ES106 LAB PART A, ACTIVITY 2

The water vapor capacity of air is directly related to, and limited by, its temperature. The table below presents the water vapor capacity of a kilogram of air at various temperatures. Use the table to answer the following questions.

Table 1: Water vapor capacity of a kilogram of air at average sea level pressure.

Temperature (ºF)	**Temperature (ºC)**	**Grams of water vapor per kg of air (g/kg)**
- 40	- 40	0.1
- 22	- 30	0.3
-4	- 20	0.75
14	- 10	2
32	0	3.5
41	5	5
50	10	7
59	15	10
68	20	14
77	25	20
86	30	26.5
95	35	35
104	40	47

Activity 2: Relative Humidity and Dew Point Temperature

Relative humidity is the most common measurement used to describe water vapor in the air. In general, it expresses how close the air is to reaching its water vapor capacity. Relative humidity is the ratio of the air's water vapor content (amount actually in the air) to its water vapor capacity at a given temperature, expressed as a percent. The general formula is:

$$\text{Relative Humidity } (\%) = \left(\frac{\text{water vapor content}}{\text{water vapor capacity}}\right) \text{x } 100\%$$

For example, the water vapor capacity of a kilogram of air at 25ºC would be 20 grams per kilogram. If the actual amount of water vapor in the air was 5 grams per kilogram (the water vapor content), the relative humidity would be calculated as follows:

$$\text{Relative humidity } (\%) = \left(\frac{5g/kg}{20g/kg}\right) \times 100 = 25\%$$

5. Use the Table 1 or Figure 1, and the general formula for relative humidity to determine the relative humidity for various water vapor contents of air at identical temperatures. Fill out Table 2, below

Table 2: Change in relative humidity with no change in temperature			
Air Temp (ºC)	**Water Vapor Content**	**Water Vapor Capacity**	**Relative Humidity**
25ºC	2 g/kg	g/kg	%
25ºC	5 g/kg	g/kg	%
25ºC	7 g/kg	g/kg	%

6. From Table 3, if the temperature of air remains constant, how does adding water vapor affect the relative humidity?

7. What effect will removing water vapor have on the relative humidity?

8. Use Table 1 and the general formula for relative humidity to determine the relative humidity for air at various temperatures with identical water vapor content. Fill out Table 3 below.

Table 3: Change in relative humidity with no change in water content			
Air Temp (ºC)	**Water Vapor Content**	**Water Vapor Capacity**	**Relative Humidity**
25ºC	2 g/kg	g/kg	%
15ºC	2 g/kg	g/kg	%
5ºC	2 g/kg	g/kg	%

9. So, if the amount of water vapor in the air remains constant, what effect will cooling or warming the air have on the relative humidity?

10. In the winter, air from outside is heated as it is brought into our homes. What effect does heating the air have on the relative humidity inside the home? What can be done to lessen this effect, while still being comfortable? (Hint: see Table 2 or 3)

11. Explain why a cool basement is humid (damp) in the summer. (Hint: see Table 3)

12. Write brief statements describing each of the two ways that the relative humidity of air can be changed. (Hint: see Table 2 and Table 3)

13. Use Table 1 to determine the water vapor content for each of the following situations. As you do the calculations, keep in mind the definition of relative humidity. Show calculations at right.

TABLE 4	**Relative humidity**	**Water Vapor Capacity**	**Water Vapor Content (g/kg)**
SUMMER Air temperature = 104ºF	20%	g/kg	
WINTER Air temperature = 59ºF	94%	g/kg	

14. One misconception concerning relative humidity is that it alone gives an accurate indication of the amount of water vapor in the air. For example, on a winter day if you hear on the car radio that the relative humidity is 90%, can you conclude that the air contains more moisture than a summer day that records a 40% relative humidity? Using the information in Table 4, explain why relative humidity does not give an accurate indication of the amount of water vapor in the air.

Refer to Table 1 for these questions

15. What is the dew-point temperature of a kilogram of air that contains 14 grams of water vapor?

Dew-point temperature =

_____ ºC

16. What is the dew-point temperature of a kilogram air that contains 5 grams of water vapor?

Dew-point temperature =

_____ ºC

17. What is the relative humidity of the air with 5 grams of water if its temperature is 25ºC?

Relative humidity =

_____ %