR	MCDB	DP	HR	MCDB	Enth	MCDB	Enth	MCDB	Enth	MCDB		
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	
(3)	26.3	21.8	29.2	25.4	20.7	28.5	24.7	19.7	27.9	86.0	30.1	82.2	29.1	78.5	28.3	1236	(3)

Extreme Annual Design Conditions

	Extreme Annual WS			Extreme Max WB	Extreme Annual DB				n-Year Return Period Values of Extreme DB								
					Mean		Standard deviation		n=5 years		n=10 years		n=20 years		n=50 years		
	1%	2.5%	5%	WB	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	
(4)	11.3	9.9	8.7	31.4	0.4	37.3	1.4	3.0	-0.6	39.4	-1.4	41.1	-2.2	42.8	-3.2	44.9	(4)

Soln:

Number of occupants=2

Number of bed rooms=1

Height of the building=2.5m

Area of the floor=200 ㎡

Internal gains：

$$\dot{Q}_{igsensible} = 136 + 2.2A_{cf} + 22N_{oc} = 136 + 2.2 * (200) + 22 * 2 = 620\,W$$

$$\dot{Q}_{iglaten} = 20 + 0.22A_{cf} + 12N_{oc} = 20 + 0.22 * 200 + 12 * 2 = 88\,W$$

*I*nfiltrations

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

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

cooling temperature $T_{cooling} = 24℃$, and heating temperature $T_{heating} = 20℃$ in Brindisi,

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

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

$DR = 7.1℃ = 7.1$

Given that $IDF_{heating} = 0.073 \dfrac{L}{s * Cm^2}$

$IDF_{cooling} = 0.33 \dfrac{L}{s * cm^2}$

Infiltration airflow rate

$Q_{i,heating} = A_L * IDF_{heating} = 481.6 * 0.073 = 35.15 \frac{L}{S}$

$Q_{i,cooling} = A_L * IDF_{cooling} = 481.6 * 0.033 = 15.89 \frac{L}{S}$

The required miminum whole - building vetilation rate is

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

$Q_{i-v,heating} = Q_{i,heating} + Q_v = 35.157 + 17 = 52.15 \frac{L}{S}$

$Q_{i-v,cooling} = Q_{i,cooling} + Q_v = 15.893 + 17 = 32.89 \frac{L}{S}$

Given that

$C_{sensible} = 1.23$

$C_{latent} = 3010$

$\Delta\omega_{cooling} = 0.0039$

$q_{inf - ventilation\ cooling\ sensible} = C_{sensible} Q_{i-v,cooling} \Delta T_{cooling} = 1.23 * 32.89 * 7.1 = 287.25\,w$

$q_{inf - ventilation\ cooling\ latent} = C_{latent} Q_{i-v,cooling} \Delta\omega_{cooling} = 3010 * 32.89 * 0.0039 = 386.13w$

$q_{inf - ventilation\ heating\ latent} = C_{sensible} Q_{i-v,heating} \Delta T_{cooling} = 1.23 * 52.15 * 24.1 = 1546\,w$