

March 22, 2006

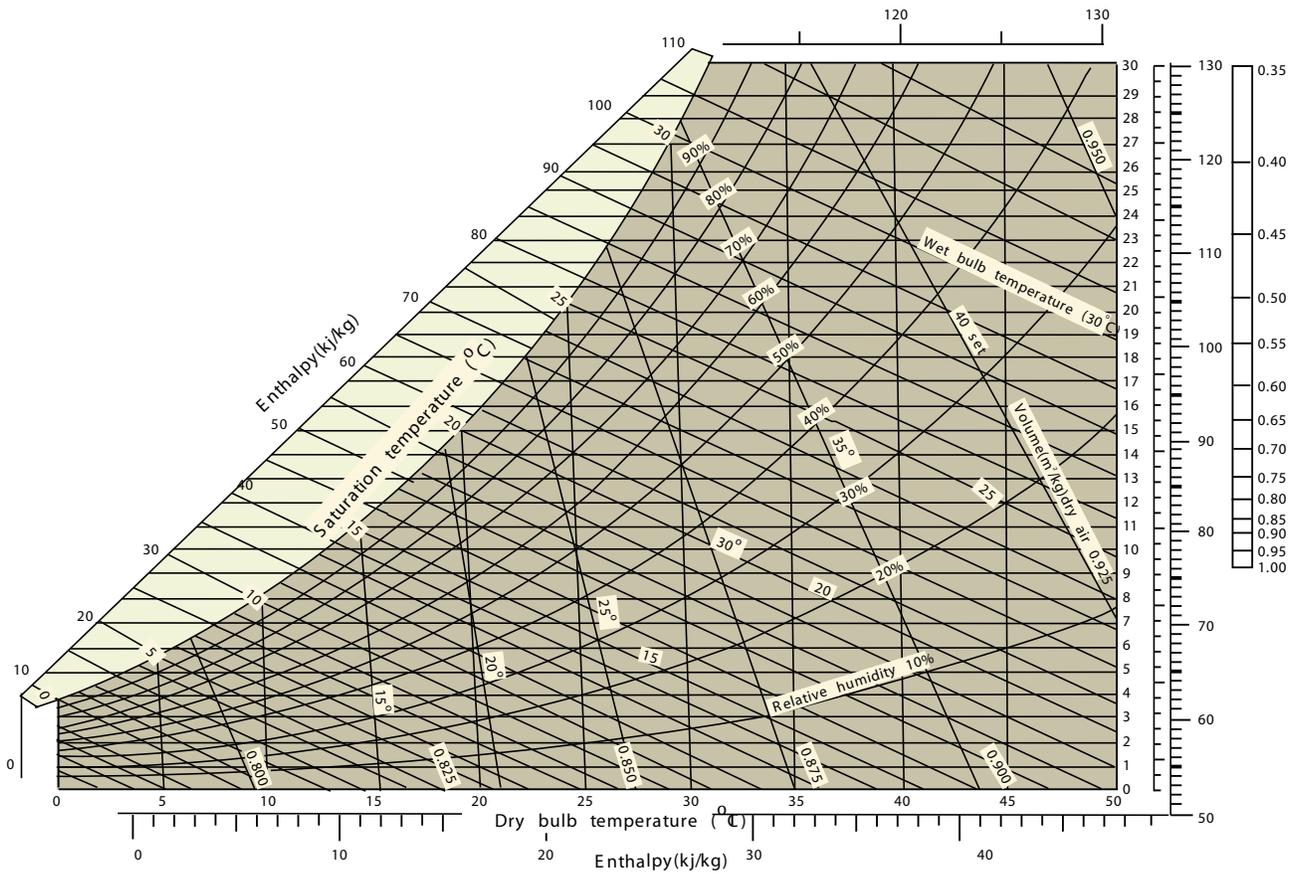
QUIZ # 1**Thermal and Lighting aspects of a building – 1 h30'****Questions 10 pts**

- 2.5 pts* a. How would you advise an architect from the equatorial region to design openings and solar protections for his building?
- 3.5 pts* b. Apart from rainwater leaking, what other process can potentially result in the presence of liquid water inside a building's envelope? What factors contribute to worsening this problem?
- 2 pts* c. Two friends decide to build a small house in the desert. One suggests using lightweight materials in order to increase the heat exchange as much as possible, the other recommends using heavyweight construction materials instead. Who do you think is right and why?
- 2 pts* d. From a visual perception point of view, how can you interpret the $V(\lambda)$ curve ?

Problems 30 pts

- 1 pt* 1. You leave a big wet towel in your bathroom, supposed to be a perfectly sealed enclosure. Just before the towel was added, the relative humidity of the air inside the bathroom was 70%, and the temperature 25°C. Point out this initial situation (with number 1) on the psychrometric chart provided on the last page.
- 1.5 pts* If you wait long enough, what will be the new values of air temperature and relative humidity (point 2)? Describe what has happened and show the evolution of the situation on the psychrometric chart by drawing the path leading from point 1 to point 2.
- 1.5 pts* You then remove the towel, being able to keep the air conditions exactly as they are, and decide to cool the air down to 16°C. Describe what happens and show the evolution of the situation on the psychrometric chart by drawing the path leading from point 2 to point 3.
- 2 pts* What is the relative humidity at point 3? What is the absolute humidity? If condensation has occurred, what is the mass of liquid water that was formed?
- 3 pts* Then you remove any liquid water that might have formed, still being able to keep the air conditions exactly as they are, and decide to decrease the relative humidity to 50%. Propose two ways to do this, and show how the situation evolves in both cases on the psychrometric chart (draw the paths leading from point 3 to points 4a and 4b).
- 1 pt* What is the final air temperature in both cases ?

Name : _____



2. The architectural space of the church of the Convent of La Tourette designed by Le Corbusier is characterized by narrow lateral and zenithal openings, actively taking part in the dynamic and richness of the luminous ambiances inside the church, chapels and oratories. These openings are of small area and of strong luminosity compared to the opaque parts of the envelope. On a sunny morning, you come in to make a diagnostic about visual comfort and about the thermal properties of the building, equipped with a luminance-meter, a luxmeter and a thermometer.

You first enter the main church and are fascinated by the interaction of the strong light with the bare concrete. Out of curiosity, you point your luminance-meter directly at the opening on the right side of the back wall (see picture on the right) then at the wall itself close to the opening. You get 3200 Cd/m² and 400 Cd/m² respectively.

2 pts Is this contrast acceptable for visual comfort recommendations?

3 pts If the wall was painted in white ($\rho = 0.8$) rather than being bare concrete ($\rho = 0.3$), what would the contrast become?

3 pts You go out and measure the illuminance on the outside of this same wall and get 100,000 lux. Knowing that natural light has an efficacy of about 110 lm/W and that the wall's surface is of about 80 m², how many Watts does the wall receive?

When you were outside, you looked at your thermometer which indicated 18°F . Then you continue your visit and enter a small, pitched-roof oratory (picture below), illuminated by a narrow zenithal opening and still made out of bare, dense cast concrete. Your thermometer now indicates 68°F .

3.5 pts What is the heat flow rate through the back wall of the oratory if its thickness is 30 cm and its surface 16 m^2 ? (use the data sheets provided in your textbook)

5.5 pts Standing inside silently, you hear a faint whistling and interpret it correctly as due to a draft caused by a shattered piece of glass in the zenithal opening (pointed out by a circle on the drawing). What is pressure difference between inside and outside at the opening's height (the entrance being open to the corridor, the pressures are equal at ground level)? In what direction does the air flow through this unintentional crack of area 0.05 m^2 ?

3 pts If the air speed is of about 7 km/h , what is the ventilation heat flow rate due this crack? Is this a significant flow?

